Submission to the NSW Resources Regulator re Tailings Dam Management
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Tailings dams are an integral part of all mining operations. Historically, very little regard was paid to their construction beyond their proximal location to a projects' processing plant. In earlier times few of the standard practices, we now accept as standard operating practices, were put in place to design, build, monitor and regulate tailings dams.

Modern mining practices now demand much higher levels of regulation including health, safety and environmental responsibility be taken into consideration, starting with the planning phase through construction, commissioning, production and eventual closure and rehabilitation.

The regulatory and compliance framework for mining and processing methodologies is a well understood and accepted practice, along with the professional credentials required by their respective practitioners. Social licence to operate is currently regarded as one of the biggest risks for all mining companies (EY, 2020 Mining & Metals Insights, EY website).

By contrast, the design, construction and management of tailing dams is typically not undertaken by suitably qualified professionals and this, as we have seen, can have tragic consequences.

The ramifications of tailings dam failures are beyond financial and leave an indelible mark on vulnerable communities and the mining industry as a whole. As an industry we must do more to improve environmental stewardship and safety in the communities we work within.

Tailings dams and the management thereof have become topical globally due to the failures, some catastrophic, of a number of such structures. Some of the failures have also impacted significantly on downstream communities. The worst such failures have decimated whole communities with significant loss of life; some have polluted water courses thus impacting on the health and viability of those communities. Others have had lesser deleterious impacts.

Tailings dam failures have been occurring at the rate of ~1.8 per year over the last twenty years (pers. com., I Canbulat) and have usually resulted in the liquefaction (by some means) of the dam wall, leading to either partial or total failure of the tailings dam.

The Australian National Committee on Large Dams (ANCOLD) is an Australian based apolitical industry body that focuses on disseminating knowledge, developing capability and providing guidance in achieving excellence for all aspects of dam engineering, management and associated issues. While it was primarily concerned with large water storage facilities, in more recent times its mandate has broadened to incorporate smaller dams and mining and tailings dams and in 2019 it published "Guideline to Tailings Dams – Planning, Design, Construction, Operations and Closure – A Revision (July 2019)" (www.ancold.org.au) ANCOLD has a Technical Working Group on Tailings Dams and plans to hold a Symposium in North Queensland in 2020.

A review of the top five universities in the world offering mining subjects, shows that none offered a course or indeed a qualification in the design, construction, operations and closure considerations of tailing dams. Some of the universities I reviewed, do have academic staff who are researching in the area, contribute to ANCOLD and are internationally recognised for

their contributions to tailing dams and mine waste rehabilitation, but many do not employ such staff.

A further brief review of the qualifications of some of the consultants working in the field shows that they are largely civil or geotechnical engineers, some of whom have had large dam building experience. Many have not had ongoing roles in operations or dam closure outside of their consultancy roles. Most have worked globally on numerous projects in various geographies and for a variety of consultancies. (Will the new COVID world we currently live in curtail some of their activities?) It is also worth noting that most of the consultants operating in the space have been more than 30 years, (many have >40 years), in industry and have learnt along the way, (I trust they are mentoring a new crop of younger professionals?)

Currently, there are no formal or specific professional qualifications required for tailings dam "professionals". Larger and well-funded entities or other more enlightened groups may utilise the services of an available civil engineer, but more often than not, the design and subsequent build has largely been the domain of either the plant manager, (Tailings Dams: we need to start 'failing forwards', Mining Magazine, 2019), who do it as cheaply as they can, or a junior site engineer as a project that requires a speedy and cost effective resolution. These people do not have the requisite authority, skills, experience or knowledge required.

This gap has been recognised by all of the global mining consultancies and they have exploited the gap by providing their services to resources companies on tailings dam design and monitoring systems.

This author believes that while there is substantive knowledge in the planning, development and operations of tailings dams, there is no current formal qualification with prerequisite skills available and that one should be investigated/established that combines all the relevant science, engineering and IT disciplines, such that a qualified and approved practitioner can plan, design, supervise construction and operations, as well as monitor and prepare such structures for closure.

A suitable, practical and industry-relevant and agreed framework should be developed. It maybe that the ANCOLD Guidelines could form a starting point, (and maybe even the end point) but in any event, practitioners will require some time to hone their skills, post-graduation, until such time as they are fully qualified and experienced (much like a mining engineer getting a first class ticket).

Further such practitioners should rightly be part of an owner's team rather than a consultant per se. External consultants and appropriately experienced consultants should be used for trouble shooting and auditing purposes. However, we are not at that stage yet.

There are numerous groups in the global resources industry that have recognised such a gap exists and some of the Australian groups currently working to plug the gap are as follows;

- GHD, one of the world's leading professional services companies operating in the global market sectors of water, energy and resources, environment, property and buildings, and transportation runs their own training course on Tailings Dam Safety for TSF Operators, which has allowed over 500 personnel from Australian mines to achieve a Certificate III qualification "Inspect and Report on Embankment Dam Safety", indirectly reducing the risk of significant tailings dam safety incidences in Australia through better understanding by operators in the field.

- The Australian Institute of Mining and Metallurgy (AusIMM) is well advanced in their planning and intends to offer an online "Certificate in Tailings Dam Management". The timing of the release (in this COVID world) is uncertain, but they are aiming for 2020.
- Various Australian universities may be interested in developing an appropriate post-graduate qualification. During the course of preparing this submission, the University of New South Wales, School of Minerals and Energy Resources Engineering indicated that they would be interested in developing an appropriate industry-recognised course and post-graduate qualification in Tailings Dam Design and Management that would incorporate all the components of the relevant science, engineering and IT disciplines. As a pre-requisite to enrolment, participants would have to have completed an undergraduate degree in an appropriate mining related discipline and had some time in the field post-graduation. Course participants would acheive an internationally recognised post-graduate qualification. The course development and the timing (in a COVID world) to release and market such a course is much less clear, but the earliest would likely be 2022. UNSW would not be able to complete such a program alone and would likely require assistance in terms of field exposure and case studies from third-party consultancies.

Government regulators will require input and should likely collaborate with all interested parties to allay community concerns and make sure mining companies have the social licence to operate. Some suggest "government regulators should not regulate or prescribe outside of their expertise, or too broadly and not based on community perceptions and emotional outrage (Williams 2019).

Such a qualification will likely take some time to develop, implement and market, but now is the time to begin. In the interim the "Certificate in Tailings Dam Management" being developed by the AusIMM and other bespoke courses such as those offered by GHD and the use of the ANCOLD Guidelines by suitably experienced consultants will likely have to suffice. Some consultancies will no doubt continue to develop bespoke operating protocols for the operations they service.

Going forward, an appropriate and globally recognised post-graduate qualification is worth investigating. This author further suggests that such a post-graduate qualification (probably at masters level), be developed and administered by reputable mining universities, where all the sciences, engineering and IT disciplines are covered, may in the longer term be more beneficial to industry (owners, miners, insurers, financiers et al) than a certificate qualification, which appears on first glance to be tailored to those that operate tailings dams. Such a post-graduate qualification would fit nicely into the mining cycle, provide more comfort to regulators and strengthen industrys' social licence to operate.

While this author is passionate about the resources sector, what it has to offer and the benefits it delivers to our society, there are likely others more qualified to take this discussion further, but I am happy to facilitate/assist in any way.