

# More And Better Mine Rehabilitation – Lessons from Queensland

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### ABSTRACT

Mine rehabilitation, whether it be progressive rehabilitation during the operational life of the mine, or that required post-mining, challenges stakeholders at multiple levels. There is a paucity of successful global rehabilitation cases and closure of complex mines leading to a sustainable post-mining land use. And yet this is a requirement in many jurisdictions.

The period 2016 to present has seen the most significant reforms to mine rehabilitation policy in Queensland's history. This has followed 30 years of incremental change, since a former gold mine in suburban Brisbane, overlain by residential subdivision, began oozing wastes to the surface in 1986. Despite the incremental and sporadic reforms from the late 1980s to 2016, the percentage of the land disturbed by mining that has been progressively rehabilitated has fallen.

Currently in Queensland, mining companies are required to rehabilitate land disturbed by mining to a safe, stable, non-polluting condition, able to sustain a post-mining land use, and to undertake this rehabilitation progressively, through the life of mine. This requirement has not always been articulated so explicitly in Queensland legislation.

This paper explores the concept of the mining industry's rehabilitation task as a 'wicked problem' and assesses its relevance to better understanding the complex interactions of technical, socio-economic and political interests and actors influencing the rate and type of progressive rehabilitation and mine closure planning in the mining industry in Queensland, Australia. The paper outlines some of the events and the legislative and policy landscape that have led to the rehabilitation framework that now exists, some perspectives of the various stakeholders involved in mine rehabilitation, some trends in progressive mine rehabilitation in selected sectors of the industry, and the ongoing policy reforms designed to achieve more and better mine rehabilitation in Queensland.

## KEYWORDS

Rehabilitation, wicked problems in mine rehabilitation, stakeholder views on mine rehabilitation.

## 1. INTRODUCTION

Queensland's resources industry is a mainstay of the Queensland economy. According to the Queensland Resources Council, the industry contributed AUD\$84.3B to the Queensland economy in fiscal year 2021, contributing \$1 in every \$5 of the economy and 1 in 6 jobs. Importantly, the resources industry provides economic opportunity in regional areas, as well as metropolitan support roles.

Currently in Queensland, mining companies are required to progressively rehabilitate land disturbed by mining to a safe, stable, non-polluting condition, able to sustain a post-mining land use, and to undertake this rehabilitation progressively, through the life of mine. At face value, this is a clear articulation of expectations. However, there are no 'complex' mines<sup>1</sup> that have been fully rehabilitated to meet the current regulatory requirements. Given that, for example, no metallurgical or thermal coal mines in Queensland have ever 'closed'<sup>2</sup>, the imperative for more and better progressive rehabilitation becomes manifest.

Queensland is not alone in this respect and has begun tackling the issue through widespread policy reforms commenced in 2016. However, mine rehabilitation, whether it be progressive rehabilitation during the operational life of the mine, or that required post-mining, challenges stakeholders at multiple levels. This paper considers the events and the legislative and policy landscape in Queensland that have led to the rehabilitation framework that now exists. The paper considers trends in progressive mine rehabilitation, considers the different perspectives of the various stakeholders involved in mine rehabilitation and analyses these as a "wicked problem". Observations to inform ongoing policy reforms designed to achieve more and better mine rehabilitation in Queensland are made.

## 2. RECENT HISTORY OF MINED LAND REHABILITATION REFORMS IN QUEENSLAND

Concern regarding the effective rehabilitation of mining impacts has been a longstanding issue within society. It can be argued that the 'modern' era of the Queensland government's focus on the industry commenced when contamination from the Mt Taylor Park gold mine became apparent. Mt Taylor Park operated in the Brisbane suburb of Kingston, from around 1915 until its abandonment in 1955 (Queensland Government, 2021b). Tailings disposal areas and other contaminated areas at Mt Taylor Park were backfilled with mining,

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<sup>1</sup> 'complex' mines are defined here as those involving extraction of resource, beneficiation, and disposal of wastes in mine waste features such as waste rock dumps and tailings storage facilities. Typically these mines require a site-specific environmental authority, and are subject to requirements to produce a Progressive Rehabilitation and Closure (PRC) plan

<sup>2</sup> New Hope Group's Chuwar coal mine was relinquished in September 2022. Chuwar consisted of two small open pits and waste dumps. The site did not host wash plant, tailings storage or loadout facilities and as such does not meet the criteria of a 'complex' mine as described above.

municipal and other wastes, and capped. Subdivisions were created in the 1960s with residential lots constructed and residential subdivision continued to be approved into the 1980s. As capping materials eroded and wastes mobilised beneath the site, residents began to experience those wastes making their way to the surface. Issues like Mt Taylor Park prompted the introduction of modern environmental protection legislation, with incremental amendments over the next 30 years.

The Environmental Protection Act (1994) (EP Act) describes the requirements for the rehabilitation of land to a stable condition which is defined in Section 111A as follows:

“Land is in a stable condition if:

- (a) the land is safe and structurally stable; and
- (b) there is no environmental harm being caused by anything on or in the land; and
- (c) the land can sustain a post-mining land use.”

In 2016, the Queensland Government commissioned Queensland Treasury Corporation to review the financial assurance framework for the resources sector (mining and petroleum activities). The review found a widening gap between the amount of land disturbed by mining and the amount of land rehabilitated. The review also found that, without improved rehabilitation performance, Queensland will remain heavily reliant on the financial assurance system. It recommended the development of clear, whole-of-Government expectations for resource site rehabilitation.

In response to the review, and the subsequent ‘Better Mine Rehabilitation for Queensland’ discussion paper (Queensland Government, 2017), the Government passed the Mineral and Energy Resources (Financial Provisioning) Act 2018 (MERFP Act) and amendments to the Environmental Protection Act (1994) on 30 November 2018, to improve mine rehabilitation outcomes. Key changes included:

- reforming the resource sector financial assurance framework
- requiring mining companies to develop Progressive Rehabilitation and Closure Plans (PRC plans) to deliver rehabilitation progressively through the life of the mine
- expanding the range of surety providers available for the provision of financial assurance
- expanding the abandoned mines program to improve management of legacy issues
- ongoing reforms to residual risk requirements to ensure sufficient money is available for the Government to manage the on-site risks following mine surrender.

Thus, the current regulations require that land must be progressively rehabilitated, and that rehabilitation must be sufficient to meet the definition of ‘stable’ and sustain a post-mining land use (PMLU) at the end of mine life or be managed as a non-use management area (NUMA) (Queensland Government, 2021a). Just over 200 mining facilities are now required to plan how they intend to achieve this through Progressive Rehabilitation and Closure (PRC) plans. Each plan must include a schedule of progressive rehabilitation. Over time, it is expected that these PRC plans will support an improved outcome in mined land rehabilitation, as more clarity on progressive rehabilitation is articulated and enforceable schedules of progressive rehabilitation are submitted and approved.

In addition, during parliamentary debate on the MERFP Act, the Queensland Government also committed to exploring options for a rehabilitation commissioner to support the implementation of these reforms. In September 2019, the government approved consultation on the proposed commissioner model and, on 20 August 2020, the updated EP Act commenced, providing for the statutory appointment of the commissioner

and detailing its functions, powers and reporting requirements. More details can be found in ‘A Brief History of Mining Rehabilitation Reforms in Queensland’ on the QMRC website (<https://www.qmrc.qld.gov.au/>).

As a result, Queensland now has an explicit articulation of expectations for mine rehabilitation and closure criteria. The appointment of a Commissioner establishes a central focus to drive these expectations into industry practice. This arguably places Queensland at the forefront of regulatory practice to support closure and rehabilitation (Hamblin et al 2022).

### 3: CHALLENGES TO REHABILITATION PERFORMANCE IN QUEENSLAND

The reform process highlighted the complex interactions of technical, socio-economic and political interests and actors influencing the rate and type of progressive rehabilitation and mine closure planning in the mining industry in Queensland. The 2021-22 report of the Queensland Mine Rehabilitation Commissioner (Queensland Government, 2022) presented progressive rehabilitation information, based on the mine types impacting the most substantially on the land. Thermal and metallurgical coal mining trends are presented here by way of illustration. The Office of the Mine Rehabilitation Commissioner analysed 90 mines extracting metallurgical and thermal coal and consulted with a wide range of stakeholders. Figure 1 shows the cumulative disturbance and rehabilitation data provided by companies in their annual returns to end CY2021. Both open cut and underground operations are included, as some mines have a combination of methods operating simultaneously. However, the focus of our analysis was on surface features of waste materials (waste rock dumps, ramps, tailings storage facilities and voids).

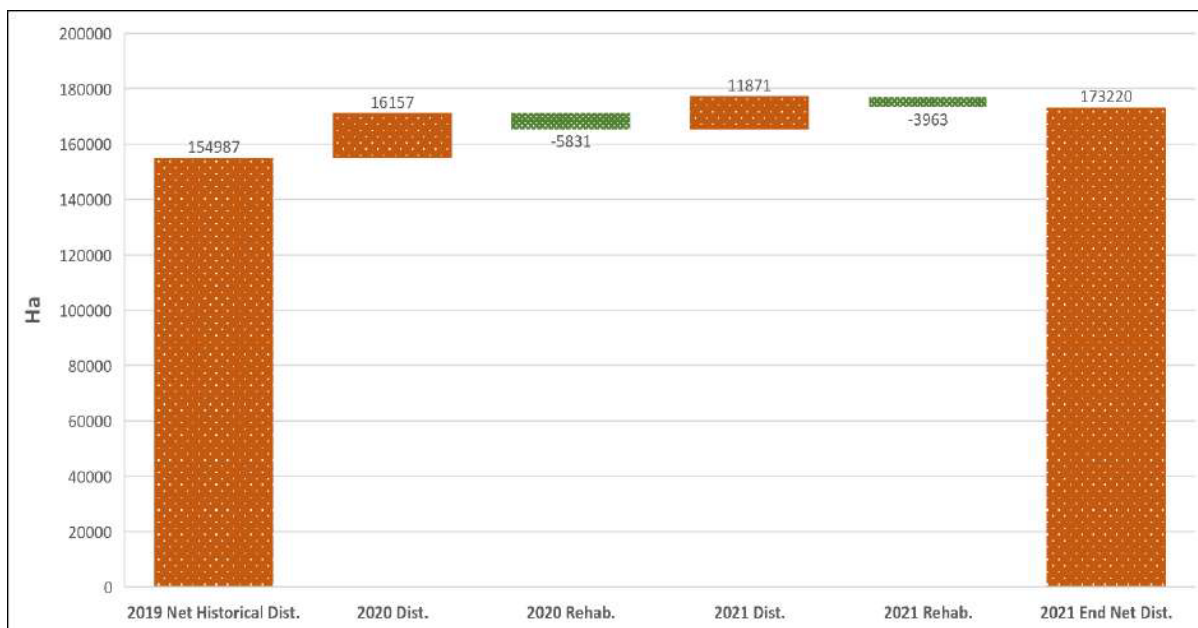


Figure 1. Progressive rehabilitation – metallurgical and thermal coal Queensland, Australia

Figure 1 shows net disturbance remaining after rehabilitation between 2019 and 2021 has increased by 18,233 ha to 173,220 hectares. Rehabilitation progress is not keeping pace with land disturbances due to mining. Total rehabilitation (historically to end of 2021) is 49,061 ha and total disturbance for the same period is 222,282 ha. The percentage of land rehabilitated to that disturbed is 22%. Put another way, as at 31 December 2021, the percentage of land disturbed by thermal and metallurgical coal mining that had yet

to be rehabilitated stood at 80% (~173,000 ha). Establishing progress, definitive performance measures and sector-wide trends in mine rehabilitation is challenging for a range of reasons.

### ***Contextual Differences***

Some of the challenges are due to technical differences between mining operations. Every operation has site specific factors affecting the type and rate of rehabilitation, such as age, site configuration and spoil disposal method. The quality and durability of rehabilitation is also influenced by external factors, such as weather, availability of topsoil and economic conditions.

For example, shallow strip mining and open cut highwall methods lend themselves to progressive rehabilitation—land becomes available for rehabilitation as the working face of the mine moves across the landscape. However, deep, open cut and underground base and precious metals mines present a different set of challenges for assessing performance and trends. Typically, waste rock dumps, tailings storage facilities and the active mine itself remain unavailable for rehabilitation throughout the mine’s life (although old mine features that are no longer used may be available for progressive rehabilitation).

### ***Competing priorities***

Industry feedback has also highlighted disincentives to progressive rehabilitation of the land “as it becomes available”. By way of example, one exhausted pit, now void, is to remain open for a period of five years (or another nominated period) due to the sequencing of operations. However, after such time, the void is to be subsequently used for tailings disposal. In-pit disposal of waste materials is a leading practice but is not reflected in progressive rehabilitation reporting until such time as the infill ceases and the landform is rehabilitated.

Additionally, industry has expressed concern that forced schedules of progressive rehabilitation may sterilise future probable resources (e.g. BHP, 2018). There is a risk that future changes to mine plans, or new development will result in “dehab” of previously rehabilitated areas (e.g. see Muswellbrook Coal Company Limited, 2009 p.85). Technology innovation, commodity prices and other factors heavily influence the commercial viability of extracting resources, and can change rapidly.

Hamblin et al (2022) identify that in general, recent regulatory reform focusses on greater codification of mine closure planning standards and requirements, allowing the state and affected members of the public more concrete avenues for legal redress in the future if mine closure standards set out in a relevant plan are not met. However, they also acknowledge the tension between the desire for clear, enforceable mine closure planning requirements and the provision of adaptable regulation capable of facilitating the effective closing of the relevant mine, an undertaking which is usually decades away.

Progressive rehabilitation is costly and brings forward in time expenditure that typical accounting practices have deferred to the end of the mine lifecycle. Traditional discounted cash flow analysis can ‘discount away’ future costs for long-term works such as climate change (e.g. Espinoza et al., 2020) or other longer-term asset optimisation considerations (e.g. Holloway, 2021).

### ***Lack of certainty***

Certification of progressive rehabilitation, or final relinquishment of mined land is essentially an act whereby liability and responsibility for residual risk is handed over from the mining company to the State. Many issues

affect the confidence of the primary parties involved in this transaction – the mining company and the regulator.

Uncertainty regarding the requirements for certification of rehabilitation may impact the priority placed on progressive rehabilitation. To address this issue, the Queensland Department of Environment and Science issued a Guideline for Progressive Certification of Resource Activities (DES, 2022) to assist the industry in meeting certification requirements. The guidelines suggest, at a minimum, five years and fifteen years of monitoring prior to application for certification of grazing and native ecosystem rehabilitation respectively (p.10). Alternative arguments can be made by proponents, but as with many guidelines, the guidance periods tend to become the default periods. There is no guarantee that certification will follow these time periods.

Determining the point at which there is sufficient information on the performance of rehabilitated mine lands to enable a lawful decision on relinquishment to be made is challenging. “Safe, stable, non-polluting” are broad objectives to apply to regulatory decision-making. For example, “stable” for how long? As relinquishment is forever, regulatory decision-making on complex sites can stretch the regulator’s capacity and risk appetite.

Additionally, the future management of post-mining land use may also exercise the minds of regulators. Mining activities in Queensland are heavily regulated relative to many other activities, such as agriculture. Rehabilitated mine lands relinquished to a grazing post-mining land use, will no longer be under the remit of the environmental regulator. The duration and intensity of grazing becomes more difficult to actively manage from the regulatory perspective. Preferential livestock traffic ways may erode cover materials and expose sodic or other materials that could subsequently lead to unintended, accelerated erosion and environmental harm. Thus, loss of “regulatory grip” may contribute to the historically low levels of progressive certification and relinquishment of leases and authorities that we see.

#### **4. MINE REHABILITATION AND CLOSURE AS A ‘WICKED PROBLEM’?**

Queensland is not alone in having low levels of rehabilitation and relinquishment. We hypothesise that this is because the characteristics of mine rehabilitation and closure are those of a “wicked problem”. The issues associated with successful mine rehabilitation and transition to a sustainable post-mining land use are many and diverse. Examples of successful mine closures leading to sustainable post-mining land uses are modest. Many are associated with benign materials, and case studies often include former hard rock quarries (e.g. see Pearman, 2009). In the case of base and precious metals mines where chemical beneficiation techniques are required to extract minerals, examples of successful rehabilitation and relinquishment of the entire mine to a subsequent post-mining land use, are far rarer.

Recent work from the University of Queensland (Holcombe & Keenan, 2020) developed a global database of case studies on the repurposing of mines. Mines self-reported as “closed” in the S and P Global Market Intelligence Database were used as source data and 141 case studies were examined in more detail. Of 1804 mines reported as closed in 2019, more than 95% were categorised as “inactive”. The remainder were most often identified as being in rehabilitation or under care and maintenance. 2 out of 1804 closed mines were classified as relinquished.

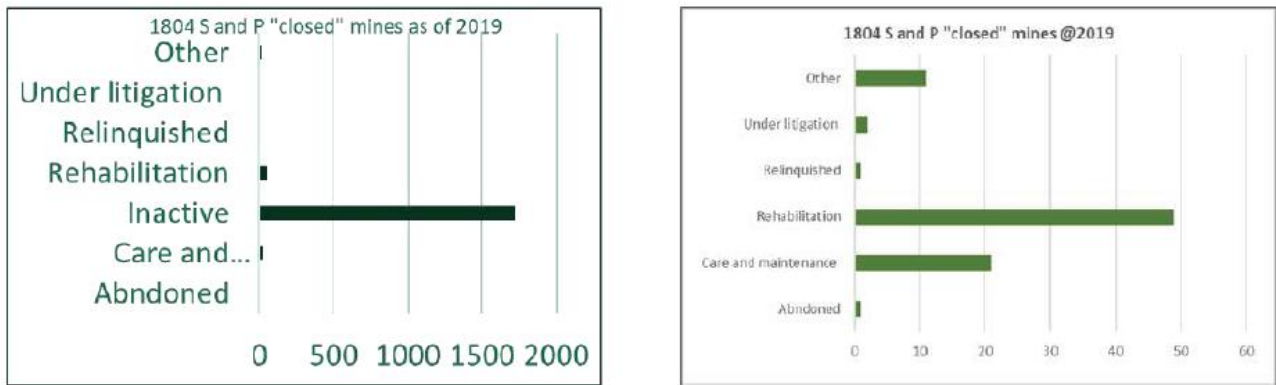


Figure 2: Data on the status of mines self reported as “closed” to the S and P global market intelligence database in 2019. Graphs compare all instances with those instances that are not merely inactive.

Moreover, Holcombe and Keenan (2020) concluded that there are few examples worldwide of industry-led and/or funded repurposing of mines post production – which is the intent of the regulatory reforms summarised above. They identified a number of issues contributing to this lack of repurposing which highlight the complex, diffuse, intersecting and non-binary nature of relationships affecting mining operations and mining regions over time. Such characteristics are used to describe “wicked problems” and differentiate them from simpler problems that are amenable to relatively well-defined solutions.

The term “wicked problem” is attributed to a paper on Dilemmas in the General Theory of Planning (Rittel & Webber, 1973) and was first coined in relation to the challenges of creating effective public policy on issues such as sewerage, healthcare, crime, social disadvantage and good education. “A **wicked problem** is a social or cultural problem that is difficult or impossible to solve due to: incomplete or contradictory knowledge; the number of people and opinions involved; the large economic burden; and the interconnected nature of these problems with other problems.”

A fundamental realisation from Rittel and Webber’s work was that wicked problems may not necessarily be solvable. Rather, interventions are made to what Herbert A. Simon termed ‘satisfice’ stakeholders (Simon, 1956; Simon & March, 1976) In cases where a single, optimal solution cannot be arrived at, incremental improvements made to help better understand and manage problems are seen as worthwhile (Head, 2022). Put simply, we respond to and ameliorate wicked problems and “success” is a relative term.

Several issues are likely to undermine any attempt to reach a single course of action in the face of a wicked problem:

- The first is that stakeholders are unlikely to agree on a course of action;
- Secondly, complex judgement is required to understand the myriad of system interactions that are occurring;
- Conceptually, there are no clear stopping rules, no objective measures of success, no right or wrong answers and only better or worse solutions;
- Therefore, there is a need to discover new options and alternatives; and
- Because right and wrong are not clear, ethics, morals and values come into play.

All of these issues arise in the context of mine rehabilitation, relinquishment and repurposing in the later stages of the mine lifecycle.

For the mining operation, the undoubtedly complex tasks of planning, building and operating a mine are addressed through the application of scientific and engineering expertise. Despite the potential intervention of disparate views regarding the establishment of a new mine, the process of planning is a problem-solving exercise with a defined outcome. Once ‘behind the fence’ a project has a defined solution to be achieved – to build and operate the mine according to the design and business case parameters in place. Although the task may involve billions of dollars capex and significant operating costs, these stages in the mine life cycle do not meet the fundamental tests of wicked problems. The final stages of the mine lifecycle - returning the mined land to some condition for a yet to be determined post mining land use acceptable to a diverse range of key stakeholders - does.

This is the stage in the mine life cycle where the views of diverse stakeholders most come to bear on decisions surrounding the release of mined land to valued and sustainable post-mining land use. (Measham et al., 2021) explore the concepts of ‘values’ rather than a singular ‘value’ (such as monetary value) and suggest that multiple values can be held simultaneously. The views of these stakeholders crystallise around the type and quality of the rehabilitation completed by the mining company, but then expand to include the views of first nations peoples, neighbours, conservation groups, local and provincial governments and those who seek to use and manage the lands post-mining. While many stakeholders have views regarding the mine in its planning, construction and operational phases, those mine life-cycle stages are most directly impacted by the mining company themselves, and the jurisdictions required to regulate the mining activity. Mine closure and post-mining land use open the debate to these wider groups and invite pluralistic perspectives, including a greater emphasis on the political decision making within democratic society (Head, 2022, p. 52).

For these reasons, we argue that rehabilitation (progressive or otherwise), closure and relinquishment closely align to the antecedent conditions most often associated with wicked problems. This stage of the mining lifecycle plays out over years. Whose perspective dominates the definition of a sustainable post mining land use? What relative priorities are placed on ecosystem services and social livelihoods? Over what timeframes and on what scale? Ultimately, time plays its part. Decisions around mine rehabilitation are made and actions taken over many decades, such that the concept of ‘closure’ is challenged. For example, when is a mine no longer a mine? Or more accurately, when is a resource no longer a resource? These matters cannot be addressed through simple binary relationships between the industry and the regulator, or through the application of technical expertise in isolation.

## **5. STAKEHOLDER PERSPECTIVES – DO THEY HELP DEFINE AND BRIDGE THE GAP?**

In mine rehabilitation, the miner and the regulator anchor the decisions to be made on how much, what type and to what standards rehabilitation must reach. But if wicked problems are in part defined by the disparate views of various stakeholders affected by the issue in question, then these stakeholders must be important actors in the decision-making process around mine rehabilitation and relinquishment.

Stakeholder perspectives represent a wide spectrum of views existing in a gap between the miner and the environmental (or other) regulator (Figure 3). These perspectives would appear to be critical in bridging the gap between the regulator and the mining company.



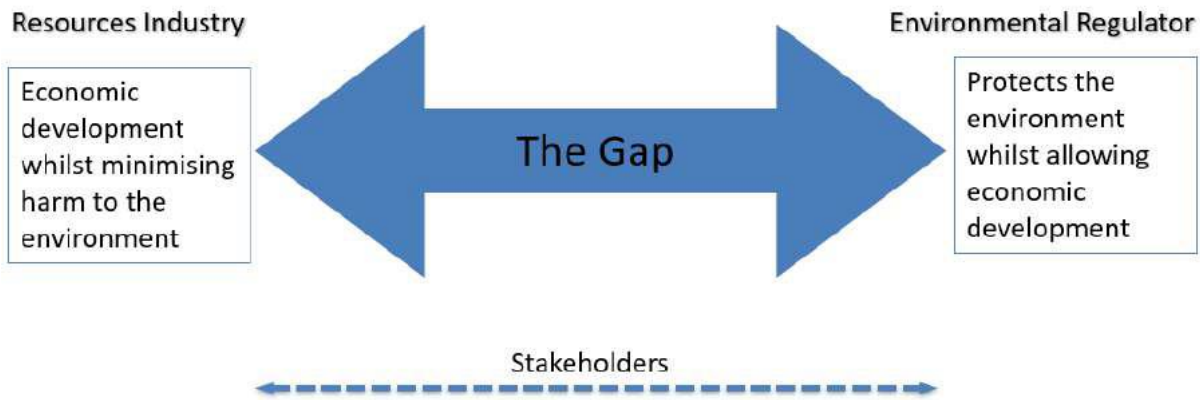


Figure 3. Bridging the gap

The importance of understanding stakeholder perspectives in all aspects of the mine lifecycle is well accepted and increasingly being codified into approval processes, regulation and best practice for mining operations (Bainton, N. and Holcombe, 2018; ICMM, 2019). Increasingly sophisticated methods and tools for stakeholder engagement proliferate and are applied in the field.

The need to consider multiple stakeholder perspectives to define rehabilitation and relinquishment plans is well understood. However, it is not enough to simply consult. The perspectives derived from consultation will not necessarily be commensurate and will raise conflicts and tensions which may not be under the control of either the regulator or the mining company and which change over time. It follows therefore that stakeholder engagement is necessary *but not sufficient* to bridge the gap between the mining company and the regulator on rehabilitation and relinquishment. The question is whether the mining company and the regulator are incentivised and empowered to respond to the issues that arise as a result of stakeholder consultation.

## 6. DISCUSSION

Amongst the many issues and challenges that the rehabilitation of mined lands presents, one of the most significant turns on the requirement for progressive rehabilitation during mine life (Environmental Protection Regulation 2019, Schedule 8A, Part 3, Table 2). Without sufficient progressive rehabilitation, the cumulative liability of disturbed lands will continue to grow, and ultimately the risk profile of the industry will shift, particularly as stronger entities sell off to others with less capacity to manage the growing environmental liabilities of unrehabilitated lands.

However, the concept of progressive rehabilitation itself is open to challenge. In a static open cut or underground metalliferous mine, waste structures are managed close to the resource, dumps grow at angle of response and often tailings storage facilities are expanded by sequential lifts on the original facility. Alternatively, more land is impacted if new storage facilities are preferred to lifts. Progressive rehabilitation prior to end of mine life can be limited. In strip mining, premature progressive rehabilitation can lead to perverse outcomes such as outer batter slopes being rehabilitated at steeper than optimal angles, poor cover design and so forth. In-pit waste disposal may require a period of years between excavation and disposal of wastes into the void, yet the final landform may be a more sustainable form than if the rehabilitation was undertaken prematurely. Through all of this, the regulator must balance the final outcome with the existential risk of the public bearing the cost of unfunded rehabilitation liability.

In Queensland, the mineral endowment is, with a few exceptions, owned by the people of Queensland. Resource companies are provided with a licence to extract, beneficiate, and sell those commodities. And like any other licence, that permission comes with a suite of responsibilities incumbent on the licence holder. The way those licences have been able to change hands between entities is a potential risk factor that has the potential to subvert the intent of issuing a licence to a competent entity in the first instance.

The Environmental Protection Act (S111A) states that mine rehabilitation must deliver the land in a “stable condition”, ensuring former mines are “safe and structurally stable”, that “there is no environmental harm being caused by anything on or in the land” and “the land can sustain a post-mining land use”. The first three criteria are the necessary foundations that must be in place before the range of alternative futures for the site (i.e. post-mining land uses) are realised. Regardless of how beneficial any particular post-mining land use may be, the fundamental rehabilitation requirements (i.e. safe, stable, non-polluting) must be established.

Early stakeholder engagement and technical research conducted by the Office of the Queensland Mine Rehabilitation Commissioner, have made it abundantly clear that ‘best practice’ must optimise the social, economic and environmental outcomes such that environmental quality objectives are met, but also that regional communities can continue to benefit from a healthy, diverse and sustainable economy. By viewing mined land as an opportunity for re-imagining sustainable futures for resource communities, the task of rehabilitation of mine sites can be one that protects the environment and provides enduring value to the communities that have hosted historic mining activity.

In summary, this suggests some priorities for approaching the development of progressive rehabilitation, closure and relinquishment plans which may be counterintuitive for some stakeholder groups. Firstly, plans need to be technically feasible, then they need to be socially “acceptable” to the local and regional stakeholders and finally they need to be economically viable. Currently, these three different attributes for a sustainable closure plan tend to be developed in parallel (and often in conflict) with each other.

## **7. FUTURE ANALYSIS AND RESEARCH**

The early assessment of rehabilitation trends in the Queensland resources industry has only scratched the surface of the challenges and opportunities that more and better mine rehabilitation present. Even in the case of strip mining, progressive rehabilitation measured as percentage rehabilitation to disturbance is a coarse measure. Mines in early life have limited capacity to progressively rehabilitate. As discussed above, mines that employ in-pit waste disposal may not record high levels of “completed” rehabilitation yet may be employing leading practice as residual voids are reduced. The ever-present challenge of resource sterilisation will continue to frustrate progressive rehabilitation and challenge the concept of mine closure when resources remain, albeit not commercial at any given point in time.

More nuanced analysis will be beneficial to better understand the industry’s overall performance. More research on how best to cost-effectively ensure a safe, stable, non-polluting landform is delivered, with a view to ensuring resources can be accessed as new mining techniques, market demand, and solutions to the environmental impacts of mining itself and the use of its commodities evolve.

## **REFERENCES**

Bainton, N. and Holcombe, S. (2018). *The Social Aspects of Mine Closure: A Global Literature Review. Centre for Social Responsibility in Mining, Sustainable Minerals Institute, The University of Queensland: Brisbane.*

- BHP. (2018). Submission to the Economics and Governance Committee review of the Mineral and Energy Resources (Financial Provisioning) Bill 2018. In <https://Medium.Com/>.
- DES. (2022). *Guideline Environmental Protection Act 1994 Progressive certification for resource activities*. Department of Environment and Science, Queensland Government.
- Espinoza, D., Morris, & J., Baroud, H., Bisogno, & M., Cifuentes, & A., Gentzoglani, & A., Luccioni, & L., Rojo, & J., Vahedifard, F., & Espinoza, \* D. (2020). *The role of traditional discounted cash flows in the tragedy of the horizon: another inconvenient truth Mitigation and Adaptation Strategies for Global Change (2020) 25:643-660*. 643–660.
- Hamblin, L., Gardner, A., & Haigh, Y. (2022). *Mapping the Regulatory Framework of Mine Closure* (Issue May). CRC TiME Limited.
- Head, B. W. (2022). *Wicked Problems in Public Policy: Understanding and Responding to Complex Challenges*. Palgrave Macmillan. <https://doi.org/10.1007/978-3-030-94580-0>
- Holcombe, S., & Keenan, J. (2020). Mining as a temporary land use scoping project: transitions and repurposing. *The Social Aspects of Mine Closure Research Consortium, March*.
- Holloway, E. C. (2021). *Risk and strategy in mineral asset optimisation and valuation* [The University of Queensland]. <https://doi.org/10.14264/6d0e585>
- ICMM. (2019). *Integrated Mine Closure Good Practice Guide: 2nd Edition*.
- Measham, T., Ackermann, F., Everingham, J., Barber, M., Haslam-McKenzie, F., & Maybee, B. (2021). *Understanding stakeholder values in post-mining economies : a literature review* (Issue June). CRC for Transformations in Mining Economies.
- Muswellbrook Coal Company Limited. (2009). *Annual Environmental Management Report 2013-14*. Muswellbrook Coal Company.
- Pearman, G. (2009). *101 things to do with a hole in the ground*. Post-Mining Alliance.
- Queensland Government. (2017). *Better Mine Rehabilitation for Queensland: Discussion Paper*. Queensland Government.
- Queensland Government. (2021a). *Guideline - Progressive rehabilitation and closure plans (PRC plans)*.
- Queensland Government. (2021b). *Mount Taylor Park remediation project*.
- Queensland Government. (2022). *QMRC 2022. 2021-22 report*. Queensland Mine Rehabilitation Commissioner.
- Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences, 4(2)*, 155–169. <https://doi.org/10.1007/BF01405730>
- Simon, H. A. (1956). *Administrative behavior*. Simon and Schuster.

Simon, H. A., & March, J. (1976). *Administrative behavior and organizations*.