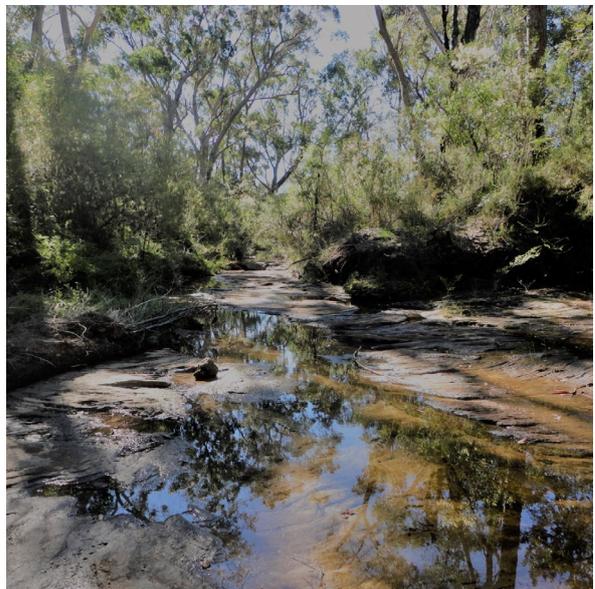




Report to the Independent Planning Commission by Peter Dupen

Issues associated with Dendrobium Underground Mine Extension Project

Engaged by Environmental Defenders Office (EDO) on behalf of Protect Our
Water Alliance December 2020



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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	Engaged by Environmental Defenders Office (EDO) on behalf of Protect Our Water Alliance
Prepared in accordance with (proposal & PO)	Expert Brief from EDO dated 24/11/2020
Prepared by	Peter Dupen, hydrogeologist, H2onestly
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1. EXECUTIVE SUMMARY

The proposal before the Independent Planning Commission (Commission) for the Dendrobium Extension Project (Extension Project) should be rejected on the grounds that the mining will have unacceptable impacts on the environment and because there remain too many critical and unresolved issues about the long-term impacts and financial costs of this mine extension on Sydney's drinking water supply and their associated catchments:

- The damage being wrought in the catchments underlain by the existing Dendrobium Mine is extraordinary in its extent and severity, and is much greater than was originally predicted. This scale of impact should not be allowed to continue further into these critically important catchments.
- There is little realistic likelihood that the surface water flows will ever return to the undermined catchments – if it does there will be less of it and it will be saturated with minerals which will coat the streams and damage the long-term water supply.
- Current surface water loss estimates from the Dendrobium Mine range from 2 to 6.5 GL/year, which will increase by at least another 3.3 GL/year of high quality, rainwater and gravity-fed drinking water if the Extension Project is approved. Despite Department of Planning, Industry and Environment (DPIE) and Independent Expert Panel for Mining in the Catchment (IEPMC) assurances, these are not small volumes considering Sydney's inevitable and expanding drought requirements.
- The risk assessment which has been carried out to assess stream and other impacts is not sufficiently robust. Besides the dubious process followed for the risk assessment being inconsistent with Australian Standards, an important set of performance criteria drafted by WaterNSW and workshopped with South32 and all relevant State Government agencies has not been included in the assessment.
- Without further intervention by the Commission or DPIE, currently proposed qualitative performance criteria would sentence the catchments to a planning approval as ineffective and unenforceable as the current one.
- The mine's principal justification for extending their catchment damage is that most of the impacts will be partially or fully "offset". As noted by the Independent Advisory Panel for Underground Mining (IAPUM) however, impacted streams are unlikely to meaningfully flow or maintain riparian habitat again. Another twenty five swamps providing critical habitat to endangered flora and fauna will be desiccated and lost to increasingly intense fires, and water quality will inevitably suffer over the long term requiring increasingly costly water treatment. Limited financial and ecological offsets do not provide adequate justification for these permanently cracked and dry catchments.
- The proposal to offset the volumetric losses from Sydney's water supply, at least some of which will be permanent, with a limited payment will effectively become a long-term subsidy for the proponent's impacts from NSW taxpayers. There remains a very big question mark over whether Dendrobium Mine, interconnected to a number of older workings which honeycomb the interconnected seams all the way to the escarpment, can ever realistically be sealed. Even if the mine could be sealed, it is almost certain that the catchments will never flow in anything like original volumes or quality. The methodology for calculating offsets for the Extension Project, for what is likely to be yet more permanently reduced catchment flows, appears deeply flawed and insufficient.

For these and many more valid reasons, in my opinion, the Extension Project should be refused.

2. INTRODUCTION

2.1 Qualifications

My experience and qualifications for providing this evidence is detailed in my CV (Attachment A).

I'm a senior hydrogeologist with over 30 years' experience in environmental regulator and consulting roles. Between 2015 and 2019 I was the Mining Manager for WaterNSW. During this period my team and I examined underground mining (particularly Dendrobium Mine) impacts on catchments in greater depth than anyone else in Australia.

I am currently working outside government, researching methods of improving environmental impact assessment (EIA) and environmental decision-making with better analytical approaches and engagement, in a PhD supported in part by DPIE.

I also 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 briefed by EDO, acting on behalf of Protect Our Water Alliance, to provide expert advice in relation to the hydrogeological aspects of the Dendrobium Extension Project. I have prepared this report in conformance with Part 31 Division 2 and the Expert Witness Code of Conduct in Schedule 7 of the *Uniform Civil Procedure Rules 2005*, and I am willing to be bound by them.

Although I remain concerned about all of the impacts occurring and proposed by the Extension Project, I am aware that others' submissions amply cover these issues so I will focus this report on the volumetric losses from Sydney's drinking water supply and their associated catchments.

2.3 Contextual setting of Dendrobium Extension Project

Under the provisions of the *Water NSW Act 2014*, Sydney's drinking water catchments are 'Declared Catchment Areas', managed by WaterNSW (previously the Sydney Catchment Authority). The Upper Nepean and Woronora catchments, located south of Sydney, was proclaimed a 'Declared Catchment Area' which includes the catchments of the Cataract, Cordeaux, Avon, Nepean and Woronora rivers, known as the Metropolitan Special Area. Special Areas are declared for the purposes of protecting the quality of stored drinking water and for maintaining the ecological integrity of the land in the general vicinity of stored drinking water.

Concerns over Sydney's water supply led to two Commissions of Inquiry to examine the risks posed by mining.

In my opinion, the Dendrobium Mine proponent clearly promised Sydney in their 2000 Environmental Impact Statement (EIS) that "we'll take the coal, you'll keep your water". The planning approval consequently included a condition that Dendrobium Mine have a "no more than negligible impact on Sydney's water supply".

Essentially the opposite has transpired.

The true extent of the Dendrobium Mine's damage to the catchments has only been confirmed in the past 5-6 years. The revelations began when detailed evidence presented by Dr Peter Turner convinced Minister Stokes in 2015 to order further investigations into catchment impacts in the face of ongoing satisfaction that all was well by DPIE and South32. These enquiries led first to independent consultants' deep analysis of existing geotechnical and hydrogeological data (Pells, Sullivan, & Meynink, 2017) and subsequently to the formation of the IEPMC in 2018.

The NSW Government, represented by DPIE, received final reports from the IEPMC in October 2019. These reports contained a range of observations about the unanticipated extent of impacts that are now understood at Dendrobium and Metropolitan Mines, and made 50 associated recommendations.

Minister Stokes commendably responded on behalf of the NSW Government in April 2020 that “*We’ve accepted all of the recommendations from the panel and have established an interagency taskforce to implement a detailed action plan throughout this year.*” (NSW Govt, 2020).

Eight months later the government has formed the IAPUM but appears to have stalled on all of the other recommendations made by the IEPMC.

As discussed in Section 6 of this report, in my opinion, the Extension Project should not be approved on the basis that key information is available but has not been presented and is not available for the Commission’s consideration. The NSW Government (2020) promised to finalise and openly discuss what it considers to be the sustainable limits of the Sydney water supplies that may be safely affected by mining, but it has not.

3. EXTENT AND CONTROL OF DAMAGE TO CATCHMENTS

3.1 Scale of impacts likely to be repeated by Dendrobium Mine

The extent and severity of impacts which have occurred in the catchments overlying the Dendrobium Mine are extraordinary. To my knowledge there has never previously been a deep underground mine over which all the undermined streams and swamps have almost instantaneously and permanently dried.

These were unpredicted consequences of the Dendrobium Mine and, in my opinion, the only reason that a major compliance action over them has never been launched is due to the qualitative and unenforceable planning approval conditions. Perhaps the most problematic of these is Condition 3 in Schedule 3 (DUAP, 2001), which reads:

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.)

In this case, the lack of quantified definition on what the term “negligible reduction” means that there is no objective or agreed means of telling whether the condition has been exceeded. Worse, the use of a flow measuring gauge more than 2 km downstream from the Dendrobium Mine footprint (at the confluence of Cordeaux River and Wongawilli Creek) makes it virtually impossible to detect the very real flow reductions below the existing mine.

I note that there is no obvious improvement in the terminology or clarity of the draft conditions for the Extension Project prepared by DPIE for Commission’s consideration. In fact, in my opinion, the proposed conditions appear to be even less enforceable than the existing mine conditions. There certainly remains no clarity of what are acceptable catchment or flow reduction limits. It appears that such losses will simply be a matter for future management plans and offset negotiations.

The details of the proposed subsidence effects, impacts and environmental consequences (collectively termed ‘impacts’ in this report unless otherwise clarified), are summarised in detail in the EIA and the many submissions before the Commission. I will just briefly summarise those

that are of most concern to me as someone who has conducted a great deal of analysis on in these catchments:

- Due to extensive cracking and reduction in regional water tables now strongly connected to the mined coal seams, most of the catchments, swamps and streams overlying the existing mine are dry, and most of these surface water losses will be permanent.
- Current surface water loss estimates range from 2 to 6.5 GL/year for the existing Dendrobium Mine, increasing by yet another 3.3 GL/year of high quality, rainwater and gravity-fed drinking water if this extension is approved. The Extension Project would almost double the quantum of Dendrobium water loss and other impacts. Given modelling inadequacies and uncertainties, the loss could be substantially greater.
- South32, IEPMC and DPIE have variously and repeatedly compared the estimated volumetric losses due to Dendrobium Mine to evapotranspiration, retail pipe loss and other questionable metrics. Despite these comforting but meaningless comparisons, these losses are not unimportant volumes nor are they in unimportant catchments given the Greater Sydney Region's rapidly expanding drought requirements.
- I suggest that it is more meaningful to compare the volumetric losses with the proportion of stored waters, catchment flows in drought, or financial impairments using IPART values.
- For example, the additional 3.3 GL/year (at least) of additional take by the proposed Dendrobium Extension Project equates to just under four Olympic-size swimming pools of water being removed from the catchments and water supply every day. This is in addition to all of the existing catchment losses. It is not a negligible volume in the increasingly frequent and extended drought periods caused in part by coal combustion.
- Of the catchments which now flow over the Extension Project, the EIA conservatively accepts a 100% reduction in flow within the Avon Reservoir catchment and a 67% reduction in harvestable stream flow to Pheasants Nest Weir.
- 100% reduction of flows is conservative but not unrealistic. The widespread damage proposed for the Extension Project is consistent with the still-unfolding functional destruction of streams WC21 and WC15 which overlie existing Dendrobium Area 3B, due to the widespread surface-to-seam fracturing and consequent groundwater level reductions caused by recent Dendrobium Mine longwalls.
- Most disturbingly, total cumulative mining impacts on Special Area catchment volumes to date or still in process total more than 450 GL (using the Volumetric Conservation method developed by Paul Tammetta for, but yet to be published by, WaterNSW) – a volume which would empty all of the undermined dams and catchments if it were to be removed all at once.
- WaterNSW estimate in their submission to the Commission that Dendrobium will be taking 10 of the 13 ML/day of surface water removed from the Special Area catchments by coal mines if the Extension Project is approved. In my opinion, these are very conservative estimates relative to those that were found using Tammetta (2018) flow-informed methodology. In my view, this is a very substantial additional take to an already monumental cumulative reduction in catchment yields for Sydney's water supply.
- There is a wide range of other impacts unfolding in the Special Areas due to mining, including the ultimate loss of most or all undermined upland swamps (many of which were known to provide key habitat for threatened species), widespread but unassessed water

quality impacts at least within the upper portions of stored waters, and the complete riparian habitat losses of many kilometres of dry streams with cracked streambeds. The Extension Project will significantly further deplete the already impacted groundwater regime between the Avon and Cordeaux Reservoirs.

3.2 Implications of Surface to Seam Connectivity

As highlighted by IEPMC and IAPUM, the most important understanding that has been confirmed in the past few years at Dendrobium Mine is that surface to seam cracking has been experienced over most of the existing mine's footprint (Figure 1). In other words, the unfractured or "constrained" zone which was hypothesised to provide ample protection to the overlying catchments (EcoEngineers, 2000) is not present over most of the existing Dendrobium Mine longwalls.

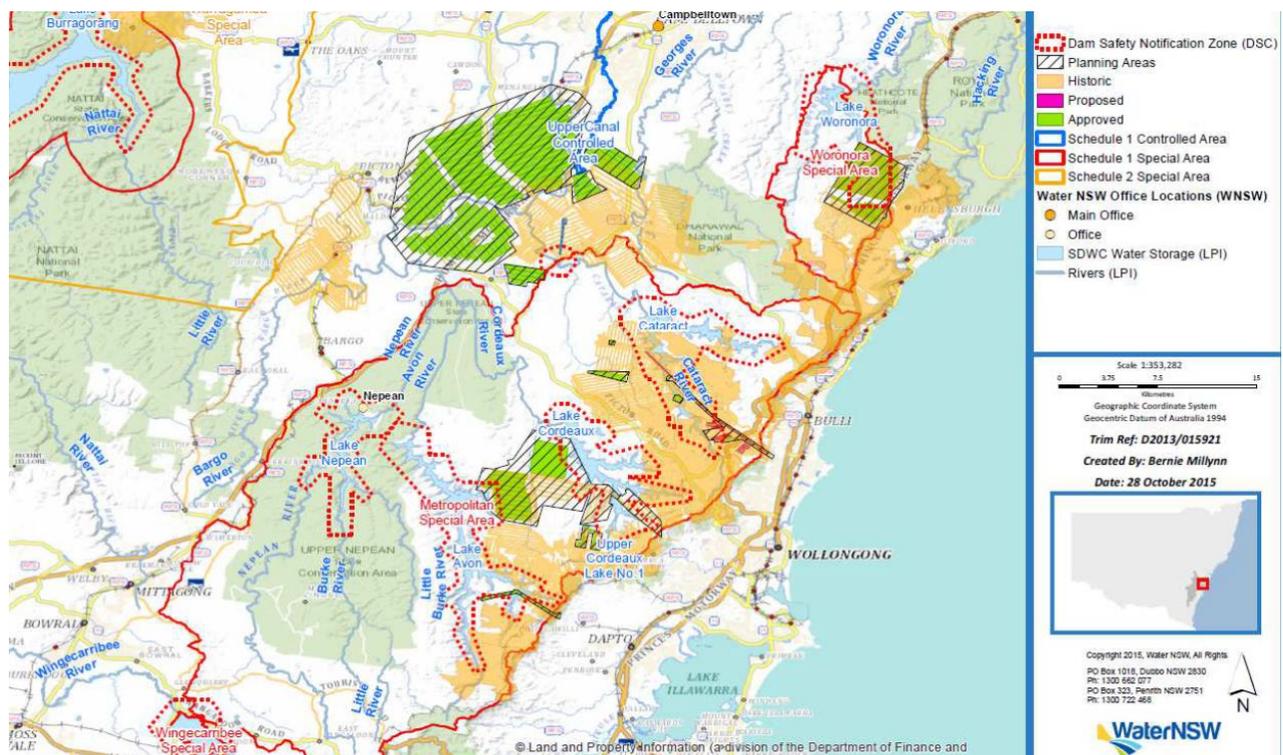


Figure 1 – Reservoirs (blue), mining footprints (orange) in Metropolitan and Woronora Special Areas. Source – WaterNSW 1st submission to IEPMC (2018)

At Dendrobium Mine it appears that the groundwater levels are still subsiding unevenly (Parsons Brinckerhoff, 2015). This extensive cracking of the entire rock column will or has caused the full desaturation of the rock column (Hgeo, 2020). As there is no regional water table to support the subsidence-affected streams, water which is intercepted by the extensive surface cracking network is diverted into the rock beneath the streams and swamps, meaning that the whole catchment underlain by longwalls is still in the process of drying out.

The truth is that no one really knows how close to pre-mining levels the regional groundwater table, which support the surface water flows, will return to after mining or how long this will take (I do offer recommendations about the most robust means of calculating the period and total loss curve in Attachment A if required). In my view the most likely long-term outcome is that the levels will remain well below current levels for centuries and quite possibly forever, based on the following considerations:

- The bulk rock permeability between the surface cracking zones (formed primarily by non-conventional subsidence) and the mined coal strata has been confirmed (Hgeo, 2020) to

be orders of magnitude higher over the longwalls than natural conditions – this is permanent and the idea that this mine and its widely cracked strata can be sealed and/or the cracks might silt up over time is not supported by any evidence that I have seen.

- The coal strata generally dip gently towards the west, away from the coast and consistent with the plateau topography (Figure 2). The coal seams are naturally more permeable than surrounding sandstones and siltstones, and may be viewed as a potential zone of increased drainage now connected to a myriad of underground workings (Figure 1) and goaves within the Illawarra Coal Measures
- Given the mostly intact nature of the coal strata to the west and the mostly fractured (behind longwalls) and/or open (in access and bord and pillar voids) state imposed by mining, hydrostatic pressures once the mine pumps are turned off will push groundwater towards the escarpment as groundwater levels start to recover. This will likely cause iron-springs to emerge from the escarpment – creating major water quality issues along the coast as well as within the Special Area catchments. Subsequent rises in groundwater levels within the Special Area will largely depend on whether these westward flows can be stemmed.

The most important implication of our new understanding of the extent of cracking and groundwater level reductions overlying these super-wide longwalls (e.g. IEPMC 2019a; 2019b) is that the surface water losses from the Special Area catchments are likely to be permanent, with the possible exception of iron-laden springs emerging when groundwater levels finally return to their reduced post-mining equilibrium conditions.

Eventually, a new equilibrium groundwater regime will be established around the Dendrobium Mine. I predict that this equilibrium will be much lower (perhaps hundreds of vertical meters) than pre-mining levels. Without groundwater providing baseflow and with the stream surfaces connected to deep cracking, surface flows over the mined regions are unlikely to ever return to functional streams again.

The framework was peer-reviewed by E/Prof Jim Galvin prior to formation of the IEPMC, and was subsequently presented to that panel given its central importance and value in assessing the risks to the catchments. The thresholds would provide a valuable perspective in reviewing the Extension Project proposal.

The IEPMC recommended in their final report (2019) that the SAFMSA thresholds (without naming them as such) should be finalised and published, but as far as I'm aware they have not been substantially progressed. If correct, this lack of progress prior to DPIE's submission of the Extension Project is bewildering and in my view should not be acceptable to the Commissioners.

I strongly suggest that the draft framework needs to at least be presented to the Commission for inclusion in the Commission's deliberations. It would have been much more appropriate however if the IEPMC's recommendations had been enacted in a timely manner (in accordance with Minister Stokes' commitments of April 2020) and these thresholds were to have already been openly debated and some consensus found (at least within government), prior to such a pivotal decision being made about the future of Sydney's water supply..

5. INAPPROPRIATE OFFSETS

The mine's principal justification for extending their catchment damage is that most of the impacts will be partially or fully offset. As noted by the IAPUM (2020) and discussed above however, impacted streams are unlikely to meaningfully flow or maintain riparian habitat again, another twenty five swamps providing critical habitat to endangered flora and fauna will be desiccated and lost to increasingly intense fires, and water quality will inevitably suffer over the long-term requiring increasingly costly water treatment that is not assured. In reality, most of these impacts will be permanent, so on what basis can in-perpetuity losses/degradation be fairly priced? In my opinion, financial and ecological offsets are not adequate justification for allowing such an extensive and permanent burden to be placed on the catchments and water supply.

5.1 Post-mining losses likely to be permanent

Sydney's water supply is finite and precious (especially the high-quality, gravity-fed water sourced from the Illawarra Plateau Special Areas). In my opinion, the proponent's offer to replace water loss of direct replacement of suitably treated water into the dams from groundwater collected in the goaf and overlying rock formations and deposited in the Special Area reservoirs (Figure 1) should be government's first preference, rather than say additional capacity in treating seawater and delivery into the bottom of the delivery catchment.

As discussed in Section 3.2 of this report, it is certain that stream losses and regional groundwater levels in the undermined catchment will ultimately reach a new equilibrium in the centuries following cessation of mining, and very likely that these will be substantially lower than pre-mining flows and levels. This clearly makes the concept of a single-lump payment for water offsets inappropriate.

Further, the basis of the post-mining predictions on which DPIE has satisfied itself that \$17.3M is an adequate level of compensation has not been made public (as far as I can determine). If we accept the IPART rates with one drought every 10 years and 3.3 GL/year take, I would expect the offset to be about \$8M/year. If correct, this would suggest that both the \$17.3M proposed post-mining compensation and the full compensation allocation of \$103M for both mining and post-mining periods, will be found to be inadequate by future Sydneysiders and taxpayers.

5.2 Methodology for calculating surface water loss offsets is critical

One of the key questions in regard to the volumetric offsets is how the total and per-year rate water losses will be firstly estimated, for the purposes of setting compensation packages, and secondly measured, for payment or replacement of water. WaterNSW engaged groundwater hydrologist Paul Tammetta in 2017/2018 to develop a defensible and accurate method for calculating losses. Tammetta's 2018 report on catchment hydrological responses was peer reviewed by an eminent academic and used by WaterNSW staff to estimate the surface water take from existing and past mines. It is unfortunate that WaterNSW has still not published the project report nor the internal findings, as it is important pioneering work which should be shared.

The rates of loss from current mines were estimated using two complementary methods in Tammetta's report. Without question, the most robust method currently available for predicting the rate and duration of losses over the mine would be to calibrate a good groundwater model (potentially combining elements of Coffeys' 2012 model with the current SLR one) using the "provisional loss curve" method results from the existing and extrapolated Dendrobium Mine (see Recommendations section of this report).

Simple application of South32's existing groundwater model for the purpose of estimating flow losses would be highly inappropriate, as noted by IAPUM and DPIE. This is effectively the same model that was implausibly predicting surface water losses of 272 ML/year in 2014 (when surface-seam cracking must have been known but had not been disclosed). These predictions were amended to 330 ML/year in 2016, to 683 ML/year in 2018, to 1,372 ML/year in 2019 – in other words this groundwater model can give a wide range of surface water loss predictions depending on expediency.

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ATTACHMENT A: RECOMMENDATIONS IF PROPOSAL IS NOT REFUSED

Although my opinion is that the Project should be refused consent for the reasons outlined above, should the Commissioners decide to approve the Extension Project, I offer the following reflections on potential improvements to the current and proposed approval regimes.

- As noted by WaterNSW in their submission to the Commission, protecting the catchments requires that a “constrained zone” of unfractured rock between the upper and lower fracture zones needs to be maintained. Given the uncertainties and gradational nature of these two zones however, I suggest that application of the Precautionary Principle requires a design intention to maintain at least 200 vertical metres to reduce the depletion of surface waters to the loss rates being recorded at Metropolitan Mine

- The SAFMSA should be used as a basis for a public discussion to identify suitable thresholds of mine-specific and cumulative loads and impacts which may be sustained by the Special Areas. It is strongly recommended that any approval for the Extension Project should reflect aspects of this framework, especially in terms of quantified performance measures and management plan action thresholds.
- One of the key questions in regard to the offsets is how the total and per-year rate water losses will be predicted and evaluated. The most technically robust method available for calculating the rate and duration of losses over the mine is to calibrate a good groundwater model (potentially combining elements of Coffeys' 2012 model with the current SLR one) using the "provisional loss curve" method results from the existing and extrapolated Dendrobium Mine. The methods are outlined with some results at <http://agc2019.m.agc.currinda.com/schedule/session/64/abstract/487> and detailed in the unpublished Tammetta (2018) Catchment Losses Assessment report, held by WaterNSW.
- If the mine is approved and the offset plan is activated, the company's offer of direct replacement of suitably treated water into the dams from groundwater collected in the goaf and overlying rock formations and deposited in the SA storages should be government's first preference, rather than say additional capacity in treating seawater and delivery into the bottom of the delivery catchment.
- Mine closure should include design options for recovering groundwater from goaves – in my opinion, this water will need to be recovered at some stage in the future, to treat it for drinking water, as it is of better quality and in a better location than seawater as used by the Botany desalination plant. South32 should ensure that this capacity is not compromised and be required to build in a design for later water recovery in their post-closure plan.

Qualifications

- Candidate, Doctor of Philosophy by research, University of Technology Sydney, School of Engineering & IT, Sydney (2019-2022)
- Master of Applied Science (Environmental Hydrogeology), University of New South Wales, Sydney (1991)
- Bachelor of Applied Science (Hons.) (Geology), University of Technology, Sydney (1986)
- Certificate in Strategic Sustainable Management (Dist.), Blekinge Tekniska Hogskola, Sweden, 2012

Expertise

- Stakeholder engagement, expert elicitation and decision-support tools
- Analysis of mining impacts on surface water catchments and aquifers (see Professional History - Mining Manager, WaterNSW)
- Advocacy on behalf of agencies, regulators, NGO's and Councils regarding water impacts from various developments
- Developing innovative approaches and tools to environmental and resource challenges
- Peer reviews of groundwater and surface water resource and quality assessments and monitoring and modelling strategies
- Integration of stakeholder engagement and big data analysis tools in surface water, catchment and groundwater management
- Geo-environmental impact and risk assessment
- Soil and water pollution - monitoring design, assessment and remediation

Key Skills

- Environmental hydrogeologist with almost 40 years professional experience in a variety of technical and management roles, primarily in water/groundwater resource evaluation and 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 management, advocacy and communications skills developed in a wide variety of settings, primarily as a regulator or consultant.

Professional History

August 2019 - Present

Founder, 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 supporting agencies 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.

August 2019 - Present

PhD Candidate, UTS

I am in the second year of a PhD, centred on a funded trial which aims to introduce new modelling technologies with social science insights to enable rapid and meaningful stakeholder engagement in major planning approval processes in NSW.

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 monitoring data, and to assess the adequacy of monitoring systems to discern potential mining impacts from other possible causes. My primary achievements during this period was developing an innovative methodology for estimating water losses due to undermining and a robust framework for assessing hydrological and ecological risks to catchments.

March 2014 - Feb 2015

Senior Hydrogeologist, NSW Department of Industry (DoI)

In this position, I assisted DoI-Water to implement the Aquifer Interference Policy, particularly with respect to the assessment of State Significant Developments (primarily mining proposals). During this period I also led several innovative projects, including one to develop and implement a new scheme enabling the government to ingest industry monitoring data into the future Environmental Data Portal (not since implemented), and initiated numerous innovations to improve the agency's effectiveness in monitoring and managing the state's water resources.