Comment: The importance of integrated closure planning for tailings storage facilities

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Tailings facilities are among the largest features to remain at a mine site following site closure and will likely form a permanent part of the post-mining landscape. Once closed, these facilities need to be safe, stable, non-polluting and able to support the next land use. However, closure of tailings facilities presents a significant challenge due to technical complexities, ongoing changes in regulatory frameworks and requirements, increased costs, evolving societal expectations and other issues (Finucane 2026).

Tailings exist in different states depending on the water/solids content. These range from unthickened slurry to thickened slurry, thickened paste and filtered 'cake' (Amoah 2024). If tailings storages underperform post-closure, there is potential for significant social, environmental and economic risk. However, there is also opportunity to optimise closure outcomes as part of a sustainable and positive legacy. Table 1 presents selected examples of the closure risks and opportunities associated with the different types of tailings.

Table 1 Selected examples of closure risks and opportunities for different tailings types

Aspect	Unthickened tailings	High-density thickened/paste tailings	Filtered tailings
Tailings facility landform design and stability	Higher risk of erosion and instability of embankment surfaces due to the size of the tailings facility. If designed appropriately, can be closed as a 'dry' facility. Consequences of tailings facility failure can be large and significant effort is needed to reduce risks to an acceptable level.	Less potential instability of embankment surfaces due to lower containment embankments. If designed appropriately, can be more easily closed as a 'dry' facility than a conventional tailings facility. If tailings facility failure occurs, this would more likely comprise local slumping unless material slumps into a water body.	Much reduced risk of instability as discharge results in a low conical pile without the need for extensive embankments. Most amendable to 'dry' closure and landform development, though not meeting material specifications consistently during construction increases the likelihood of slope failures. Amenable to progressive rehabilitation which helps to control residual risk of erosion. If failure occurs, this would more likely be highly localised unless material slumps into a water body.
Rehabilitation of tailings facility	Increased requirement due to typically larger size of conventional tailings facilities, with large surface areas. Poorly consolidated tailings with large central pond with long drying times delay start of works. Often require significant volumes of fill material to attain a final shape compatible with site closure objectives.	Reduced earthworks due to smaller facility. Improved water recovery results in earlier tailings consolidation and access (improved trafficability). High density material can present a very deep and highly compacted profile resistant to plant root development. Substrate with a largely uniform texture will have few of the physical structure that aid plant establishment such as fissures.	Placing tailings at higher density allows for a smaller footprint area for the tailings facility and minimises time-dependent consolidation. Rehabilitation can commence very early in mine life due to improved accessibility, though trafficability can be challenging depending on tailings moisture contents and climate conditions. Reduced earthworks and simpler cover systems reduce closure risks.
Post-closure mobilisation of tailings/ liquefaction	Loose saturated tailings have potential to mobilise if tailings facility fails, especially under seismic conditions.	Potential for mobilisation as tailings not compacted and not fully contained by the facility in the event of structural failure.	Lower moisture content of tailings reduces vulnerability to seismic events.

Aspect	Unthickened tailings	High-density thickened/paste tailings	Filtered tailings
Geochemical risks	Highest risk during both operations and closure. Can provide saturated conditions for management of potentially acid-generating tailings, though wet covers can be difficult to maintain in drier climates.	Highest risk during both operations and closure. Large-scale operations have a higher risk of acid and metalliferous drainage than small-scale operations or conventional tailings facilities.	Lower risk during closure than operations. Reduced risk of acid generation due to reduced potential for air voids/oxidation, but low saturation of materials can make it difficult to control acid drainage.
Seepage and contamination	Higher risk due to higher volume of entrained water in tailings.	Lower risk due to less supernatant liquor and overall drier tailings.	Much reduced risk due to lack of tailings pond and very low (if any) appreciable seepage.

Sources: Williams et al. (2008), Hogg (2010), Davis (2011), Jones and Watkins (2015), KCB (2017), NSW Resources Regulator (2020), Thompson and Moreno (2017), Sanchez et al. (2023), Kemp and Chapman (2024), WSP (2025) and Finucane (2026).

Our thinking in terms of what we can do with a mine site following cessation of operations is changing rapidly as the mining industry and its stakeholders look for ways in which closed tailings facilities could be an asset rather than a liability and provide enduring value (Finucane 2026). As mining companies seek to develop and implement sustainable closure strategies, we're seeing increasing innovation in post-mining land uses, greater focus on processes that enable transition to those uses, and recognition that integration of closure considerations into business units and processes is essential for optimising closure outcomes for tailings facilities (International Council on Mining and Metals [ICMM] 2025a). This is timely as up to 1,000 mines worldwide may close in the next decade (Jiskani et al. 2026), with nearly 240 mines expected to close by 2040 in Australia alone (Commonwealth Scientific and Industrial Research Organisation 2023).

Designing and operating a tailings facility for closure requires a long-term and holistic view, and is at its best when conducted in a collaborative and integrated manner that commences in the early stages of project planning and continues through to the post-closure phase (Finucane 2026). This approach reduces closure risks and liabilities, improves the likelihood that final closure objectives and agreed outcomes will be achieved, and facilitates site relinquishment and/or transfer to the next landholder or land use (ICMM 2025b). The importance of integrating closure planning into wider project planning cannot be understated as decisions made during the conception phase may prove to be some of the most important in the entire life cycle of a tailings facility (ICMM 2025a).

The construction, operation and closure of tailings facilities do not occur in isolation from other activities at mines, but are a function of mining and ore processing techniques and the wide range of decisions made in this regard (ICMM 2025a). Despite this, the design, construction and operation of a tailings facility is often conducted separately from its closure and rehabilitation and a persistent disconnect remains, resulting in operational inefficiencies, regret costs and underfunded closure liabilities (McKenna & Van Zyl 2020, O'Kane 2025). So how can we do better? Suggestions to facilitate integrated closure planning for tailings facilities and other mine features are discussed in Finucane (2026) and include:

- ensuring that governance structures are in place to facilitate effective communication and collaboration between tailings, closure and other relevant personnel;
- breaking down disciplinary silos to allow development of holistic assessment methods and workflows for decision-making;
- matching decision-making tools to project complexity and timing;
- ensuring that project designs are developed with consideration of closure timeframes, not just operational timeframes;
- leveraging experience-based insights and lessons learned to strengthen mine closure planning and implementation across an asset's life cycle; and
- recognising that profitability and sustainability are not mutually exclusive.

Navigating the complexities of TSF closure design and implementation requires a delicate balance between engineering precision, environmental stewardship and regulatory compliance (Walls 2025) so it's important that these processes are undertaken in a way that makes sense for a site given its environmental and social setting, company drivers, technical and other challenges and opportunities, and other factors (Finucane 2026). When conducted in a robust and meaningful way, integrated closure planning not only reduces long-term liabilities for the mining company, it maximises the potential for post-mining landscapes to retain value and purpose for local communities, realise localised economic opportunities and facilitate post-closure transition to the next land user(s).

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