THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

31 December 2019

Sustainable Minerals Institute

Professor Bruno Oberle
Chair
Global Tailings Review
consultation@globaltailingsreview.org

Cc: Tom Butler, Ligia Noronha, Adam Matthews

Reference: 'Consultation on Draft Global Tailings Standard'

Dear Professor Oberle,

We appreciate the opportunity to provide comment on the draft Global Tailings Standard as part of the public consultation phase of the Global Tailings Review. The University of Queensland was delighted to host you for the Eastern Australia consultation events earlier this month and share with you our reflections on the draft Standard.

In this letter, we have summarised our feedback, structured as general and strategic comments, described herein, and specific comments on the principles and requirements, attached as an annex.

At the outset we would like to commend your team on the professionalism that you have applied to your mandate. The management of mine and mineral processing wastes are one of industry's greatest challenges. Tailings arguably represent the most significant risk that the mining industry poses to the environment and communities and this fact elevates the importance of the task at hand.

Strong endorsement of the principles-based approach

We strongly endorse the decision to develop a broad-based Standard that is designed to complement other existing technical guidance and focus on the management and governance of tailings. As a principle-based standard, I don't think there are any of the listed principles that one could disagree with, either from a company or a community perspective. Many of these principles reflect good practice that is already required by a myriad of other standards, policies and laws, now applied specifically to tailings. The principles, if followed would also bring more general benefit to the industry. For example, the promotion of a learning culture within the mining industry has long been an objective of the industry, and achievement of this requirement would go a long way to improving the efficiency of mining operations more generally.

Should an operator follow and satisfy the principles and requirements outlined in the draft Standard to the highest possible level then we believe the Standard would significantly reduce the risks of tailings storage facilities to people and the environment. The adoption of a risk-based approach, the clarity provided through the footnotes and glossary and the palpable intent of driving towards zero harm are all to be applauded.

Acute and Chronic risks can be catastrophic

The weight of emphasis on the geotechnical stability of tailings dams and the consequences of a catastrophic failure is understandable. However, we hold a concern that this emphasis has narrowed down the scope of the Standard. Given that the Standard adopts a risk-based

The University of Queensland
Brisbane QLD 4072 Australia
T +61 7 3346 4003
F +61 7 3346 4045
E smi@uq.edu.au
W uq.edu.au
ABN: 63 942 912 684
CRICOS PROVIDER NUMBER 00025B

approach, it is important that it provides a sophisticated underlying knowledge of the multidimensional and subjective nature of risk.

Tailings present both acute and *chronic* risks and consequences, which can both be catastrophic in their own way. An example of the latter are the health outcomes of mine workers and of those living in communities neighbouring mine sites from hazards such as respirable dust and seepage of potentially contaminated water into local waterways from tailings storage facilities. Consequences might include shortened lifespan, and or reduction of quality of life/wellbeing through cumulative exposure effects (over time and space), which may play out slowly due to long-developing disease periods, and individuals' inherent health differences. The environmental and human health impacts of tailings through physical deterioration and erosion, sediment transport, dust propagation, seepage and runoff of contaminated water can in some cases have much more significant in spatial and temporal dimensions – particularly given their cumulative nature over time.

At the moment, some of these issues are hidden under 'social aspects' of the Standard but we recommend that chronic long-term risks are given a higher profile in the Standard more generally, including the preamble and opening discussion. The Standard is also relatively silent on issues of *residual risk* and closure, although it does anticipate a "tailings lifecycle" which presumably ends at some point. Greater clarification of how residual risk and closure will be managed would greatly enhance the Standard.

Insufficient incentive to remove water from tails

The presence of water in tailings presents perhaps the most significant geochemical and geotechnical stability risk factor, and we support the reference in the Standard to minimize the amount of water placed in external tailings facilities. The Standard, however, has chosen to be technology agnostic and, as a result, is silent on the physical and chemical properties of tailings required to reduce catastrophic failures. There are known causal factors for catastrophic tailings dam failures that could be identified in the Standard as key risk factors – thereby strengthening its ability to drive improved performance. We understand, given the fast pace of new technologies available the reluctance to specify technologies, nevertheless, this should not prohibit creating incentives within the Standard to encourage the achievement of an outcome, e.g. drier and more consolidated tails, irrespective of the technology adopted. Ultimately it will be the removal of water, and the reduction and removal of tailings all together that will create a step change in tailings outcomes over the long term, and as it stands there is little in the Standard that would accelerate this transition.

Stress testing of the Standard

As a final recommendation, we suggest considering whether, and if so, how, the Standard as currently written, would have prevented some of the catastrophic failures experienced over the past few years. This would be a way of "stress testing" the proposed Standard against historical tailings dam failures through a 'what if' scenario, identifying those provisions within the Standard with the potential to drive the most significance change. This would be a delicate exercise, harder than it sounds as many of the historical dam failures will have occurred due to existing practices/standards not being followed. Nevertheless, as an exercise it could assist by identifying those risk factors where coverage in the Standard is strong and those that are weak.

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

Bold sustainability reform will stand the test of time

By way of conclusion, we would like to recognise the importance of your task and encourage you to be bold in your deliberations and reflections on the Standard. Change is not steady, but is replete with periods of stasis and dramatic moments of acceleration. I believe that we are in one such change moment and the outcome of the Standard will have considerable repercussions for the future.

The disasters at Brumadinho, Mt Polley and Mariana are reminders that despite being core to the Mining, Minerals and Sustainable Development Project's call to action nearly 20 years ago, tailings remain a challenge. It is worth reflecting that each period of sustainability reform in the mining industry has been marked by both leaders and resisters. The vast majority of the big sustainability reforms, whether it be the MMSD itself, recognition of Native Title and Free Prior and Informed Consent, or the transparency agenda have stood the test of time and created a much stronger minerals industry.

Overleaf, please find specific comments against the individual principles and recommendations in the Standard.

We wish you all the best in your endeavours

Sincerely

Professor Neville Plint
Director Sustainable Minerals Institute

Annex 1: Specific comments on Global Tailings Standard principles and requirements.

Annex 1: Specific comments on Global Tailings Standard topics, principles and requirements

Topic, principle & requirement	#	Comment
SCOPE	1	Definition of tailings storage facility We acknowledge the scope of the review, which is to evaluate existing global good practice to inform the development of an international standard on tailings storage facilities that addresses the following: • A global and transparent consequence-based tailings facility classification system. • Requirements for emergency planning and preparedness. • A system for credible and independent assurance of tailings facilities. However, we find that the standard is confusing with regards to its domain of application. It refers to Tailings Storage Facility (TSF) defined as "a facility that is designed and managed to contain the tailings produced by the mine. Tailings can be placed in mined-out underground mines, in open pit mines and on external surface facilities. Tailings can be produced and managed as slurry-based at various moisture contents (…)". The definition includes various types of TSF but many items within the standard, particularly those dealing with design criteria and consequence assessment, only apply to "tailings dams", the structures that are built to contain a slurry with high water content ("wet" tailings). It is this type of structures that lead to the worst consequences in case of failure. Other types of structures tend to be associated with less severe consequences from failure. The standard needs to be clearer and clearly outline which requirement applies to which type of TSF. For instance, the requirement for an inundation study will apply to a tailings dam. For in-pit disposal, the study of the consequence of overtopping is more relevant. For co-disposal areas, the consequence of a collapse needs to be assessed. A mine that selects to dispose of wet tailings is a mine that consumes large volumes of water. The decision to produce and store wet tailings is intrinsically linked to water supply. The potential for dam failure is not the only issue. It can also have a significant impact on water availability in the catchment or region. The guidance for selecting the type of TSF needs to include a detailed analysis of water supply, which includes all social, economic and technical aspects.

		Since water and tailings management on a mine are usually integrated, the standard needs to clarify whether it applies to water storage structures. Many companies have a single standard, covering both water and tailings storage. Many regulatory frameworks do not differentiate between water and tailing storage structures. For instance, the Queensland regulatory framework imposes conditions on “regulated structures” which include both water and tailings storage structures. A consequence assessment is required for all structures. Further, consequence assessments should not be limited to dam failure but should consider all failure scenarios, including a failure to contain mine-affected water or tailings. Further we assume that the Standard is not intended to be applied to direct discharge of tailings into the environment, so-called riverine tailings disposal, lake tailings disposal, ocean-surface tailings disposal and submarine tailings disposal. However, after careful reading of the Standard there does not appear to be any provision or requirement that would rule out direct disposal from seeking and gaining accreditation under the standard. It would be possible to limit the scope through careful adoption of the definition of tailings storage facility, though this is not currently the case as written. Care should be taken if taking this approach as some riverine tailings disposal sites are bounded by levees to prevent overflow of tailings beyond river banks and other natural features, and as such could meet the definition of ‘contained.’ An alternative option could be to add a requirement to contain tailings in the smallest practicable surface footprint, whilst meeting safety objectives.
SCOPE	2	Wider technical input recommended Our reading is that in the drafting of the Standard significant input appears to have been received from a geotechnical engineering perspective, with comparatively less input from a broader range of technical specialists, including geochemists, hydraulic engineers, mineral processing specialists etc. Notwithstanding the multi-disciplinary perspectives received during the consultation phase we recommend wider technical input on the standard.
SCOPE	3	Wider risk factor coverage recommended The standard reads like a document designed to respond to the most recent two tailings dam failures in Brazil, and the risk factors that contributed to them, rather than a comprehensive standard that address the panoply of risks that threaten tailings management and regulated structures. To meet the ambition of a ‘Global Tailings Standard’ all risks and sustainability issues with respect to tailings must be covered.
SCOPE		Standard versus guidance

		As a Standard the requirements of Operators must be clear and directive. As currently written there are a number of instances where the Standard suggests or recommends an outcome, often using the word 'should', rather than requires a certain action or behaviour. We recommend replacing the word should, with shall, and reviewing each requirement to ensure expectations are clear. For example, footnote 7 states: Data collection *should* include participatory processes, follow established ethical research protocols, and consider matters of privacy and data sovereignty. *A comprehensive approach would include* data and information relating to: the physical environment.. Alternative wording could read: Data collection *shall* include participatory processes, follow established ethical research protocols, and consider matters of privacy and data sovereignty. Comprehensive data shall be collected on: the physical environment..
THE ROLE OF THE STATE	4	Not sufficient to guidance to the State We hold a concern that in its current form the standard is not sufficient to guide the State, especially where the State does not currently have the capacity to regulate TSFs. The Standard, for example does not cover any risk associated with site water balance which is a key risk for the State.
PREAMBLE	5	Zero tolerance for loss of life The Standard introduces the concept of zero tolerance for loss of life in its Preamble. And yet, in the Consequence Matrix included as Table 1 it introduces different classes of consequence based on how many lives are put at risk (Extreme = >100, Very High =- 10 – 100 etc etc). As well as the obvious inconsistency between these two statements, this exposes the standard to potential criticism from an ethical point of view - is a village of 50 people less important than a town of 500? Who gets to decide that? This issue is a common one when highly structured (engineered) approaches to risk are adopted. While there is no easy way to address this, whilst also differentiating action based on the scale of potential disaster, you may wish to consider the extent to wish you could extend all requirements that apply to Extreme and Very High consequence ratings to facilities rated High, thus grouping all ratings that imply a loss of life together. A second approach could be to adopt a probabilistic threshold for the potential loss of human life.

TOPIC I: KNOWLEDGE BASE **PRINCIPLE 1 & 2**	6	We suggest reconsidering the configuration of Principle 1 & 2 so that the emphasise is on reviewing all options for tailings disposal and assessing the business case for each storage option appropriately. There are many technologies available to avoid disposal of wet tailings and achieve lower exposure to catastrophic events. We have not seen their broad-scale implementation with just 5% of facilities disclosed during the Church of England process corresponding to dry, past or thickened tailings. A key barrier tends to be that evaluation processes are heavily focused on short-term, project-focused costs and direct benefits, while overall site or company benefits and indirect values (such as water security and potential environmental and social impacts) are not fully assessed. There needs to be greater focus on business case analyses that incorporate and quantify long-term risks, including those related to water availability. This is particularly relevant in the context of climate change. We suggest emphasising this as part of Principle 1 or 2.
TOPIC I: KNOWLEDGE BASE **PRINCIPLE 1 & 2**	7	Sufficient focus on tails in EIS The requirement for a knowledge base is indeed essential but we would argue that it would be in place in most cases, as selection of a new TSF would form part of a larger project requiring an Environmental Impact Study or equivalent. The issue is ensuring sufficient budget is made available to acquire the data and information that will lead to a design that minimises risks. Investigation of the root cause of the Mount Polley dam failure in British Columbia found that the tailings dam collapsed because of its construction on underlying earth containing a layer of glacial till, which had not been identified during site investigation. The number of exploration bores that were dug to acquire data and information was not sufficient to fully describe the stratigraphy. The extent of the field work would have been customised to the budget made available and was not sufficient to produce a suitable knowledge base. This principle should incorporate a requirement for companies to allocate sufficient funds to data acquisition, including field data.
TOPIC I: KNOWLEDGE BASE **PRINCIPLE 1 & 2**	8	Inundation studies The requirement for an inundation study is most relevant for tailings dams, as distinct from alternative facilities. Failure mechanisms need to be assessed for all types of structures: overtopping for in-pit disposal structures, collapse for co-disposal areas, various failure mechanisms for underground storage. In a few places, including in this Requirement 1.3, the standard provides technical guidance that is the realm of specialised technical studies (any specialised consulting engineer will know how to conduct an inundation study). Rather, we suggest stating

		that a consequence assessment must be undertaken by a suitably qualified and experienced person with relevant professional experience (and provide a suitable definition for such person). The standard should also state that the consequence assessment must include documentation, including the methodology used, of the potential to place lives at risk, downstream impacts on infrastructure and environmental values, long term potential adverse effects due to the release of contaminants, any other impacts deemed significant.
TOPIC I: KNOWLEDGE BASE	9	Specificity of physical data collection Significant uncertainty exists when attempting to understand the physical parameters that contribute to both risk and consequence. *We suggest greater specificity in the regarding the data expected by the standard.* Weathering, the ionic strength of pore water, the mineralogy of clay minerals, surface charge and surface chemistry of sheet silicates, the behaviour of nanoparticles and colloidal matter, flocculants and coagulants, all affect how the tailings solids within the TSFs, the underlying geology and the geo-materials used in the construction of tailings dam behave.
TOPIC I: KNOWLEDGE BASE	10	Climate change The significance of climate change warrants a specific provision to collect climate data and develop or use appropriate climate models, which can be coupled with site water balance models. Footnote 10 *encourages* Operators to address uncertainties around climate change and its potential impacts on environmental and social conditions and trends, which is insufficient given the gravity of changed climatic conditions on tailings stability and safety.
TOPIC I: KNOWLEDGE BASE	11	Use of knowledge base by other operators The Standard currently refers only to a tailings storage facility at a specific operation – with little/no reference in the standard for operators to share details on their TSF knowledge base with other operators. Having this written into the standard as a recommendation would allow operators to learn from one another and reduce the likelihood repeating mistakes. This could most logically occur in Requirement 7.6 “Refine the design, construction and operation throughout the tailings facility lifecycle by considering the lessons learned from ongoing work and the evolving knowledge base as well as the available knowledge bases from other operators, and by using opportunities for the inclusion of new and emerging technologies and techniques.”

TOPIC I: KNOWLEDGE BASE **REQUIREMENT 1.2**	12	Tailings characterisation Footnote 3 defines updates as 3 years for facilities with extreme and very high consequence and 5 years for all others, even while Requirement 1.2 requires regular update of tailings characterisation. This apparent contradiction needs clarification and the definition of a periodicity for regular tailings characterisation at the discharge point and elsewhere.
TOPIC I: KNOWLEDGE BASE **REQUIREMENTS 1.1-1.4**	13	Data for groups most at risk A reading of Requirements 1.1-1.4 implies that only a limited range of socio-economic data must be collected in the inundation area ('land, livelihood and demographic data for groups most at risk'). This is due to Requirement 1.2 only applying to the vicinity of the facility and Requirement 1.4 listing a more limited request for data in the inundation area. Given the catastrophic nature of a flow failure it is not clear how 'most at risk' stakeholders could be defined. Are not all people in a potential inundation area at risk of fatality or injury?
TOPIC I: KNOWLEDGE BASE **PRINCIPLE 2**	14	Decision not to ban particular technologies Footnote 9 implies that the expert panel feel unduly constrained by the scope of work. A reader would expect that the Chair and expert panel agree with the scope of work in taking on the assignment and therefore we would recommend to remove the footnote and instead make a substantive case for the decision not to ban particular technologies. For example, that upstream facilities can be designed to perform to high safety standards in some (dry & flat) environments.
TOPIC I: KNOWLEDGE BASE **REQUIREMENT 2.6**	15	Insurance and assurance The wording of Requirement 2.6 would make it possible for a facility to receive accreditation under the standard even in the event that the Operator held no insurance and was not required to submit any assurance with the State. This is situation would undermine the credibility and intent of the Standard. We suggest revision of the Requirement along the following lines: REQUIREMENT 2.6: Taking into account actions to mitigate risks, the Operator will obtain appropriate insurance to the extent commercially reasonable and/or ensure that the level of financial assurance registered with regulatory authorities is sufficient to address risks relating to the construction, operation, maintenance, and/or closure of a *tailings facility*.

		There is an argument that issues of insurance and assurance could be expanded and placed under their own principle. Insurance processes are complex and dealt with as part of broader programs. Further guidance (as a footnote) on the term 'commercially reasonable' may help avoid confusion or contestation.
TOPIC I: KNOWLEDGE BASE **REQUIREMENT 3.2**	16	Requirement to meaningfully engage Requirement 3.2 is an almost word for word restatement of Principle 3. We suggest that the Requirement state the actions and expectations needed to meet the principle, which could come from elevating some of the extensive material in the footnotes.
TOPIC I: KNOWLEDGE BASE **PRINCIPLE 3**	17	Wet tails and project-affected people When considering wet tailings disposal in a new tailings dam, if the consequence assessment shows that it could lead to loss of life or catastrophic environmental harm, our view is that the option of wet tailings disposal should be precluded. Given that scale of the catastrophic loss of life and catastrophic environmental harm from the Mariana and Brumadinho tailing dam failures, it is reasonable to question whether zero harm can be achieved, even with this Standard in place. There are alternatives available. When lives and environmental values are at such risk, an appropriate business case analysis should lead to the conclusion that safer disposal options should be selected.
TOPIC III: DESIGN, CONSTRUCTION, OPERATION AND MONITORING OF THE TAILINGS FACILITY **PRINCILPLE 4**	18	Failure means more than collapse Principle 4 includes a "presumption that the consequence of failure classification is 'Extreme', unless this presumption can be rebutted". 'Failure', here implies reference to the sudden catastrophic failure of tailings dam walls, rather than a long term failure of a TSF to contain tailings solids, water and contaminants in perpetuity. We suggest considering amendment or adoption of additional requirements related to the failure of facilities beyond the collapse of engineered structures.

TOPIC III: DESIGN, CONSTRUCTION, OPERATION AND MONITORING OF THE TAILINGS FACILITY **PRINCILPLE 4**	19	Extreme consequence classification for alternative facilities We support Principle 4 for tailings storage dams. However, it is much less salient for other disposal options. Again, we suggest the standard clarifies its domain of application. Consideration should be given to whether it is desirable to place equivalent conditions on dry tailings as wet tails facilities as it reduces the incentive to move toward alternative options.
TOPIC III: DESIGN, CONSTRUCTION, OPERATION AND MONITORING OF THE TAILINGS FACILITY **PRINCILPLE 4**	20	Consequence category assessments For the consequence category assessments, some companies' internal standards require that they'd be undertaken (or at least finalised) as part of a workshop gathering all stakeholders from the mine teams and corporate teams. This has proven successful as it provides a good avenue for knowledge sharing and raising issues that may not be fully known across the company. There is scope to extend the workshop to external stakeholders for better alignment with Principle 3. We recommend that the standard include the requirement for consequence assessments to be finalised with the input of multiple stakeholders.
TOPIC III: DESIGN, CONSTRUCTION, OPERATION AND MONITORING OF THE TAILINGS FACILITY **REQUIREMENT 4.1**	21	Alignment of risk categories with regulatory frameworks While Annex 2 provides details there is the risk that the defined categories will not align with local regulatory frameworks and/or companies internal standards. Guidance should be provided about selecting the most stringent criteria or other alternatives. There are technical issues around flood estimation of extreme events (e.g. 1:2500 and 1:5000 AEP). Some countries may have good technical guidance, but not all.

TOPIC III: DESIGN, CONSTRUCTION, OPERATION AND MONITORING OF THE TAILINGS FACILITY **REQUIREMENT 4.3**	22	‘Feasibility’ of a required upgrade A lot hangs on the concept of ‘feasibility’ in Requirement 4.3. To avoid a situation where high-risk existing facilities are accredited to the Standard we recommend the expert panel provide greater parameters around what would define non-feasibility of making a required upgrade.
TOPIC III: DESIGN, CONSTRUCTION, OPERATION AND MONITORING OF THE TAILINGS FACILITY **REQUIREMENT 5.1**	23	‘Consider’ alternative tailings technologies Requirement 5.1 covers a very important area of the Standard, but has the potential to allow operators to satisfy the requirement without really committing to its intent. As such the requirement provides very little incentive to adopt alternatives to wet tailings. We believe the standard should be stronger about encouraging alternative options when lives and environmental values are at risk. Operators should be required to justify any decision to construct a wet tailings facility, given the higher geochemical and geotechnical risks associated with their management, especially where the consequence rating is Extreme and Very High. We suggest the following alternative wording: REQUIREMENT 5.1: Apply technologies that minimize the amount of tailings and water placed in external tailings facilities to the greatest extent practicable, including but not limited to in-pit disposal and underground tailings placement. Where external wet slurry tailings facilities are adopted the Operator shall provide justification that all alternative options were analysed and considered as per Requirement 2.1 and publish reasons for its decision. Requirement 5.1 should be stated at the beginning of the standard and used to clarify the domain of application for the remainder of the standard. Without earlier reference it is confusing to state it here after so much has already been discussed.

TOPIC III: DESIGN, CONSTRUCTION, OPERATION AND MONITORING OF THE TAILINGS FACILITY **REQUIREMENT 5.3-5.6**	24	Performance objectives for design Requirements 5.3 to 5.6 provide technical information that is mostly only applicable to tailings dams. It would be more pertinent to list the performance objectives for the design rather than focus on specific design items. For instance: • For a failure scenario related to a failure to contain: requirement to select appropriate design containment criteria • For dam breaks: requirement for hydraulic performance, design by suitably qualified persons etc.
TOPIC III: DESIGN, CONSTRUCTION, OPERATION AND MONITORING OF THE TAILINGS FACILITY **PRINCIPLE 6-8**	25	Alignment with local regulatory frameworks These principles are very detailed and could clash with internal company standards and/or local regulatory frameworks. It would be more pertinent to focus on performance objectives rather than the means to achieve them.
TOPIC III: DESIGN, CONSTRUCTION, OPERATION AND MONITORING OF THE TAILINGS FACILITY	26	Critical controls Our interpretation of the sentence "*Performance outside the expected ranges shall be addressed swiftly through critical controls **or** trigger response action plans (TARPs)"* is that, if during the monitoring of the tailings facility, results show that the "Critical Controls" are not being maintained and working as intended then the corrective actions that need to be taken should be carried out according to a pre-established Trigger Action Response Plan. The degree of variation from the expected result should be managed according to the severity of the hazard that is now evident. We recommend changing or to and, which would mean that the operators of the facility must have identified the Critical Controls that are necessary to prevent a catastrophic event taking place, and by monitoring these Critical Controls against pre-determined criteria a series of escalating actions can be set in place.

REQUIREMENT 8.3		
TOPIC III: DESIGN, CONSTRUCTION, OPERATION AND MONITORING OF THE TAILINGS FACILITY **REQUIREMENT 8.3**	27	TARPS In Requirement 8.3 TARPs are introduced. This is a key part of management. The responsibilities and roles for setting and reviewing TARPs are not covered. The relation of TARPs to emergencies is not covered – emergencies seem only to be considered failures (Principle 15), whereas one would expect that the highest TARP to equate to an emergency response. A separate Principle and set of Requirements for adaptive management including TARPs may be warranted. The section about risk management should be reviewed by safety specialists.
TOPIC III: DESIGN, CONSTRUCTION, OPERATION AND MONITORING OF THE TAILINGS FACILITY **PRINCIPLE 8**	28	Robustness of metallurgical testing to inform tailings facility design At the design stage, often a very small number of ore samples (typically 1-3 samples) are sent for metallurgical tests and a subsample of tailings from metallurgical tests are examined for predicting the long-term physical and geochemical behaviour of tailings. The mineralogy of that small sample are used to build geochemical models that predict water quality of runoff and seepage from TSFs in perpetuity. There is an opportunity with the standard to mandate a testing program at the design stage to cover the variability of the orebodies and the environmental settings were the TSFs are constructed; and recognise that testing limitations create uncertainties in the hydro-geochemical models that underpin the prediction of long term risk.
TOPIC IV: MANAGEMENT AND GOVERNANCE	29	Public engagement in governance The Management and Governance topic should have something on engagement with external stakeholders (beyond consultants!). Working with public sector agencies is equally important in this topic as it is for Topic 5 on Emergency Response (where they are explicitly mentioned) An effective relationship with the inspectorate for example is a critical element in a governance regime.

TOPIC IV: MANAGEMENT AND GOVERNANCE	30	Salience and broad applicability of the management and governance principles The Principles outlined under this topic are excellent and if applied, could influence the industry's performance with respect to managing regulated structures (and ideally not just tailings dams).
TOPIC IV: MANAGEMENT AND GOVERNANCE	31	Independent reviewers The use of "independent" reviewers is a prevalent part of the Standard. Either the Standard should more seriously address what it means by "independent" or the word should be omitted.
TOPIC IV: MANAGEMENT AND GOVERNANCE **REQUIREMENT 10.2**	32	Minimise the environmental and social Impacts of failure It is not clear why Requirement 10.2 only seeks to minimise the environmental and social impacts of failure and not the environmental and social impacts of tailings more generally.
TOPIC IV: MANAGEMENT AND GOVERNANCE **REQUIREMENT 10.3**	33	Responsible TSF Specialist The term Responsible Tailings Facility Engineer (RTFE) does not capture the multidisciplinary nature of tailings management. An alternative title is "Responsible TSF Specialist". Alternatively, if an engineer is considered necessary consider requiring multiple specialists to cover the diverse expertise demanded of tailings management.
TOPIC IV: MANAGEMENT AND GOVERNANCE	34	Design for low levels of ongoing management post-closure We recommend that in strengthening the closure aspects of the Standard that consideration be given to a Requirement to design for a low-levels of management post-mining and post-closure. In reality governance and

PRINCIPLE 11		management arrangements post-mining cannot be guaranteed and to the gretest extent possible facilities should not be designed that require long-term management.
TOPIC IV: MANAGEMENT AND GOVERNANCE **REQUIREMENT 11.4**	35	Frequency of DSR contractor renewal Requirement 11.4 states that: The *DSR* contractor cannot conduct a subsequent *DSR* on the same facility. It is unclear whether the term 'subsequent' implies the immediate next review or all subsequent reviews.
TOPIC IV: MANAGEMENT AND GOVERNANCE **REQUIREMENT 14.4**	36	Whistleblowers The terms "good faith" and "possible violation" could benefit from further clarification and definition within the glossary.
TOPIC V: EMERGENCY RESPONSE AND LONG-TERM RECOVERY **PRINCIPLE 15**	37	Local knowledge Consider extending the stakeholders necessary of engagement in emergency response and long-term recovery to include local universities and indigenous people who have historical knowledge and understanding of the natural environment and the ecology of the region.
TOPIC V: EMERGENCY RESPONSE AND LONG-TERM RECOVERY **REQUIREMENT 16.4**	38	Community involvement in monitoring only after failure Because Requirement 16.4 sits under Principle 16 ('Prepare for long-term recovery in the event of catastrophic failure') it is not clear whether the intent of the Requirement is to ensure community involvement in ongoing monitoring of the facility or only ongoing monitoring after failure.

TOPIC VI: PUBLIC DISCLOSURE AND ACCESS TO INFORMATION	39	Record and data storage Currently the requirements in Topic VI do not require long-term record management and data storage. We suggest addition of wording to the effect of: Store all relevant records and data, including those referred to in this standard until relinquishment of the facility; and transfer all relevant data and records to subsequent facility owners and/or managers
TOPIC VI: PUBLIC DISCLOSURE AND ACCESS TO INFORMATION **REQUIREMENT 17.1**	40	Specification of data to disclose It is not clear at what level the data should be provided in Requirement 17.1. It might be effective for the standard to be clearer on the specification of what data, what format, and what level of detail.
TOPIC VI: PUBLIC DISCLOSURE AND ACCESS TO INFORMATION	41	Collaborative environmental management Consider making reference in the Standard to the opportunity to create shared databases that would enhance information gained from individual sites. For example, catchment scale hydrological data.
ANNEX 2	42	Concept of negligible The concept of negligibility is applied in Annex 2 of the Standard. This raises the question of how will this be measured and by whom? An issue could arise whereby ambiguity in the use of such a concept could enable operators to comply with the standard without necessarily improving the safe and secure management of their tailings storage facilities.