

A framework for developing
mine-site completion
criteria in Western Australia

CHAPTER

6

Summary, limitations and recommendations

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6 Summary, limitations and recommendations

Extractive industries worldwide face the challenge of supporting an ever-rising demand for raw materials whilst, at the same time, protecting the natural and social environments they operate in. Both regulators and operators must constantly work, learn and adapt to rapidly-changing conditions, fuelled by changes in markets and industry, climate change, growing community needs and expectations, and exponential advances in rehabilitation and monitoring technologies. Across the globe, and in Western Australia, companies have the obligation to rehabilitate their sites to a state that supports post-mining land uses (PMLUs), while avoiding negative environmental and social impacts. This results in the need to define closure objectives and completion criteria that mark the necessary outcomes to be achieved, for the mine to become eligible for relinquishment. Thus, current questions are: 'how should closure objectives and completion criteria be defined and how should progress towards meeting completion criteria be monitored?'

In response to such need, the purpose of this report and the included framework is to provide a roadmap for the definition of mine completion criteria with associated monitoring that are S.M.A.R.T. — Specific, Measurable, Achievable, Realistic and Time-bound, and will make mines safe, stable, non-polluting and capable of sustaining an agreed PMLU, as required by the Government of Western Australia (DMP 2016). While this project was undertaken within the mine regulatory framework of Western Australia, the processes described can potentially be applied to other Australian and international jurisdictions, as well as to other industries that require similar rehabilitation of disturbed lands (e.g. infrastructure of oil and gas).

The framework described in Chapter 2 provides guidance on how to set *Specific* completion criteria by tailoring them to address definitive attributes of the pre-agreed PMLU. Criteria should be *Measurable*, as they must be defined upon attributes that can be monitored, using a suite of techniques described in this guide. The evaluation of monitoring data against chosen reference sites will inform mining proponents and regulators whether rehabilitation is trending towards the agreed outcomes. Closure outcomes will necessarily be informed by science based evidence, which means that only *Achievable* targets are selected in the definition of completion criteria. Importantly, such targets must be regularly revisited to understand whether they remain achievable as the life of mine and rehabilitation practices progress. The iterative nature of this process ensures that completion criteria remain *Realistic* to the circumstances of the mine site, even as these change and new risks are identified. This approach also results in criteria, monitoring and corrective actions being *Time-Bound*, where possible, along a rehabilitation trajectory whose ultimate goals are for the mine to be closed and relinquished.

This project could not have been completed without the valuable contribution of experts, mining proponents and regulators, who advised about the gaps and opportunities present in relation to mine completion criteria in Western Australia. First, the review of science, guidelines and practices relevant to completion criteria and monitoring helped map the regulatory framework in Western Australia, as well as provide a wider overview across Australia and internationally. This review is the first of its kind, resulting in a comprehensive summary of the available guidelines for the definition of completion criteria and risk-based monitoring methods. The review identifies a broad list of attributes that can be potentially used in the definition of completion criteria, as well as a sub-selection of those that are most recommended and commonly used for projects with PMLUs relating to the natural environment. In addition, the review describes several techniques to monitor and evaluate ecological attributes, and provides guidance on the most appropriate approach, based on the type and level of criticality of each attribute.

Second, personal interviews and a survey involving mining proponents, regulators and consultants provided an understanding of the key challenges faced by closure professionals in Western Australia. Interestingly, while opinions could be expected to vary across stakeholders, analysis revealed shared areas of concern among different stakeholder groups, thus reinforcing the need and opportunity to work collaboratively towards common ground. In response to stakeholder consultation, critical issues that were closely related to definition of completion criteria were added to the scope of this project. The summary provided in Table 6.1 illustrates how identified issues have been addressed in the framework.

TABLE 6.1 Identified gaps and their responses in the framework

	Gaps identified through interviews and survey	How gaps are addressed by the Framework
Post-mining land use(s) (PMLU)	Limited consideration of alternative PMLUs	List of possible PMLUs following the Australian Land Use and Management classification
	Lack of guidelines on selection of PMLUs	Summary of available processes for selection of PMLUs
	Contradiction of preferred PMLUs between regulators and stakeholders	Indication of participatory and objective processes for selection of PMLUs Assertion that PMLUs are shaped by existing tenure and must be agreed at an early stage of completion criteria development
Reference(s)	Reference site conditions unrealistic for hard-rock mining	List of possible references and/or benchmarks to ensure selection is appropriate for the site
	Unrealistic benchmarking against reference sites 'what was there before'	Recognition that 'References' can range from baseline conditions to conceptual models, as appropriate to PMLU and agreed through the framework
Completion criteria	Narrow focus on numerical targets and ecological aspects, thus missing 'big picture'	Consideration of holistic approach and assessment of completion criteria as a package of targets
	Contradiction between excessive prescription vs lack of guidance	Framework to be used as a toolkit and tailored to specific needs
	Completion criteria to be risk based	Risk-based attribute prioritisation
	Inconsistent terminology	Glossary provided
Monitoring	Untargeted monitoring without matching against completion criteria	Inclusion of monitoring techniques for attributes in the framework and explicit need to associate with SMART completion criteria
	Lack of monitoring guidelines	Risk-based attribute prioritisation included with risk-based monitoring suggestions

6.1 Policy and knowledge gaps

Several important issues raised throughout the project highlight areas for future work and research directions in the field of mine closure and relinquishment.

6.1.1 Alternative PMLUs

The identification and agreement of PMLUs that differ from land uses that are similar to previous or surrounding land uses (i.e. other than pastoral, conservation or agricultural use) remains an area of complexity. Although the framework presented in this document includes the ability to identify and agree to alternate PMLUs, this process has few precedents in Western Australia.

More broadly, important questions remain on how current practices for the definition and evaluation of completion criteria may be applicable for unconventional PMLUs, such as residential development or renewable energy generation. Indeed, most mine closure plans in Western Australia propose a return to pre-mining conditions, although a gradual change in attitudes was reported by both regulators and mining proponents. Although the harsh climate and remoteness of many Western Australian mines limits the feasibility of certain PMLUs, future research may benefit from learning how other jurisdictions, such as the USA or Europe, accommodate a variety of PMLUs, many of which result in long-lasting, positive outcomes for local communities and beyond.

6.1.2 Setting references and completion criteria standards

The framework steps of setting references and completion criteria standards are also subject to agreement with stakeholders. To date, practice in Western Australia has varied to some extent with different approvals processes, regions and dates, as well as with different PMLUs and impacted values. It will continue to be an area where agreement ultimately requires meeting regulatory expectations. However, further documentation and research into the benefits or costs of particular standards may help to clarify decision processes and trade-offs and avoid application of conservative precautionary principles.

Decades of research and recent technological innovation have led to remarkable improvements in the definition, monitoring and evaluation of mine rehabilitation success, particularly regarding ecological aspects, such as water, soil, vegetation and fauna. However, significant work still needs to be done to advance our understanding of restoration ecology, ecosystem development and contribution to local or regional biodiversity outcomes. Notably, further guidance is needed in Western Australia for the selection of targets for ecological criteria and the interpretation of their value.

6.1.3 Criteria for non-biophysical attributes

In Western Australia, as in other parts of Australia and the world, mine rehabilitation has been largely dominated by a focus on ecological restoration. Conversely, guidance and research on non-ecological aspects (e.g. landforms) stills lags behind. This was confirmed as a major gap through our stakeholder consultation. To make up for current shortcomings, a formal review of non-environmental aspects, attributes and monitoring is recommended as a future project to support revised versions of this report.

6.1.4 Relinquishment

A recurring concern by mining operators relates to the development of clear and transparent relinquishment processes. Mines successfully transitioning through a closure process and achieving relinquishment is a key issue for the resource sector in Western Australia and across Australia. A recent study conducted by The Australia Institute (Campbell *et al.* 2017), and republished by the Parliament of Australia (APH 2017), notes that over 60,000 abandoned mine features exist all over the country whilst less than 25 are known to have been relinquished (LPSPD 2016d). Whilst initial steps have been taken by regulators in Western Australia to improve the transparency of the mine relinquishment process, more work is needed. Currently, there is no documented process for mine relinquishment in Western Australia, even where sites have met agreed completion criteria and been undertaking monitoring for some time. This reflects the complexity of mine closure and relinquishment as a process distinct from mine site rehabilitation. The solution to this issue requires focussed policy consideration, together with transdisciplinary research and activity that develops and integrates knowledge and processes across multiple domains, from engineering and geotechnical disciplines, the ecological and social sciences and economic and finance systems. This needs to be driven by active collaboration between research, policy, mining and METS sector and by policies and guidelines that enable relinquishment and a successful transition to the next land use.

6.1.5 Risk and residual liability

Importantly, one of the main roadblocks for relinquishment is the question of risk and residual liability. Residual liability is a particular challenge to completion and relinquishment, with subsequent land or lease owners unwilling to take on significant remaining liability.

Despite being fundamental to the planning and management of mine operations and closure, the evaluation of risk (levels, likelihood, and consequences) remains contentious — without a consistent set of definitions. The International Standardisation Organisation (ISO 2018) does not provide risk definitions, but rather a series of examples and guiding principles, grounded on the notion that risk is circumstance-specific and, therefore, needs to be defined case-by-case. This ‘tailoring’ approach leads to undesirable consequences, chiefly, high levels of subjectivity and lack of transparency. Within the context of mine closure and relinquishment, significant knowledge gaps exist, expectations are often high and there is a significant level of uncertainty across a number of areas. This can often lead to poor prioritisation processes that omit critical requirements for successful mine closure or establish unachievable goals that lead to system failure and orphaned mines. Ideally, a unique set of guiding principles for the definition and understanding of risk within the specific context of mine closure would benefit all stakeholders, including companies as well as regulators.

6.1.6 Emerging technologies

Another key area for future policy development in Western Australia is enabling mine closure monitoring to take advantage of future technologies. As frequently occurs in tech-driven industries, advances in tools and methods happen at a much faster pace than regulations can be re-examined and rewritten. Recent monitoring techniques, such as remote sensing, are revolutionising how rehabilitation success is assessed and, thus, which indicators could be used in the definition of completion criteria. Under this optic, it is difficult, if not impossible, to envisage which tools will be commonplace in 10, 20 or 30-years’ time — when mines that are now developing their first closure plans are likely to reach their time of closure. When followed diligently, strict regulations have the advantage of helping reduce risk and yet, by the same token, they preclude innovation adoption. Ensuring there is an active link between science and policy development will create robust guidance material while supporting innovation that improves assessment and reporting outcomes.

(END OF CHAPTER 6)

