OD Hydrology

18 July 2022

Hunter Thoroughbred Breeders Association
P.O. Box 538
Scone NSW 2337

Re: Review of surface water aspects of Mount Pleasant Optimisation Project

The following provides a summary of key outcomes and conclusions from our review of the Mount Pleasant Optimisation Project, with particular reference to:

- Mount Pleasant Optimisation Project State Significant Development Assessment SSD 10418, May 2022. NSW Department of Planning and Environmental (hereafter referred to as the 'Department Assessment Report').
- Recommended Development Consent for Application Number SSD10418 MACH Energy Australia Pty Ltd
- Mount Pleasant Optimisation Project (SSD – 10418) -Environmental Impact Statement ('the EIS').
- EIS Appendix D: Mount Pleasant Optimisation Project Surface Water Assessment. Hydro Engineering and Consulting Pty Ltd, December 2020.

The following provides a summary of key review findings in respect to the proposed modification and information presented in the above documents.

Key points from review include:

Overall review findings are that the reported assessment lacks sufficient detail with which to assess key elements of the proposal. It is our opinion that based on currently available information it is not possible to make a fully informed decision regarding the water-related risks and potential impacts associated with the proposed project.

Our main concerns comprise:

1. Uncalibrated or validated water balance model: The Project water balance model, upon which all conclusions are based, is an uncalibrated model with no demonstrable evidence of accuracy or representativeness of simulated behaviours to likely future on-site conditions.
2. The hydrological information being relied upon is 10+ years old, with no consideration of significant climatic conditions that have occurred since that time or significant change in understanding regarding potential climatic/hydrologic risks associated with water resources generally and within the Hunter Valley specifically.

3. No recognition or consideration of the likely effects of climate change over the next 30 years or implications for the Project water balance.
4. Significant water supply risks to the Project which have not been recognised or assessed and which have material implications for Project operational viability.
5. Rehabilitation and long-term post-Project legacy structures
6. Lack of clear, definitive performance measures for Project water management coupled with postponement of the requirement for a water management plan until after Project approval.

Within this context, we find that there is significant uncertainty and lack of clarity within the available information which casts significant doubt on the confidence that can be placed in the precision of results as reported or conclusions stated based on those results.

Further discussion of these key deficiencies is provided below.

Uncalibrated models

The Project water balance model, upon which all conclusions are based, is an uncalibrated model with no demonstrable evidence of accuracy or representativeness of simulated behaviours to likely future on-site conditions.

This concern was also raised within the Independent Expert Scientific Committee advice to the decision maker[1], with MACH response to IESC comments stating that:

> *"Site-specific calibration of the site water balance model was not considered appropriate"*

Mach indicated that it did not consider it "appropriate" to calibrate or validate the water balance model to monitoring data because the progressive development of the site since 2016 and a prolonged drought over this period in their view:

> *"significantly reduced the opportunity to gather additional site-specific runoff and catchment data sets*"

Confidence in the set-up and performance of the water balance model is central to a wide range of precisely quantified and critical predictions of Project performance (e.g. spill risks, supply risks, etc) and the reviewer finds this justification concerning for a number of reasons, including:

1. Hydrological and project water balance understanding is greatly enhanced through gathering and verification of information over dry periods – in fact the opportunity to understand the project catchment responses and water balance over very dry conditions is perhaps some of the most critical information to gather and calibrate against, rather than a "reduced opportunity" as stated. Either neglecting to apply this data in the surface water studies associated with the Project, or having neglected to collect this information at all, both represent an approach well below best practise.

[1] Advice to decision maker on Mount Pleasant Optimisation coal mining project IESC 2021-121: Mount Pleasant Optimisation Project (EPBC 2020/8735 and NSW SSD 10418) – Expansion

2. In addition to the information that could have been gathered over the 5+ years since MACH took ownership of the Project, mining and associated water balance development and use has been ongoing within the Hunter Valley for a significant period of time, with the adjacent Bengalla mine operating as far back as 2000. A wide range of directly relevant climatic, hydrological and mine water balance information exists which could be readily applied to model validation to demonstrate whether the model is able to represent mine water balance behaviours to an appropriate level for decision making regarding potential risks and impacts.

Without some form of calibration/validation information, it is difficult to justify the confidence with which model outcomes have been reported and adopted as being a robust and valid representation of what actual mine water balance behaviours and impacts would be.

Being unable to place confidence in the Project water balance model, we cannot know the potential risks/impacts associated with either water build-up during wet periods or supply shortfall during dry periods. Noting that over 26 years, there is a reasonable probability that the Project will be affected by both at least once.

Outdated inputs

Reporting indicates that the climatic and hydrological information used to underpin Project assessment is limited to 1892 to 2012. The key hydrological information being relied upon is therefore some 10+ years old over which time there has been significant change in understanding regarding potential climatic/hydrologic risks associated with water resources generally and within the Hunter Valley specifically.

As an illustration of the significant change in understanding and need for updated assessment, the Greater Hunter Regional Water Strategy (NSW DPI, 2018) has identified that:

- Mine-related reductions in the base flows and climate change greatly increase the risk of drought.
- Climate variability is much greater than has been observed.
- The Upper Hunter is likely to experience less rainfall than previously used for water supply security estimates.
- Climatic conditions similar to those experienced in the 1940s would see General Security allocations reduced to zero for approximately 12 consecutive years.

Without consideration of more recent, significant climatic/hydrologic conditions and updated understanding of the Hunter River catchment water supply scheme it is again not possible to place confidence in the outcomes and conclusions being reported.

The most recent 10 years represents a significant period of climatic and hydrologic variability, including several historically significant dry years, and cannot be justifiably dismissed or ignored when considering supply and management risks over the next 30 years.

No recognition of or accounting for climate change within life of Project

Critically, Project surface water assessment does not consider climate change impacts on water supply, water management or flooding risks over the life of the Project. The recognition and understanding of the likely effects of climate change and associated implications for the Project, surrounding water resources and environments is of key importance in terms of understanding the potential water supply, water management and flood risk issues and impacts over the proposed project life.

Table 1 and Table 2 below illustrate how ignoring climate change in the water balance and surface water assessment presents an extremely limited and potentially misleading picture of water supply and water management risks over the length of the Project life.

Both tables show the range of projected change in annual rainfall and time in drought as projected from the latest global and regional climate models that informed the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report. The results effectively show the potential range of outcomes a projected by the numerous models applied, and importantly the relative 'consensus' of those models regarding which type of change is likely to occur.

The projected 2050 climate future under the Representative Concentration Pathways (RCP) scenarios present best current available climate predictions for a project such as this which has a mine life to 2048.

Table 1 summarises projected 2050 climate future under scenario RCP 8.5, a future with little curbing of emissions, with a CO_2 concentration continuing to rapidly rise. To date, global CO_2 concentrations continue to most closely following this scenario. Table 2 shows projected climate futures under scenario RCP 4.5 with lower emissions, achieved by application of some mitigation strategies and technologies. CO2 concentration rising less rapidly (than RCP8.5).

In both cases, results indicate a wide range of potential futures, from much wetter to much dryer, with the majority of outcomes towards the dry end of projections. For example:

- Under RCP 8.5: 12 of 32 models project a large increase (> 30%) of time in drought, and 20 out of 32 models projects at least a 10% increase in time in drought.
- Under RCP 4.5: 11 of 30 models project a large increase (> 30%) of time in drought, and 17 out of 30 models projects at least a 10% increase in time in drought.

These types of projected change have significant implications for both the sensitivity of surrounding environment and water resources, as well as the viability of the Project itself, which have simply not been recognised or addressed.

Noting the very high degree of confidence within the climate science regarding rising CO_2 concentrations and temperatures (Table 3), the rainfall and time in drought results demonstrate the significant uncertainty in exactly how these rising temperatures will effect climate and hydrology at a local or regional level. The lack of recognition of climate change as a highly significant factor in the Project water balance going forward is therefore a major deficiency in assessment and does not allow for well-informed conclusions regarding potential risks and impacts.

Table 1: East Coast Climate Futures (2050, RCP 8.5) (Source: CSIRO Climate Change in Australia website[2]) – Rainfall, Time in Drought

		Annual Time In Drought (%)				
		Large Decrease < -30.00	Small Decrease -30.00 to -10.00	Little Change -10.00 to 10.00	Small Increase 10.00 to 30.00	Large Increase > 30.00
Annual Rainfall (%)	Much Wetter > 15.00		1 of 32 (3%)			
	Wetter 5.00 to 15.00	4 of 32 (12%)	1 of 32 (3%)	1 of 32 (3%)		
	Little Change -5.00 to 5.00		2 of 32 (6%)	3 of 32 (9%)	1 of 32 (3%)	2 of 32 (6%)
	Drier -15.00 to -5.00				7 of 32 (22%)	4 of 32 (12%)
	Much Drier < -15.00					6 of 32 (19%)

Table 2: East Coast Climate Futures (2050, RCP 4.5) (Source: CSIRO Climate Change in Australia website) - Rainfall, Time in Drought

		Annual Time In Drought (%)				
		Large Decrease < -30.00	Small Decrease -30.00 to -10.00	Little Change -10.00 to 10.00	Small Increase 10.00 to 30.00	Large Increase > 30.00
Annual Rainfall (%)	Much Wetter > 15.00		1 of 30 (3%)			
	Wetter 5.00 to 15.00	2 of 30 (7%)		1 of 30 (3%)		
	Little Change -5.00 to 5.00	3 of 30 (10%)	3 of 30 (10%)	3 of 30 (10%)	5 of 30 (17%)	3 of 30 (10%)
	Drier -15.00 to -5.00				1 of 30 (3%)	6 of 30 (20%)
	Much Drier < -15.00					2 of 30 (7%)

2 https://www.climatechangeinaustralia.gov.au/en/

Table 3: East Coast Climate Futures (2050, RCP 8.5) (Source: CSIRO Climate Change in Australia website) – Evapotranspiration, Mean Surface Temperature

		Annual Mean Surface Temperature (C)			
		Slightly Warmer < 0.50	Warmer 0.50 to 1.50	Hotter 1.50 to 3.00	Much Hotter > 3.00
Annual Evapotranspiration (%)	Large Increase > 4.59		8 of 29 (28%)	18 of 29 (62%)	
	Small Increase 1.00 to 4.59		2 of 29 (7%)	1 of 29 (3%)	
	No Change -1.00 to 1.00				
	Small Decrease -4.59 to -1.00				
	Large Decrease < -4.59				

As temperatures and evaporation increase, about which there is high certainty, catchments will be generally drier, less overall flows and critically less baseflows.

And within this environment of declining streamflows and water resources generally, mining projects of this type will likely also have increased demands due to increased evaporative losses from storages, less local runoff and likely reduced availability under the general security licences supplied from Glenbawn Dam.

Noting that Project assessment generally describes impact in terms of a percentage of pre-2012 flows – for example, a "5.3% decrease in average Sandy Creek flows" compared with simulated 1895-2012 flow, are the predicted impacts on, for example Sandy Ck, realistic under this higher demand, reduced flow climate? Without a clearly validated model and the appropriate understanding and inclusion of climate change as it will affect the project over its proposed operational life it is not possible to know.

Water supply risk

A key point of note regarding reported project water supply/management information is that all understanding and (in particular quantified values) for water movements onto, within and off of the project site are based on an uncalibrated, unvalidated model, rather than any updated, project-specific analysis and understanding. Climate and hydrologic data used is limited to pre-2012 information and there has been no recognition of the changing climate and it's implications for rainfall, catchment runoff, surface water flows, evaporative losses and the likelihood and potential duration of droughts.

This is of particular importance as there have been a number of significant water supply -related studies undertaken specifically for the Hunter River system over the past several years which show critical outcomes for any activities relying on water that have not been recognised or accounted for within the project assessment.

Of particular note are, the Greater Hunter Regional Water Strategy, developed by the NSW Department of Industry, states the following key findings:

- Drought security was confirmed as the primary economic risk facing the Upper Hunter. This risk extends to all sectors, including urban, agriculture, mining and power generation.
- Analysis of historical rainfall patterns shows that droughts have been under-estimated in the Upper Hunter and a stronger variation in rainfall occurs across the Greater Hunter region.
- A repeat of the 1940s drought (the worst on record) would see general security water allocations reduced to zero for approximately 12 consecutive years.
- Analysis of the variability of climate indicates that the 1940s drought may occur on average 1 in 40 years.
- Reductions in the base flows of rivers have occurred, and will continue to occur, as mining intercepts surface runoff and lowers groundwater levels near rivers.
- The proposed closure of Liddell Power Station in 2022 will not significantly mitigate the risk of failure of supply to water users in the Hunter Regulated River.

The above findings clearly indicate the need for updated/improved understanding and assessment of water supply risks associated with any project.

Notwithstanding the reviewer's concerns stated above regarding the appropriateness of the water balance model for predicting future behaviours, Project reporting (EIS Appendix D, Section 6.4) indicates that the water supply system is predicted to fail (i.e. the Project would be forced to shut-down) over the life of the project, with an estimated average of three (3) months without sufficient water to operate and up to two (2) years of shut-down indicated within the modelling.

Again notwithstanding that the reported risks are based on an assumed climate similar to that of 1892-2012 and therefore likely underestimate actual risks, the reported values are not immaterial and are stated without meaningful discussion of potential implications, with commentary limited to potential options for reduced haul road watering requirements and the sourcing of water from other parties – noting that under dry conditions these other parties would likely be under similarly constrained water supply conditions.

It is also worth noting that these reported periods of lost operation do not take into account the potential additional project interuption beyond the period of physical water failure (i.e. project machinary and personnel would not simply stay idle until such time as water supply was re-instated and then immediately start production again), and these disruptions have not been accounted for in project financial/economic assessment with regards employment impacts (fullt-time, casual, contractor), royalties, etc. Additionally, given the open cut nature of the mine, air quality impacts and fugitive emissions would continue to occur even if the mine was "shut down".

Have these risks been accounted for in Project planning and assessment? Project Economic reporting (EIS Appendix O, Figure 2-3) shows an uninterrupted production schedule over the full proposed life of the Project. Therefore, from an economic perspective:

- Are the costs of the estimated periods of shut-down accounted for in cost-benefit analysis?
- What are the social and employment impacts of a shut-down?
- What are the implications for Project sustainability and consequently for ongoing environmental management and rehabilitation outcomes?

Considered in the context of a changing climate – with a strong likelihood of lower rainfall, higher evaporative losses, more time in droughts - and these reported risks are almost certainly under-estimated. Potentially by quite a large margin.

Post-Project legacy issues

The final void management concept comprises leaving the voids open and (accepting reported model outcomes) acting as a groundwater 'sink' -that is, no outflows from the void are predicted, with inflows balanced by evaporative losses over time. Implications of this conceptual plan include:

- If reported model results are accepted: The formation of a large volume, hyper-saline water bodies, located upstream of areas of alluvial aquifer which have been classified as 'highly productive' by the NSW Government via groundwater vulnerability mapping which is still listed within the NSW Spatial Data Catalogue - noting that when sought from the NSW Data Broker by Groundwater Assessment Solutions (GWAS) who undertook review of groundwater aspects of the Maxwell EIS, the listed groundwater vulnerability mapping were described as no longer available to the public, with no explanation as to why this was the case.

- Noting above concerns regarding lack of reported proof of model performance against recorded/real-world data (i.e. no reported calibration/validation), without confidence in model accuracy/representativeness, it is not possible to say with confidence that significantly different final void behaviours could occur compared with those currently reported (e.g. higher final void levels), with associated risks and impacts to local and regional surface and groundwater resources.

The proposed fine coal rejects (or tailings) management and post-mining concept proposed comprises a significantly modified approach than previously proposed and approved in 1999. The original 1997 EIS proposal was based on a series of terraced progressively filled and rehabilitated storage cells. The new proposed approach consists of a single, large, continuously filled storage and increasing dam embankment, intended to store approximately 36M cubic metres. The final dam wall embankment is proposed to be approximately 60m in height, an increase of approximately 39m from previous planning, with the entire volume of tailings located in the upper portion of the Sandy Creek catchment, which drains ultimately through the highly productive alluvial area to the south and ultimately to the Hunter River (Figure 1).

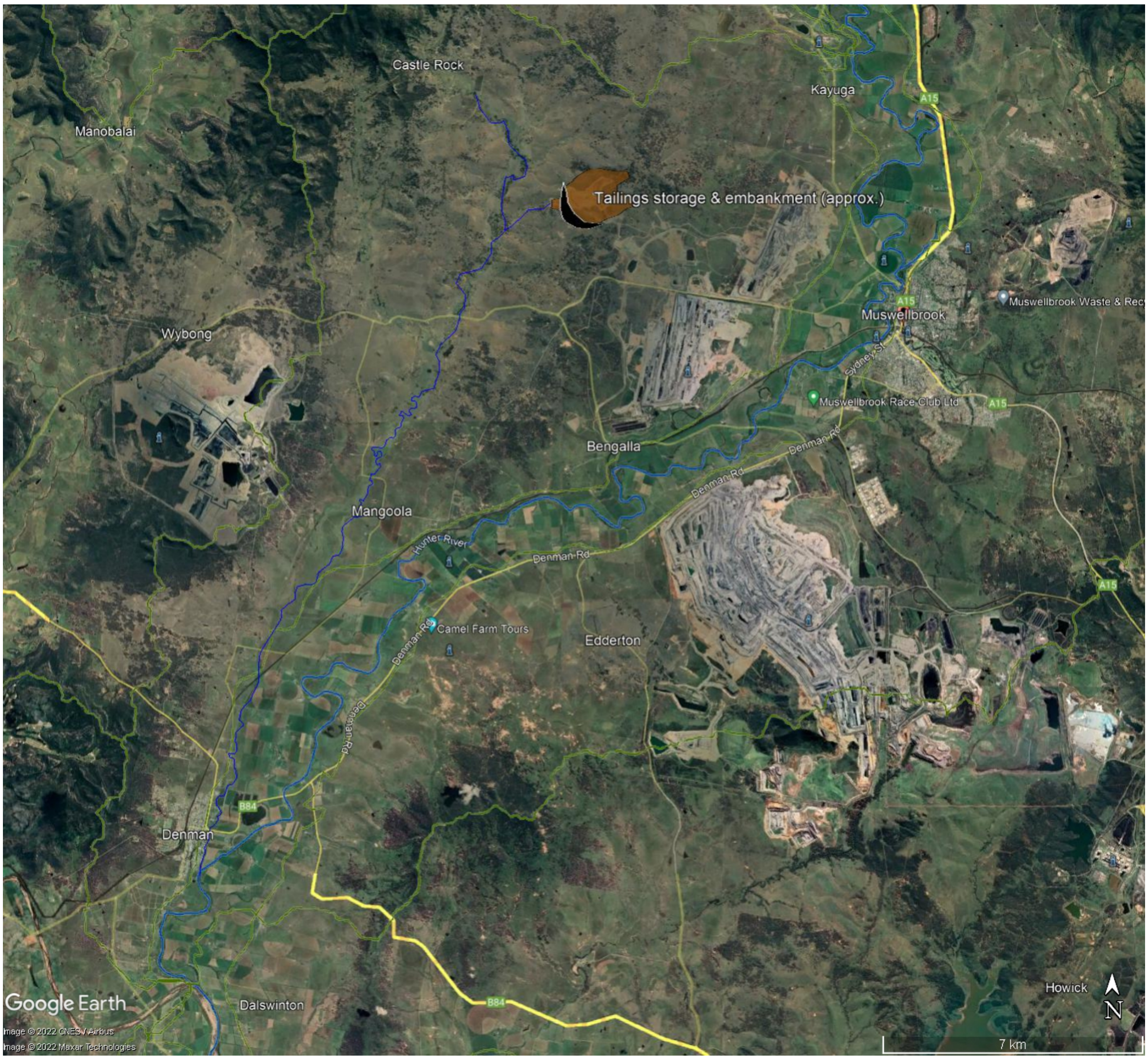

Figure 1: Tailings storage location

With the location of the storage directly upstream of highly productive agricultural land, Hunter alluvial aquifer and Hunter River itself, any potential for embankment failure and discharge of tailings represents a major environmental, social and economic issue.

In his presentation to the IPC, Dr Steven Pells raised his concerns regarding tailings dam failures over history, with the proposed storage representing "… a very significant structure" and "… a big risk item". Dr Pells concerns were mostly directed towards embankment design and the potential for embankment saturation through operational and mine sequence changes over time, which itself represent a key risk over both the life of the Project and beyond.

In summary, the post-Project plan represents a legacy for the State and community. The proposed approach comprises leaving behind:

1. Open mine pits which gather water and become hyper-saline over time. There has been no meaningful assessment of the real risks and impacts of leakage/seepage of this water into the surrounding groundwater and surface water over the years to come; and,
2. A major dam wall (approximately 60m high at its highest point) holding back some 36,000,000 cubic metres of tailings material stored above ground and located in the upper part of the Sandy Creek catchment which flows directly to the Hunter River.

Both of which represent significant, very long-term legacy issues for the region and the State.

Conditions of Consent

A characteristic of the conditions of consent recommended by the Department is the general wording of requirements for technical assessment and inherent acceptance (or non-recognition) of the uncertainty in results and potential impact reported within EIS assessments. In effect, the reported level and type of impact is accepted as reported by the Project Proponent and assumed to be addressed at a later stage via management plans, noting that a management plan is not required to be submitted until up to six months after development has commenced (as per Condition B52 reproduced in part below, with emphasis added).

> *B52. The Applicant must prepare a Water Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:*
>
> *(a) be submitted for approval* ***<u>within six months of the commencement of development</u>*** *under this consent*

Further, there is a lack of clear, definitive or measurable objectives are described in the recommended conditions. Conditions related to the "performance measures"[3] to be applied to water management compliance are described generally and without meaningful measures against which to test compliance – for example:

- *"Minimise risks to the receiving environment and downstream water users"*
- *"Maximise, as far as reasonable, the diversion of clean water around disturbed areas on the site"*

The conditions as currently written therefore effectively postpone, until after the Project has been approved, both the requirement for a water management plan as well as the specifics of how the performance of that plan is to be measured.

[3] Recommended conditions of consent Table 6 – Water Management Performance Measures

In terms of more appropriate and definitive conditions, to meaningfully address the concerns raised would require the potential for greater independent scrutiny and review of more detailed environmental impact assessment results.

The modelling studies undertaken throughout the approvals process are used for predictive purposes to provide an estimate of impacts under the proposed operation. As such all reported (and approved) impacts rely on these models providing an appropriately accurate prediction. Inaccurate assessment or inappropriate reporting will fail to provide realistic understanding of the impacts that may occur in reality. On this basis, conditions of consent for the areas of surface water and groundwater should include specific requirements for actual operation to match modelled conditions upon which the estimated impacts are based, as well as ensure that measured outcomes/impacts during that operation validate the original predictive modelling. To provide for this the conditions of consent would require:

- Specific reference to the type of assessment required and type/level of precision of results reported;
- Allowance for independent review of water management plans and underpinning assessment tools; and,
- Ongoing independent validation of model predictions with set levels of required accuracy.

On the basis of modelling undertaken for prediction of impacts under the proposed Project, the following modification of condition B52 provides suggested wording in order to ensure this consistency and ongoing validation of predictions, with suggested modifications shown in bold, underlined text (where added to original wording) and strike-out (where removed from original wording) :

B52. The Applicant must prepare a Water Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:

*(a) be submitted for approval ~~within~~ six months **<u>prior to</u>** ~~of~~ the commencement of development under this consent;*

…

(f) include a:

*(i) **Site Water Balance** that includes details of:*

- *predicted annual inflows to and outflows from the site;*
- *sources and security of water supply for the life of the development (including authorised entitlements and licences);*
- *water storage capacity;*
- *water use and management on the site, including any water transfers or sharing with neighbouring mines;*
- *licensed discharge points and limits;*
- *reporting procedures, including the annual preparation of an updated site water balance; and*

- *a program to periodically validate the water balance for the development* ***- .***

  The Site Water Balance must be validated without modification of model structure or parameters from those upon which approval is granted at least twice each calendar year during the term (at no longer than 6 monthly intervals). A validation report must be provided to the Secretary and made available to CCC and any interested person on request. The validation report must address mine water balance (volume) and characteristics (quality) over the period since commencement with direct comparison of simulated versus real behaviours within each separate water management system (i.e. mine water system, disturbed area system, clean water system, etc).

With defined, quantified values for minimum validation performance requirements for volume and quality outcomes. For example:

- "Validation must show differences in simulated versus recorded mine water volume of less than 5% at all times".
- "Simulated levels for reported water quality parameters must be within 10% of recorded values at all times, with no instances of simulated values underpredicting recorded behaviours".

To allow for transparent and objective measurement of both model performance, in appropriately predicting mine water balance and quality, and therefore potential impacts, and actual real-time mine water management performance in ensuring reported operational objectives are met.