2021–22 Report

Queensland Mine Rehabilitation Commissioner

Queensland Government

The Office of the Queensland Mine Rehabilitation Commissioner acknowledges the Aboriginal and Torres Strait Islander peoples on whose lands the resources industry operates.

Purpose of this report

The report forms part of the Office of the Queensland Mine Rehabilitation Commissioner's corporate governance framework and fulfils the Commissioner's obligation under section 444O of the *Environmental Protection Act 1994* to provide the Minister (Minister for the Environment and the Great Barrier Reef and Minister for Science and Youth Affairs) with an annual report about the operations of the rehabilitation commissioner during the year within four months of the end of financial year.

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Queensland Mine Rehabilitation Commissioner 2021–22 Report

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1. Introduction

This inaugural report outlines the role and objectives of the Queensland Mine Rehabilitation Commissioner (the Commissioner). It describes the approach taken by the Commissioner to engage with parties with an interest in mine rehabilitation.

This report also summarises the research, analysis and evaluation work undertaken by the Commissioner to date, and reports on the rehabilitation performance and trends of resource activities in Queensland.

1.1 The Commissioner's role

The Commissioner is an independent person, appointed under the *Environmental Protection Act 1994* (the EP Act) to provide advice to the responsible Minister on rehabilitation management practices, outcomes and policies. The Commissioner's role covers 'resource activities' in Queensland, including mining and petroleum activities.

The Commissioner also monitors and reports on rehabilitation practice and trends, raises awareness of rehabilitation management matters, and provides advice on public reporting on rehabilitation performance. The role of the Commissioner is independent and separate from the administering authority that regulates resource activities.

The Commissioner was appointed by the Governor in Council on the recommendation of the Minister responsible for the EP Act and reports directly to the Minister. The Commissioner and staff of the Office of the Commissioner (QMRC team) are dedicated to working collaboratively with all interested parties, including Aboriginal peoples and Torres Strait Islander peoples, industry, environmental and scientific groups, communities and government.

Our approach

The vision of the Commissioner and QMRC team is to *lead Queensland to achieve best practice in mined land rehabilitation*. We do this through four key strategies:

Connect

- Consult with stakeholders to raise awareness on technical, scientific and engagement matters.
- Facilitate the engagement of First Nations peoples in mine site rehabilitation and recognise their unique perspectives.
- Synthesise stakeholder perspectives and best practice mine rehabilitation to optimise environmental, social and economic outcomes.

Research

- Identify rehabilitation priorities for Queensland.
- Produce advice informed by global best practice.
- Collaborate with stakeholders to undertake research.
- Identify opportunities and challenges to achieve best practice mine rehabilitation, by optimising environmental, social and economic outcomes.

Advise

- Provide advice to the Minister on mine rehabilitation and management practices, outcomes and policies.
- Provide advice to the Minister on public interest evaluation processes and performance.

Report

- Report annually to the Minister and parliament on best practice mine rehabilitation.
- Publish advice, reports and guidance on the Queensland Government website.
- Report on rehabilitation performance and trends in Queensland.

1.2 Drivers for the establishment of the Commissioner

The establishment of a rehabilitation commissioner originated from consultation feedback on the Mineral and Energy Resources (Financial Provisioning) Bill 2018. Queenslanders wanted a better understanding of how resource companies will rehabilitate mined land and the condition of rehabilitated land. Resource companies requested certainty around what the Queensland Government (the Government) considered best practice rehabilitation. The Government wanted greater visibility and transparency of progressive rehabilitation achieved by the Queensland resources sector.

1.3 History of rehabilitation reforms

In 2016, the 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 EP Act, 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.

During debate, the Government committed to exploring options for a rehabilitation commissioner for resource activities. In September 2019, the Government approved consultation on the proposed commissioner model. 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.

2. Stakeholder engagement

Since commencing in October 2021, the Commissioner and QMRC team have consulted with a broad range of stakeholders. We have held 104 consultation meetings with First Nations organisations, academia, professional associations, peak bodies, conservation stakeholders, resource companies, local governments and local community members. We have also visited 38 mine sites up to 30 June 2022.

Stakeholders expressed a wide range of views regarding progressive rehabilitation, closure planning and post-mining land uses. We will continue to engage with affected parties to better understand aspirations and inform our advice.

2.1 First Nations organisations in the resources sector

A key focus of our stakeholder engagement has been with First Nations organisations involved in the resources industry. The industry has long been a strong contributor to First Nations economic development and mine rehabilitation is a potential growth opportunity for First Nations organisations. Regional Economic Solutions was tasked to develop an engagement strategy and provide cultural capability training to the QMRC team. In 2021–22, we engaged with 16 First Nations-owned companies and organisations to better understand challenges and opportunities in mine rehabilitation.

Providing services to the resources sector requires a specific set of capabilities, including technical knowledge, strict health and safety protocols, and fitness for work. Pre-qualification of contractors to mining companies can be challenging for organisations not familiar with the industry's requirements. Therefore, the QMRC team initially engaged with First Nations organisations working within the industry, with first-hand knowledge of its challenges and opportunities. The companies actively engaged in the industry were unanimous in their view that providing a valued, reliable and cost-effective service was paramount. Commercial viability is a pre-requisite for sustainable success for First Nations employees and companies.

Our early consultations found several broad themes facing First Nations organisations. Contracting strategies were of primary importance—industry can assist by matching work packages to the existing capabilities of First Nations organisations. Too often, mining companies call for tender on a single, overarching package of works and leave it to the prime contractor (or even sub-contractors) to deliver commitments on First Nations employment, contracting and skills development. This delegation of responsibility often results in 'tick-the-box' engagement (for example, where a commitment to trainee work hours results in a large turnover of trainees).

A recurrent theme was the prevalence of non-Indigenous businesses taking unfair advantage of an Indigenous business for the purpose of gaining access to Indigenous contracts. Resource companies should monitor post-contract performance and ensure that growth opportunities are shared commensurately between joint venture partners. As a work package size increases, there is a risk that the First Nations partner's contribution remains static, while the non-Indigenous partner grows. The greater the level of 'on-ground' cultural capability within the industry (i.e. in mine work crews and site leadership roles) the more likely initiatives lead to longer-term contracts, employment and skills development for First Nations businesses.

As the resources industry commits to more and better mine rehabilitation through Indigenous Land Use Agreements and PRC plans, opportunities for First Nations peoples should remain a priority. The QMRC team will continue to consult with First Nations organisations to understand how they can participate and benefit.

3. Research on leading practice

The QMRC team has collaborated with research partners to investigate leading practice in rehabilitation. Table 1 summarises research we commissioned in the past year in response to stakeholder feedback. In 2022, we also joined over 70 research, industry and government partners in the Cooperative Research Centre for Transformations in Mining Economies.

Table 1. QMRC research contracts awarded in 2021-22

Research Topic	Contract Award Date	Partner
Mine waste cover systems	12 January 2022	Okane Consultants
Modelling residual void hydrology and water quality	27 January 2022	Australasian Groundwater and Environmental Consultants Pty Ltd and WRM Water and Environment
Mapping biodiversity corridors and rehabilitation opportunities	2 March 2022	Centre for Mined Land Rehabilitation, Sustainable Minerals Institute, University of Queensland
Identifying post-mining land uses for residual voids	4 March 2022	Centre for Water in the Minerals Industry, Sustainable Minerals Institute, University of Queensland
Native ecosystem rehabilitation	4 March 2022	Aspect Ecology Pty Ltd
Higher degree research internship QUT	7 March 2022	Queensland University of Technology

3.1 Mine waste cover systems

Rehabilitating mine waste held in tailings storage facilities (TSFs), waste rock dumps (WRDs) or heap leach piles (HLPs), remains a critical challenge for the mining industry in Queensland and globally. Effective management of mine waste requires an understanding of

how local climate affects weathering and leaching of waste material. Cover systems are an integral part of preventing impacts to the surrounding environment and are therefore key to effective mine rehabilitation.

This year, we published a research brief on 'Mine waste cover systems' (qmrc.qld.gov.au/publications/research) and engaged Okane Consultants to research best practice mine waste cover design and rehabilitation planning for waste that has the potential to generate acid and metalliferous drainage (AMD). The research is producing short technical briefs (for the general public) and technical papers (for environmental professionals) that describe a framework to categorise mine waste structures (WRDs, TSFs, HLPs) to reflect the risk of AMD.

The research will examine cover design objectives for mine wastes in each category and assess cover design components (such as reduced permeability layers, capillary break layers and thicker inert material layers) that support post-mining land uses (PMLUs) and minimise the maintenance burden for future landowners. It will also recommend best practice principles for cover design over wastes with a high risk of AMD. The technical briefs and papers are due for publication on the QMRC website in financial year 2023.

3.2 Modelling residual void hydrology and water quality

Water-filled residual voids are commonly left in place after the closure of a mine. These voids can provide a valuable resource for regional communities when planned and managed correctly. However, when they hold poor quality water, they can become a liability that requires ongoing management. Good modelling outcomes that support rehabilitation planning and void water management are key to achieving positive outcomes for mine voids. Currently, many approaches are used to predict long-term water balance and water quality. The lack of consistent modelling approaches makes it difficult to compare and assess modelling results and make transparent decisions.

This year, we published a research brief with further information on 'Best practice rehabilitation and management of mine voids' (qmrc.qld.gov.au/publications/research). We also engaged Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) and WRM Water and Environment (WRM) to develop a technical guideline on best practice approaches for modelling the water balance and water quality of residual voids. The research is producing technical briefs and papers, including a review of current practices, a description of best practice modelling approaches and a step-by-step guide on how to implement best practice. The technical papers and briefs are due for publication on the QMRC website in financial year 2023.

3.3 Mapping biodiversity corridors and rehabilitation opportunities

One of the most common PMLUs nominated by mining companies is ‘native ecosystem’. Currently, PMLUs are nominated by mining companies on a site-by-site basis during the environmental approval process or rehabilitation planning. An opportunity exists to connect high value native ecosystems in Queensland if rehabilitation efforts are considered more broadly, for example at a regional rather than site level. This could involve connecting native ecosystems in a coordinated way to develop biodiversity corridors across multiple mine sites.

The Fitzroy Basin is a useful region to test this opportunity. It is home to the vast majority of coal mines in Queensland and is entirely within the Brigalow Belt bioregion, where 81 percent of the remnant vegetation is considered of state significance and 80 percent has state or regional-level biodiversity values (DES, 2018).

This year, we engaged the Sustainable Minerals Institute at the University of Queensland to identify, compare and evaluate the potential of mine rehabilitation areas in the Fitzroy Basin to connect high value ecosystems and enhance biodiversity. The research involves integrating spatial data on regional ecosystems and mines with ecosystem and biodiversity values as outlined in the Biodiversity Assessment and Mapping Methodology for the Brigalow Belt (EHP, 2014). A technical brief, a technical paper and maps are due for publication on the QMRC website in the first half of financial year 2023.

3.4 Identifying post-mining land uses for residual voids

One potential strategy for rehabilitating mine voids is to leave them open to fill with water, as this could deliver benefits for regional communities (such as for irrigation or recreational use). However, the quality of water in voids may deteriorate over time and water-filled voids can pose risks relating to instability, toxicity, overtopping and seepage. Another strategy to achieve a ‘stable condition’ is to backfill the void to create an area of land suitable for grazing or natural ecosystems. However, backfilling is often dismissed as impractical or expensive. There is a need to describe leading practice for decision-making to achieve the best outcome for multiple stakeholders.

This year, we published a research brief with further information on ‘Best practice rehabilitation and management of mine voids’ (qmrc.qld.gov.au/publications/research). We also engaged the Sustainable Minerals Institute from the University of Queensland to develop a technical guideline on best practice approaches to identifying, assessing and comparing PMLU options for voids (including backfilling). The research is producing briefs and technical papers, including advice applicable to all stages of mine life. They are due for publication in financial year 2023.

3.5 Native ecosystem rehabilitation

Native ecosystems that develop in highly modified landscapes may be:

- Natural – ecosystem restored in line with the natural/historical landscape.
- Hybrid – ecosystem has some, but not all, characteristics of the natural/historical landscape and some novel attributes.
- Novel – a new assemblage of living and non-living elements resulting in a stable alternative ecological form (Doley et al., 2012; Doley and Audet, 2013).

This year, we engaged Aspect Ecology Pty Ltd to research the feasibility and benefits of these varying native ecosystem rehabilitation outcomes, and best practice methods for assessing native ecosystem rehabilitation success. The researchers conducted an online survey in June 2022 to collate stakeholder perspectives on native ecosystem rehabilitation outcomes (natural vs hybrid vs novel), ecosystem rehabilitation assessment methodologies, and the importance of regional contexts (such as adjoining ecosystems). A report synthesising these stakeholder views is being prepared and is due for publication on the QMRC website in the first half of financial year 2023.

Technical briefs and papers are also being developed, including an evaluation of the feasibility and benefits of natural, hybrid and novel ecosystem outcomes. The work includes a critical review, comparison and recommendations of assessment methodologies for evaluating native ecosystem rehabilitation success. The research will determine a best practice approach to ensure consistent evaluation of native ecosystem rehabilitation across the state. Training workshops on best practice assessment of native ecosystem rehabilitation success will be conducted in financial year 2023. The technical briefs and papers are due for publication on the QMRC website in financial year 2023.

3.6 Higher degree research students

This year, we hosted a higher degree research student from the Queensland University of Technology (from March to June 2022). This project produced a technical report that summarises trends in approaches to rehabilitate mine voids and considers the requirements to plan and achieve the best possible post-mining outcomes for mine voids.

Last year, we hosted an industry placement student from the University of Queensland (from July to October 2021). This project produced a technical report that summarises the scientific literature on water treatment technologies suited to the coal industry and describes an innovative approach to comparing water treatment options.

Both students' reports are due for publication on the QMRC website in the first half of financial year 2023.

4. Rehabilitation performance and trends

This section describes rehabilitation performance and trends for all mines subject to a PRC plan in Queensland. It explains the prioritisation and grouping of different sectors of the mining industry for the purpose of performance reporting. We used annual calendar year return data (provided by companies to the Department of Environment and Science (DES) by 31 March each year) to analyse progressive rehabilitation and area of disturbance. Where available, we also used financial year data and 'effective date' data to provide the most up-to-date analysis possible. Our analysis included land reported by companies as 'certified' or 'rehabilitated' and excluded land reported as 'commenced rehabilitation'. Our analysis did not test the accuracy of data provided by companies in their annual returns, however, an independent auditor verified the methodology and accuracy of our calculations.

Challenges in measuring rehabilitation performance

Establishing definitive performance measures and sector-wide trends in mine rehabilitation is challenging.

Every operation has site-specific factors affecting the type and rate of rehabilitation, such as mining method, 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. 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. Whereas deep, open cut and underground base and precious metals mines present a different set of challenges for assessing performance and trends. Usually, WRDs, TSFs, HLPs 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). Again, technology, commodity prices and other factors heavily influence the commercial viability of extracting resources, which can change rapidly.

Industry feedback highlighted the potential shortcomings of rehabilitation versus disturbance as a performance measure, given the challenges that *'…as land becomes available…'* raises. For example, an exhausted pit, now void, may remain open for a period of five years (or another nominated period) due to the sequencing of operations. However, after such time, the void may be used for tailings disposal. In-pit disposal of waste materials is a leading practice but is not reflected in progressive rehabilitation reporting until the infill ceases and the landform is rehabilitated. Also, new technologies, regulatory requirements and commercial and economic drivers influence rehabilitation decisions. Much fixed infrastructure is also required until end of operational life.

Our approach

For the purposes of this report, we have allocated the 207 Queensland mines subject to PRC plan requirements (as at 31 May 2022) into sectoral groupings. The groupings are metallurgical and thermal coal mining, large-scale strip mining other than coal (for example, bauxite, phosphate, silica and mineral sand), base/precious metals operations and smaller strip operations (for example, monument stone and clays). See table 2 for details on the sectoral groupings used in this report and section 4.6 for the status of PRC plans as of 31 May 2022.

The primary focus of this inaugural report is large-scale mining operations that are required to prepare and submit PRC plans. Such operations have been identified as the highest priority sites for more and better rehabilitation. Other mining activities have a lower land disturbance footprint and present a much lower potential environmental impact in their locality. The following are not a priority for evaluation in this inaugural report but may be addressed further in future Commissioner's reports:

- oil and gas fields (however, brine pond management and decommissioning of expired wells are important rehabilitation activities for the petroleum and gas sector and may form part of future reports)
- small mining claims, seismic lines and other exploration activities
- mine features for metals mining (see the survey results in section 4.4.1)
- other resource activities' such as monument stone and clays.

Table *2*. Sectoral groupings of mines used in this report

Groupings / number of mines	Description	Example Commodity
Metallurgical and thermal coal N = 90	Major coal operations that predominantly mine in a horizontal direction (i.e. shallow deposit or pre-strip operations) such that land can be rehabilitated progressively. Underground coal mines are included as several mines use both open cut and underground workings.	Hard coking coal, pulverised coal for injection (PCI), thermal coal
Other large-scale strip mining N = 18	Major operations that predominantly mine in a horizontal direction (i.e. shallow deposit or pre-strip operations) such that land can be rehabilitated progressively.	Bauxite, phosphate, silica and mineral sands
Base and precious metals N = 67	Major operations that predominantly mine in a vertical direction such that land cannot be as readily rehabilitated progressively.	Copper, gold, lead, silver, zinc
Other resource activities N = 32	Medium/major operations that do not fit into the groupings above. Typically, these operations are bespoke and may progress horizontally, vertically or both.	Clay, bentonite, limestone, sandstone
Note: We grouped operations with multiple commodities or mining styles to best reflect their context—for example, coal infrastructure leases were allocated to the 'metallurgical and thermal coal' group.		

We analysed the progressive rehabilitation performance of all 207 mines subject to PRC plan requirements. The results are presented as 'waterfall' graphs for the sector and each grouping. Historical disturbance up to the end of calendar year (CY) 2019 was used as the starting point—calculated as the total disturbance companies reported up to the end of CY2019 less the total completed or certified rehabilitation that companies reported up to the end of CY2019. Annual return data for disturbance and rehabilitation is then presented for CY2020 and CY2021 and the net level of disturbance. The 32 sites described as 'other resource activities' subject to PRC planning requirements are included in the total rehabilitation analysis (Figure 2) but not presented as a separate grouping.

4.1 Industry-wide

We found that there has been consistent growth in the industry's overall liability of rehabilitation yet to be carried out across the mining sector. Figure 1 shows the trend of increasing Estimated Rehabilitation Cost (ERC). This figure should be read as indicative only, as the consistency and rigour of the data points have varied over time. Regardless, the figure does provide an indication of the trend in rehabilitation liability over the period.

Changes in liability are influenced by several factors, including:

- area of disturbance—the area of land disturbed by mining and yet to be rehabilitated has increased year on year (total outstanding rehabilitation area to the end of CY2021 was 215,555 hectares—see Figure 2)
- number and type of mine waste structures—more complex waste structures such as metalliferous tailings storage facilities carry a greater ERC than more benign mine-affected lands
- area of actual rehabilitation—certified mined land rehabilitation removes areas from the ERC calculation
- schedules of rates—the cost of rehabilitation is subject to market forces and inflation
- the sector's transition from the previous Financial Assurance system to one based on ERC—this removed the discount system, introduced a contingency provision and updated unit costings.

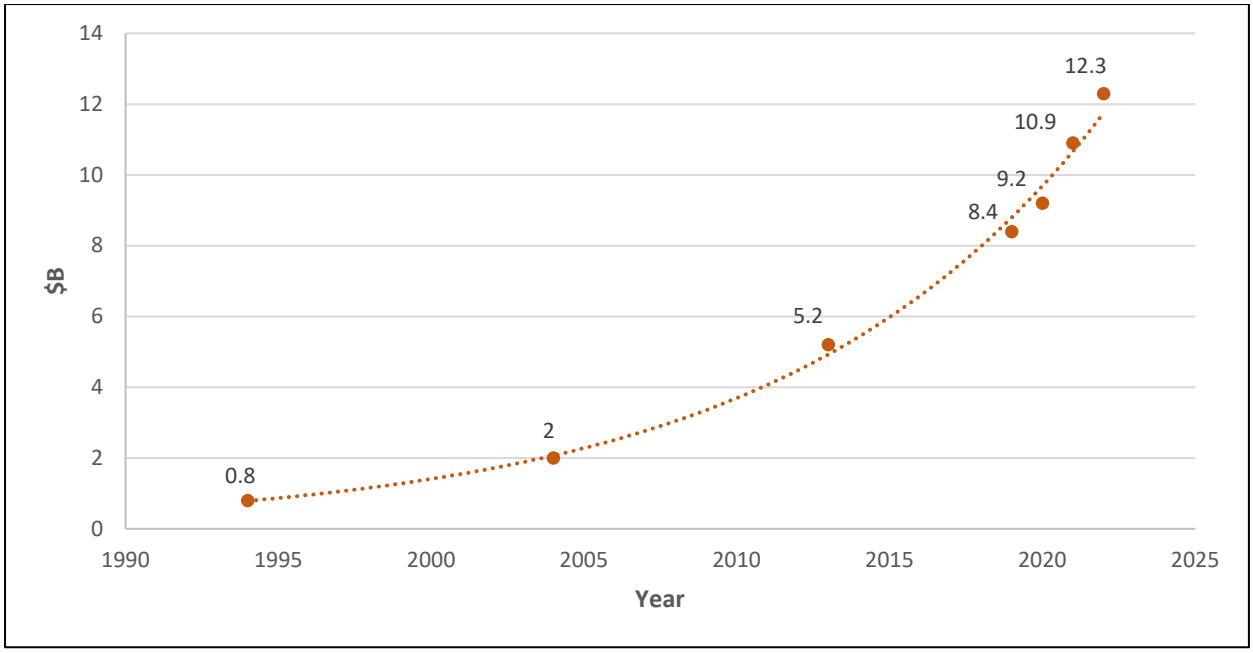

Figure 1. Outstanding rehabilitation liability (estimated) in Queensland 1994–2022

We analysed 207 mines subject to PRC plan requirements. Figure 2 shows the industry's cumulative disturbance and rehabilitation data provided by companies in their annual returns to the end of CY2021.

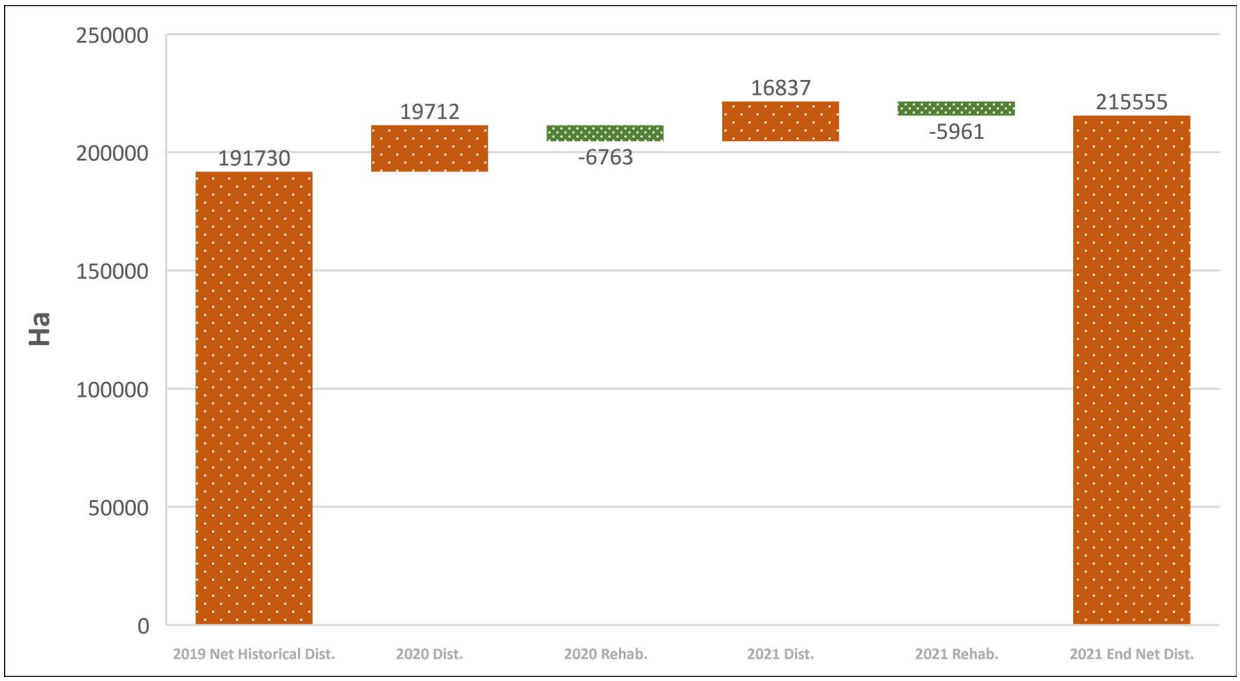

Figure 2. Progressive rehabilitation – for all mines required to prepare a PRC plan

Figure 2 shows that net disturbance (Dist.) remaining after rehabilitation (Rehab.) between 2019 and 2021 has increased by 23,825 hectares (ha) to 215,555ha.

Total rehabilitation (historically to end of 2021) is 78,223ha and total disturbance for the same period is 293,778ha. The percentage of land rehabilitated to that disturbed is 27 percent.

4.2 Metallurgical and thermal coal

We analysed 90 mines extracting metallurgical and thermal coal. Figure 3 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 (WRDs, ramps, TSFs and voids).

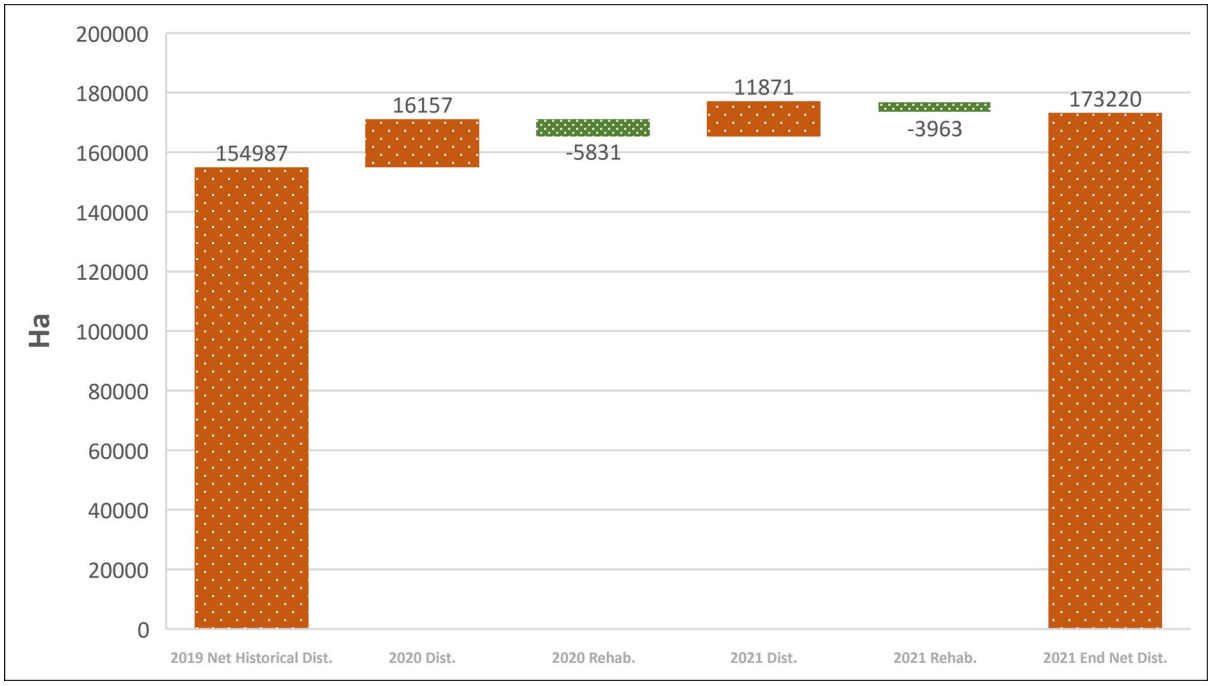

Figure 3. Progressive rehabilitation – metallurgical and thermal coal

Figure 3 shows net disturbance remaining after rehabilitation between 2019 and 2021 has increased by 18,233ha to 173,220ha.

Total rehabilitation (historically to end of 2021) is 49,061ha and total disturbance for the same period is 222,282ha. The percentage of land rehabilitated to that disturbed is 22 percent.

Figure 4 shows the total rehabilitation and total disturbance reported to end CY2021 for each coal mine site subject to a PRC plan. The figure shows the variance in rehabilitation against disturbance in mines across the sector. The dashed line represents the average of rehabilitation to disturbance in the metallurgical and thermal coal sector to end CY2021.

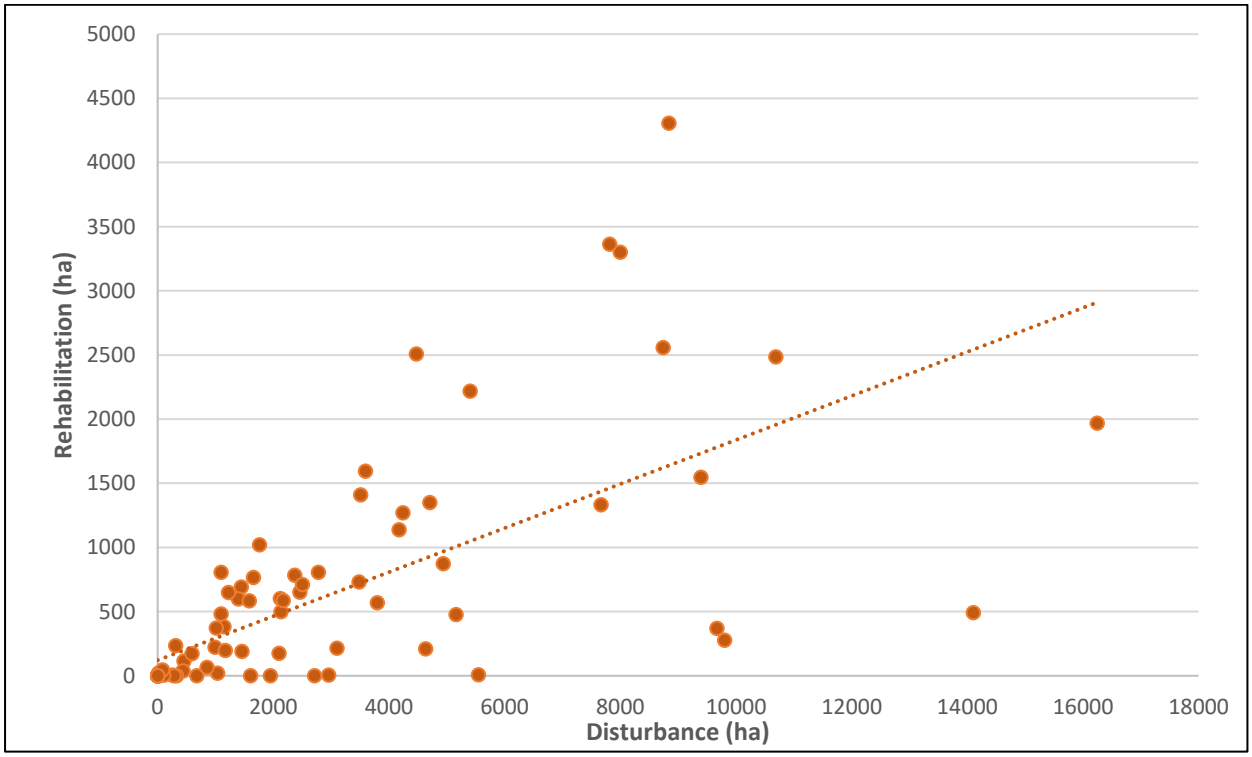

Figure 4. Scatter graph of rehabilitation to disturbance for all metallurgical and thermal coal sites subject to PRC plan requirements

4.3 Large-scale strip mining (other than coal)

We analysed 18 mines extracting bauxite, phosphate, silica and mineral sands. Figure 5 shows the cumulative disturbance and rehabilitation data provided by companies in their annual returns to end CY2021.

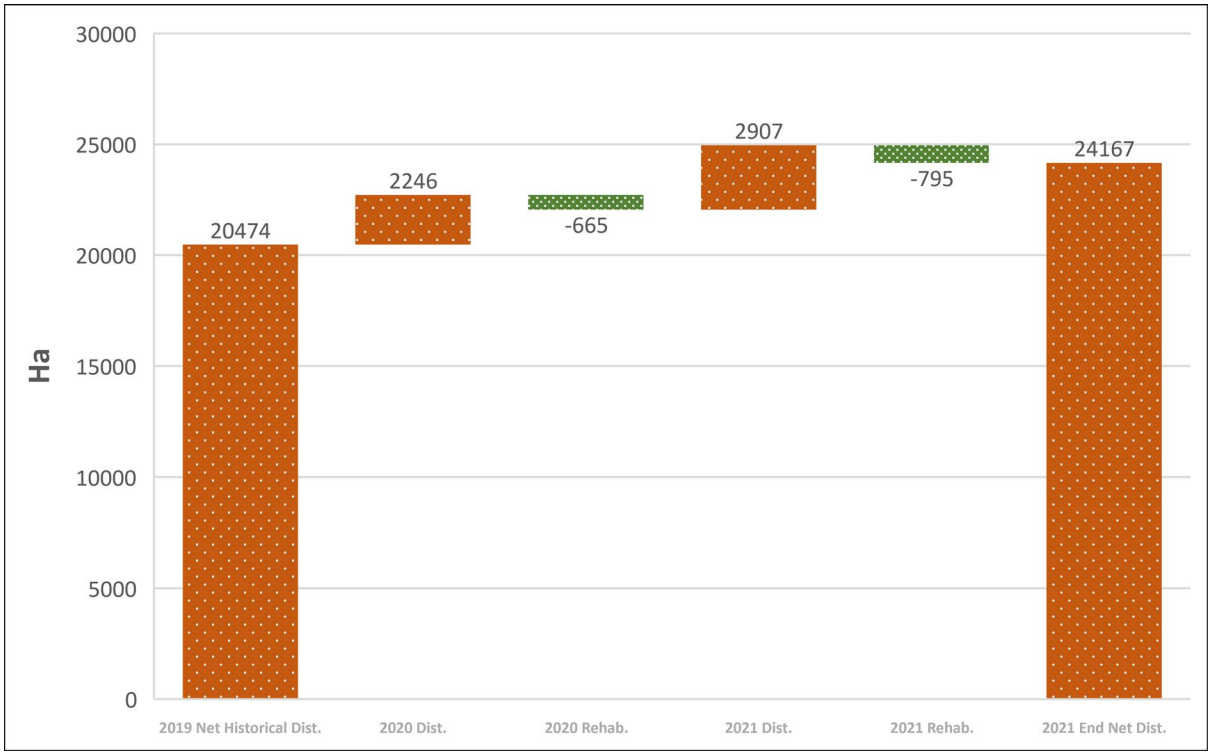

Figure 5. Progressive rehabilitation – bauxite, phosphate, silica and mineral sand

Figure 5 shows net disturbance remaining after rehabilitation between 2019 and 2021 has increased by 3,693ha to 24,167ha.

Total rehabilitation (historically to end of 2021) is 23,512ha and total disturbance for the same period is 47,679ha. The percentage of land rehabilitated to that disturbed is 49 percent.

4.4 Base and precious metals

We analysed 67 mines extracting base and precious metals. Figure 6 shows the cumulative disturbance and rehabilitation data provided by companies in their annual returns to end CY2021.

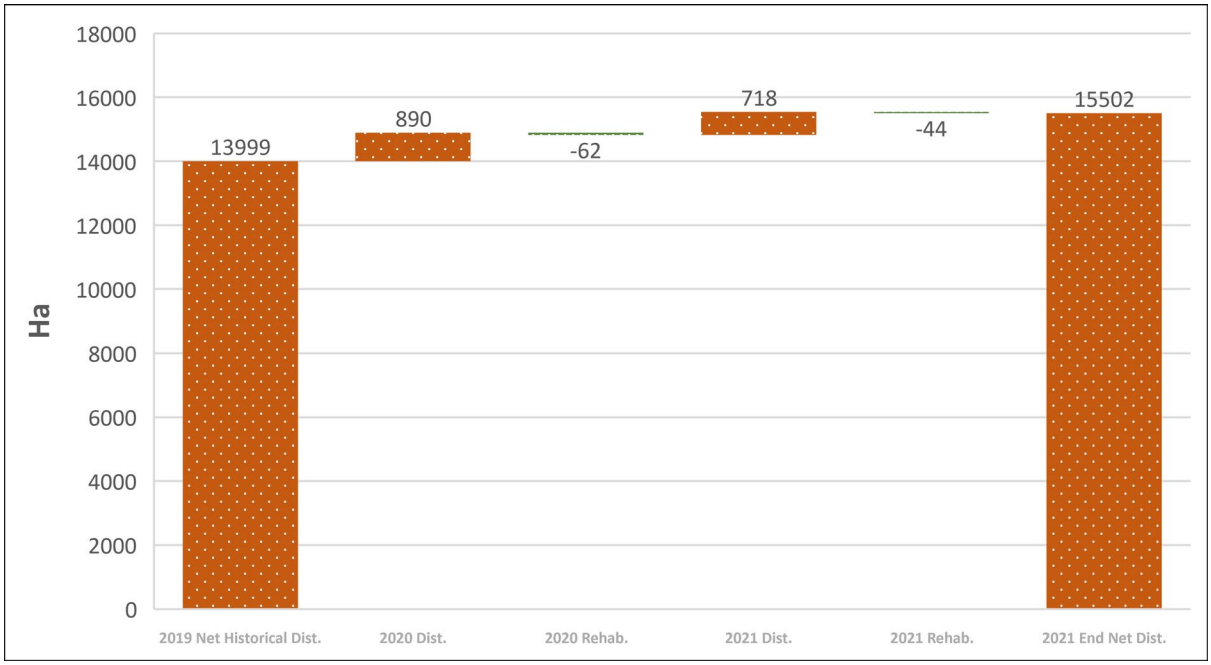

Figure 6. Progressive rehabilitation – base and precious metals

Figure 6 shows net disturbance remaining after rehabilitation between 2019 and 2021 has increased by 1,503ha to 15,502ha.

Total rehabilitation (historically to end of 2021) is 3,103ha and total disturbance for the same period is 18,604ha. The percentage of land rehabilitated to that disturbed is 17 percent.

4.4.1 Metal mines survey

There are inherent challenges for reporting progressive rehabilitation trends for metal mining operations, which typically operate within a fixed disturbance footprint. For example, many mineral mines use the same mine void for a significant portion of the mine's operational life. So, we investigated the potential of alternative measures of rehabilitation performance for this sector.

In December 2021, the Commissioner addressed the Environment Committee of the Queensland Resources Council (QRC) and sought the industry's view on best practice performance measures for progressive rehabilitation in metal mines. No feedback was received from companies but QRC referred us to guidance provided by the International Council on Mining and Metals (ICMM) on indicators that might be useful. These include

material characterisation assessments, rehabilitation plans and compliance against those plans, direct placement of salvaged topsoil, reshaping of waste rock facilities and management of reactive material (ICMM, 2019, 2020).

The QMRC team prepared and distributed a simple survey to mine operators about metal mine rehabilitation activities and preparedness for closure. It ran for six weeks from April to May 2022 and targeted the 66 metal mines across Queensland that were required to prepare a PRC plan at that time. Participants were advised that survey responses would be de-identified and only aggregated responses would be included in this report. The QRC was informed of the survey and encouraged relevant members to complete it.

The survey questions and responses are outlined in Appendix B (Figures B1 to B7). We received a total of 11 responses to the survey, therefore the insights do not necessarily reflect the industry as a whole. However, responses were received from mines with a wide range of operational life remaining. Four sites estimated less than five years of operational life remaining, four sites estimated 5–10 years of operational life remaining and three sites estimated 10–30 years of operational life remaining (see Figure B2).

Of the 11 respondents, eight reported a current rehabilitation plan in place and eight also reported a rehabilitation and closure stakeholder engagement plan (see Figure B3). Seven respondents reported undertaking rehabilitation research trials (see Figure B4). Trials were reported to relate to cover designs, water treatment, vegetation establishment and material re-use. Respondents were asked (see Figure B5) to confirm whether they use any of the six published leading practice waste rock stockpile construction approaches, such as installation of engineered gas management layers, tip head heights less than 15 metres, paddock dumping and compaction, encapsulation of reactive waste, selective placement of oxygen-consuming materials and/or sulphide passivation (INAP, 2020):

- Nine respondents reported using encapsulation of reactive material on their site.
- Five reported disposing of waste via paddock dumping with thin lift construction of waste rock stockpiles.
- Three reported waste rock deposition from tip head heights less than 15 metres.
- One site reported selective emplacement of oxygen-consuming non-acid-forming materials.
- One site reported using sulphide passivation techniques.
- No respondents used engineered gas management layers.

Most sites (eight respondents) were disposing of their tailings as slurry, with two of these also undertaking paste backfill of the tailings into underground workings. One site reported tailings deposition via dry-stack and two sites did not have tailings deposition on site (Figure B6). Generally, respondents felt confident in the level of geochemical characterisation of the

waste materials on site (median response – 9 on a scale of 0 to 10) and felt their site had strong landform designs in place (median response – 7 on a scale of 0 to 10). Stakeholder engagement relating to rehabilitation was generally scored less strongly (see Figure B7).

We will continue to engage with metal mining entities and content experts to refine our approach on the best way to assess rehabilitation trends.

4.5 Other resource activities

A total of 32 of the 207 projects subject to PRC plan requirements fall into the ‘other resource activities’ grouping. These consist of commodities such as bentonite, limestone, sandstone and clays. Mines in this grouping have not been assessed for progressive rehabilitation trends or performance, other than as part of the whole-of-industry analysis depicted in Figure 2.

As outlined above, the primary focus of this inaugural report is the large-scale mining operations that are required to prepare and submit PRC plans. Such operations have been identified as the highest priority sites for more and better rehabilitation. Future reports may introduce other rehabilitation performance and trends across operations with a lower land disturbance footprint, such as petroleum activities.

4.6 Progressive Rehabilitation and Closure Plans

Of the 207 mines required to produce a PRC plan, 204 were existing mines that are transitioning into the PRC plan framework. In these early stages of companies submitting PRC plans, it is more difficult to assess progressive rehabilitation at an industry level (the scheme commenced on 1 November 2019 with three years for DES to issue transition notices). As more PRC plans are submitted and approved over coming years, a better understanding of the industry’s rehabilitation progress and life-of-mine profile will emerge.

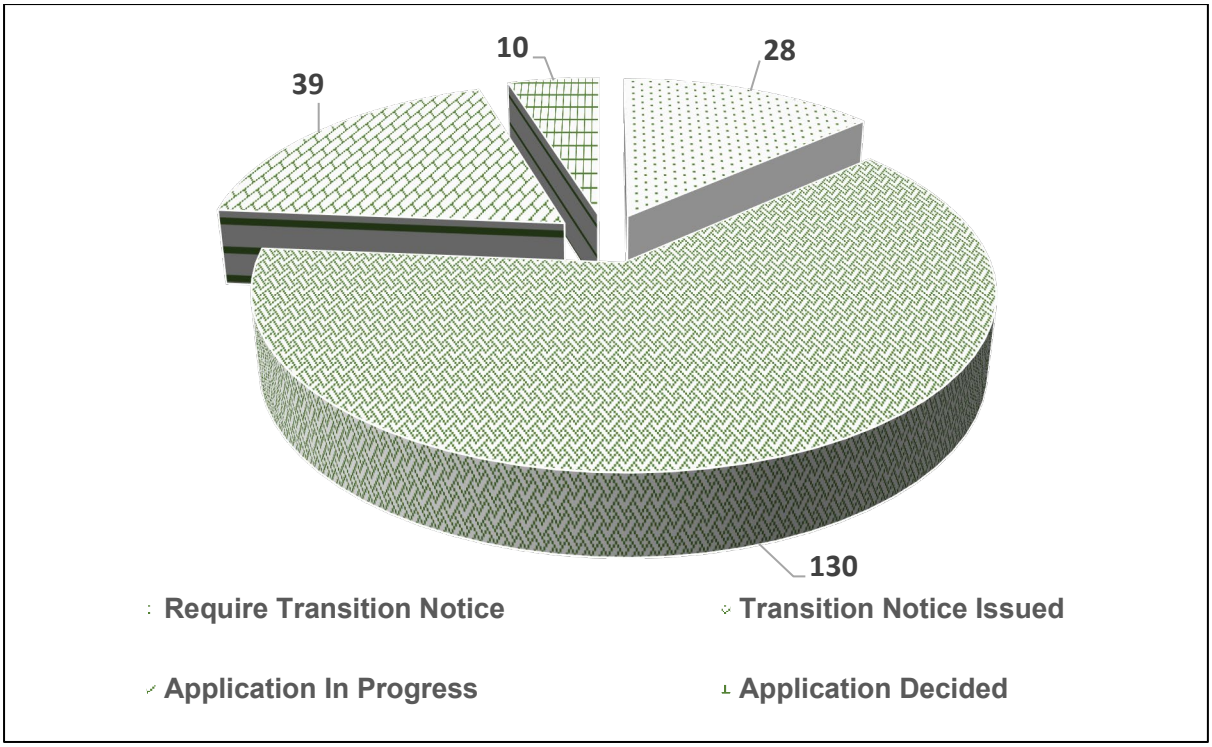

Figure 7. Status of PRC plan delivery as at 31 May 2022

4.7 Public interest evaluations

The Commissioner is required (under s444I of the EP Act) to provide the Minister with advice on public interest evaluation processes and performance. To date, no public interest evaluations have been submitted to the administering authority. Should public interest evaluations be submitted in the future, the Commissioner will assess the process and performance as required.

5. Looking forward

Stakeholders have provided valuable feedback on the analyses of trends presented in this inaugural report. In subsequent reports, we hope to include a more nuanced analysis of thermal and metallurgical coal mine progressive rehabilitation (such as, a breakdown by age of mine, mean, median and range of progressive rehabilitation performance across the sector and progress on the certification of rehabilitated areas).

We will also work closely with the Financial Provisioning Scheme Manager to better understand how asset sales and mines in care and maintenance affect progressive rehabilitation and risk to the State. With another year's worth of data, we will seek to gain a better understanding of rehabilitation and mine life across the sector as more PRC plans are approved.

Queensland is well-positioned to continue to benefit from its mineral and energy endowments. We have many of the natural resources required to support a technologically driven, low carbon future. The responsible use of these resources is supported by a robust, risk-based evaluation of industry participants by the Scheme Manager (Financial Provisioning Scheme), ongoing research by the Commissioner to identify leading practice approaches to rehabilitation, a growing capacity to address the industry's legacy mines and a strong regulatory environment.

The Commissioner and QMRC team will continue to conduct applied research across priority areas to refine our understanding of industry rehabilitation trends and performance and provide advice to the Minister.

Appendix A – Administration

Corporate support

DES provided support for the establishment of the Better Rehabilitation Team in June 2020 which became the QMRC in October 2021. This included the secondment of five staff, as well as financial and human resources support. DES continues to provide corporate support to the QMRC.

Human rights

The Commissioner and the QMRC team carry out their role with appropriate consideration of human rights under the *Human Rights Act 2019*, including recognising the unique interests of First Nations peoples. As per section 6 of the EP Act, we consult with, and have regard to, the views and interests of First Nations peoples under tradition and custom.

Integrity Act 2009

The Commissioner is undertaking a higher degree by research program at the University of Queensland. Professor Neville Plint, former Director of the Sustainable Minerals Institute, University of Queensland is the degree supervisor. The Commissioner is involved with the Cooperative Research Centre for Transitions in Mining Economies through those studies.

Directions from the Minister

Since appointment, the Commissioner has received directions from the Minister under section 444N of the EP Act and subsequently acted. The table below outlines the directions given by the Minister and the actions taken in response.

Directions from the Minister 2021–22

Directions received from the Minister	Actions arising from these directions
Develop a methodology to assess the performance of progressive rehabilitation across the resources industry.	Section 4 of this 2021–22 report includes information on the progressive rehabilitation performance of various sectors within the Queensland resources industry, from 2019 to 2021 inclusive.

Appendix B – QMRC 2022 Metal Mines Survey

QMRC Metal Mines Survey

1) Q: Site Name (Optional)
2) Q: Site contact (Optional)
   A: name, email address
3) Q: Based on your current mine plan, how many more years of operation does your mine have?
   A: 0-5, 6-10, 11-20, 21-30, 31+
4) Q: Are you currently undertaking or planning to undertake further exploration work that could change your life of mine plan?
   A: yes, no
5) Q: How often do you update/refresh your mine plan?
   A: 0-6 months, 6 months – 1 year, 1-2 years, 3-5 years, 5+ years
6) Q: Do you have a life-of-mine rehabilitation plan?
   A: yes, no , if yes please include hyperlink if it is publicly available.
7) Q: Does your site have a rehabilitation and closure stakeholder engagement plan?
   A: yes, no
8) Q: What is your level of engagement with community stakeholders on rehabilitation and closure planning?
   A: 0 (none) – 10 (very extensive)
9) Q: Have you undertaken or are you currently conducting, trials or research to define or improve your approach to rehabilitation?
   A: yes, no, if yes please provide further detail (e.g. addressing topsoil deficits)
10) Do you have final landform designs for mine waste structures on your site?
    A: 0 (none) – 10 (very extensive)
11) Q: What level of geochemical characterisation of material in mine waste structures have you undertaken on your site?
    A: 0 (none) – 10 (very extensive)
12) Q: How are tailings on site currently deposited?
    A: Slurry, Co-disposal, Dry Stack, Filtered, Paste backfill, Other
13) Q: Are any of the following practices relating to waste rock dump construction, employed on-site at present (practices outlined in more detail in INAP (2020)[1])?
    I. Installation of engineered gas management layers within waste rock stockpiles
       A: yes, no
    II. Tip head heights of <15m
       A: yes, no
    III. Paddock dumping of waste rock and base-up, thin lift construction of the stockpile
       A: yes, no
    IV. Encapsulation of potentially acid forming material
       A: yes, no
    V. Selective placement of oxygen-consuming non-acid forming materials
       A: yes, no
    VI. Sulfide passivation techniques
       A: yes, no

[1]INAP 2020, *Rock Placement Strategies to Enhance Operational and Closure Performance of Mine Rock Stockpiles Phase 1 Work Program – Review , Assessment & Summary*, INAP International Network for Acid Prevention.

Figure B1. QMRC 2022 Metal Mines Survey questions

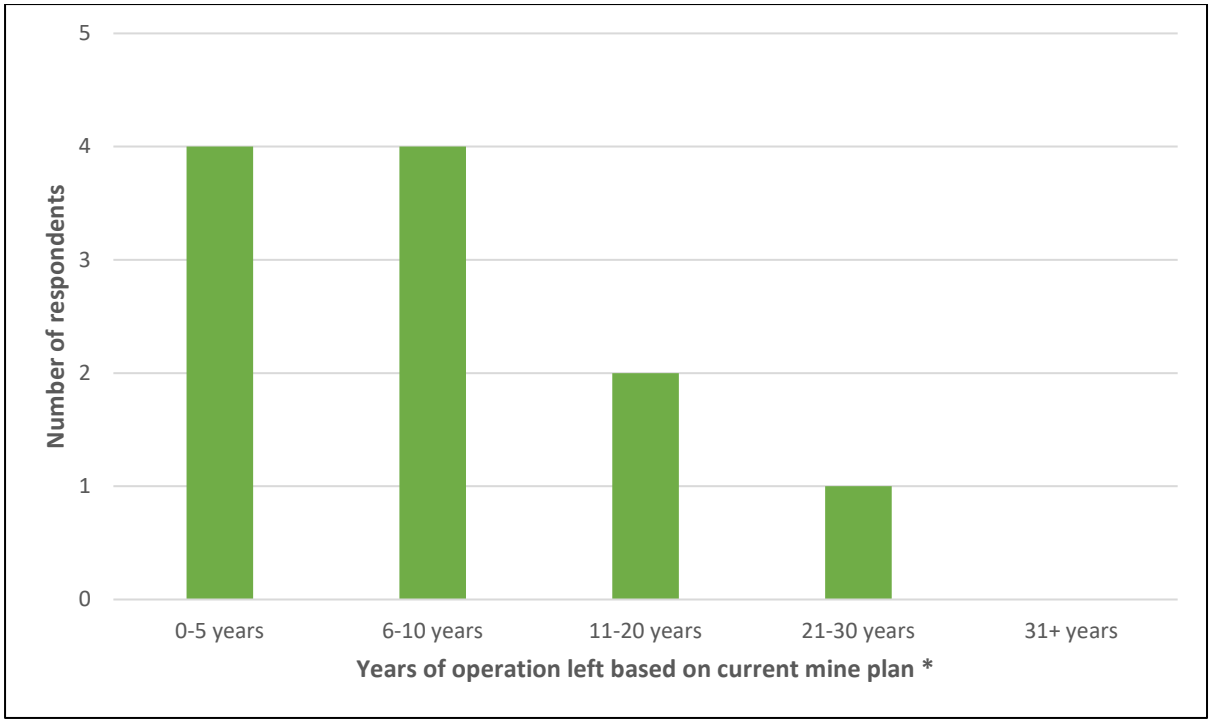

Figure B2. Years of operational life remaining – responses from the QMRC metal mine survey

*9 sites indicated they are undertaking or planning to undertake exploration work that might change these life-of-mine estimates.

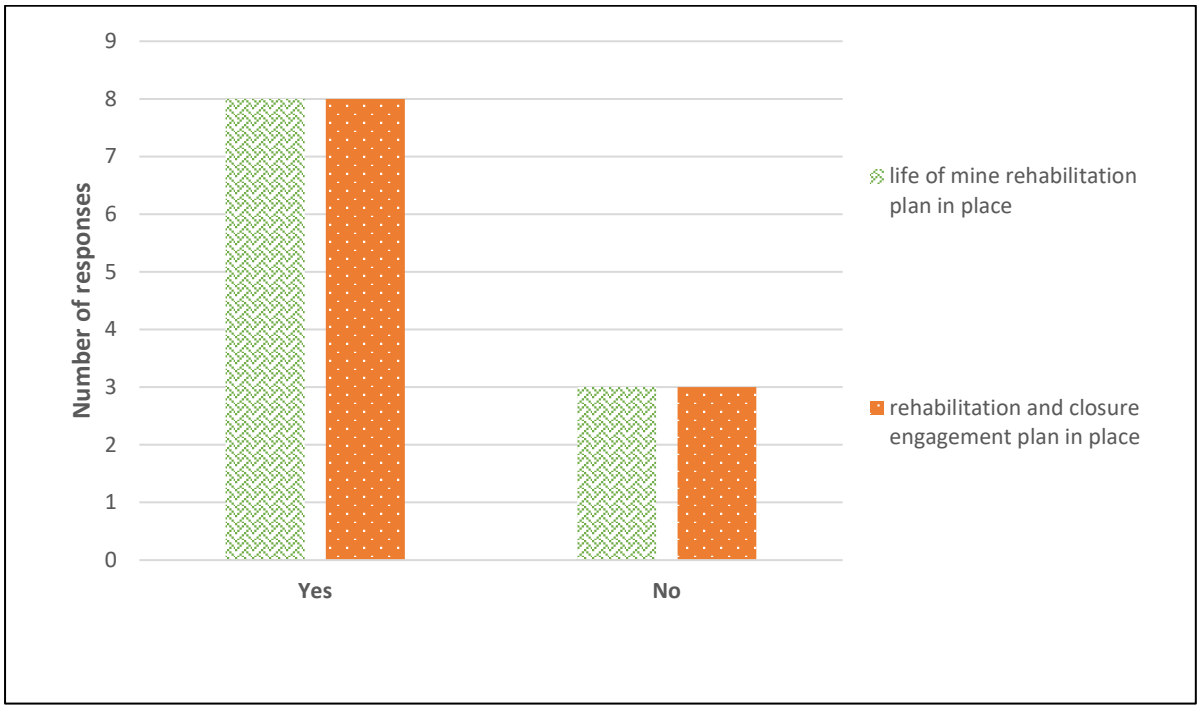

Figure B3. Life-of-mine rehabilitation plan or rehabilitation stakeholder engagement plan in place – responses from the QMRC metal mine survey

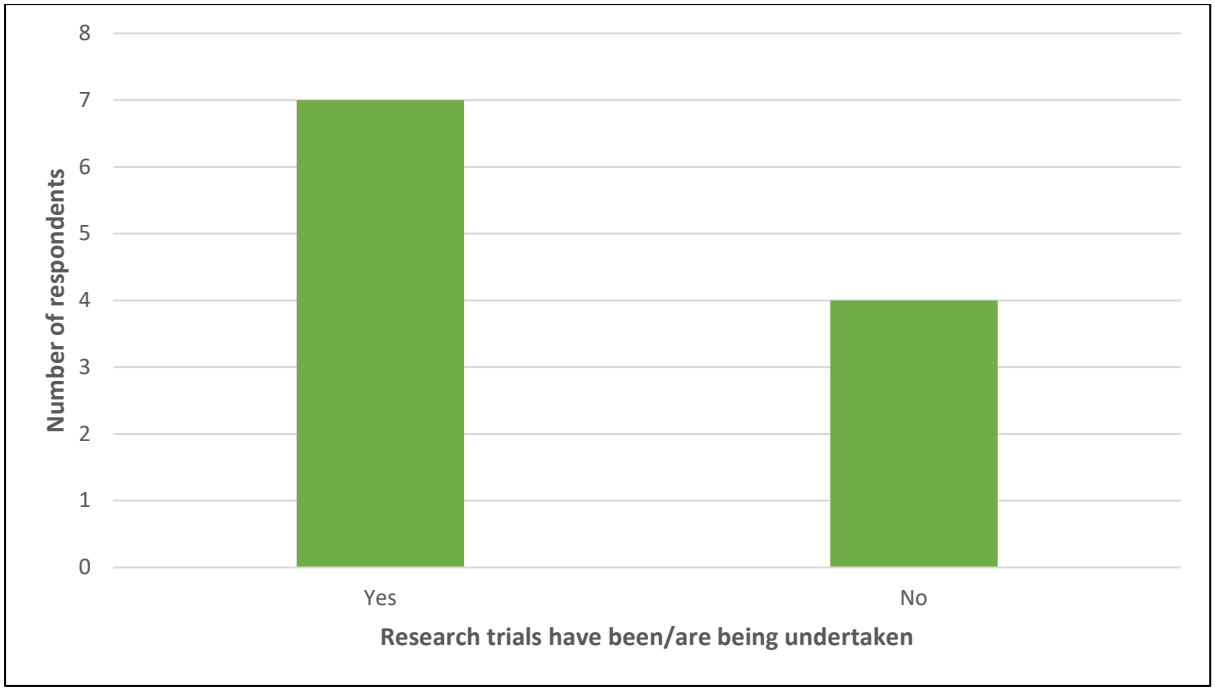

Figure B4. Metal mine rehabilitation research trials undertaken – responses from the QMRC metal mine survey

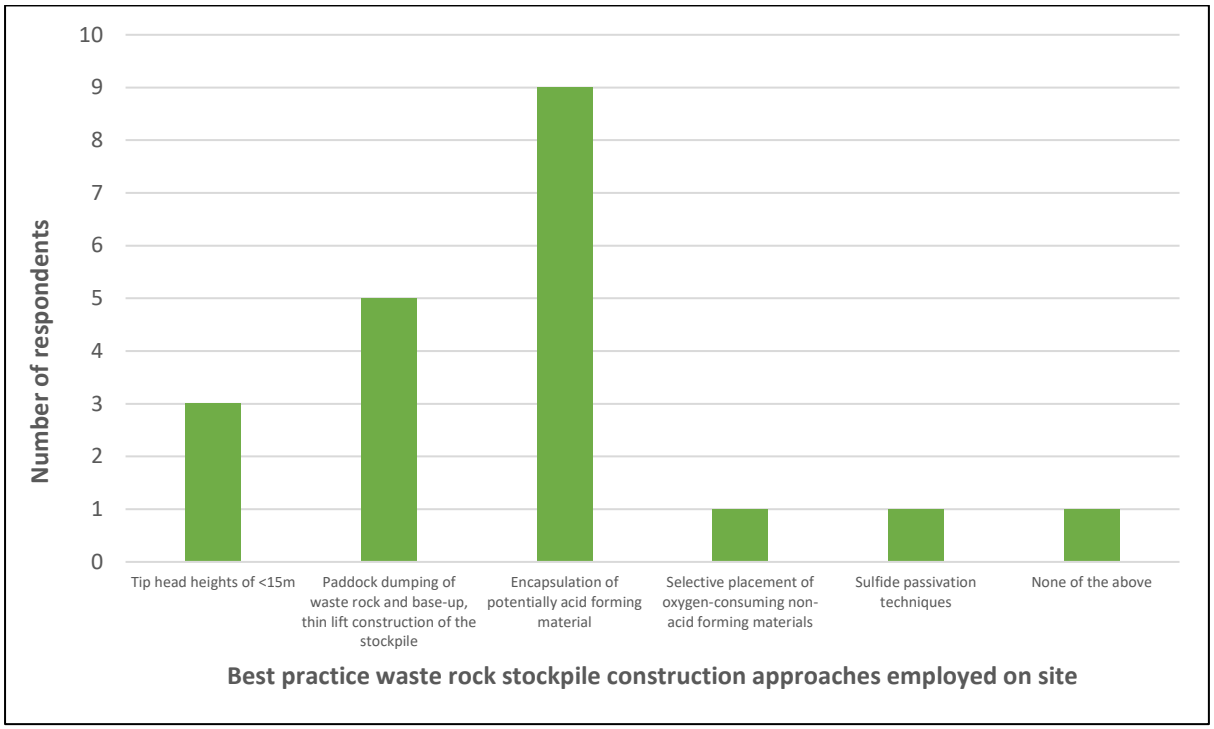

Figure B5. Best practice waste rock stockpile construction approaches – responses from the QMRC metal mine survey

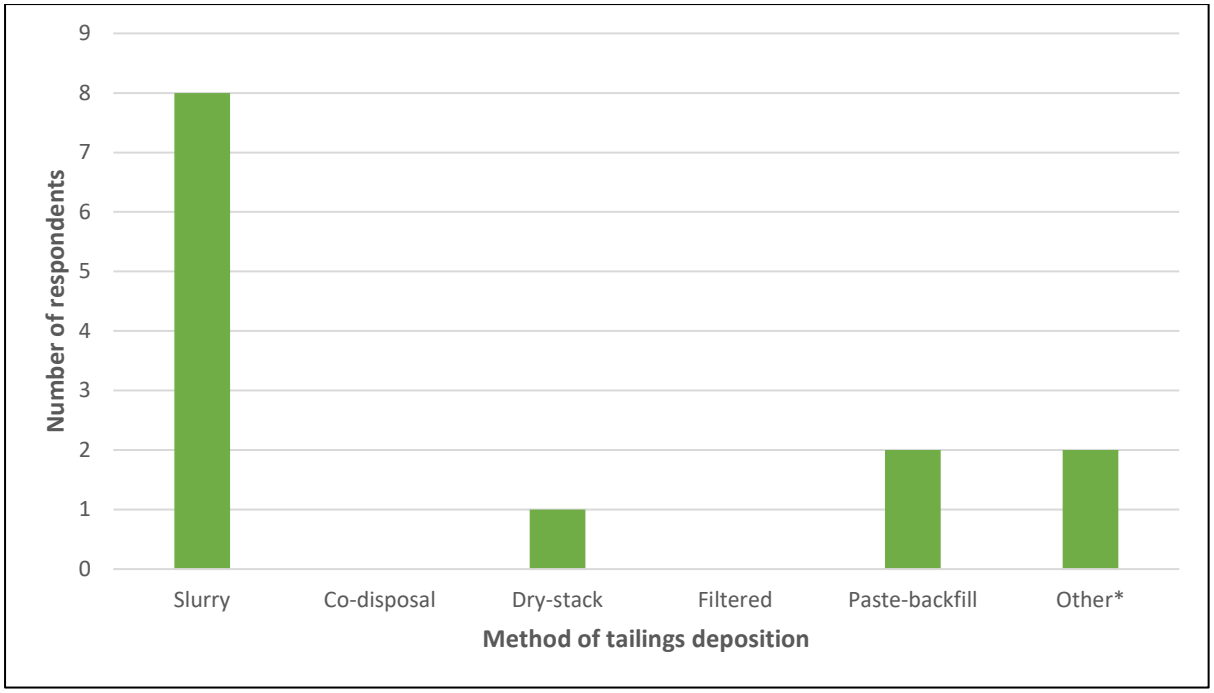

Figure B6. Method of tailings disposal on site – responses from the QMRC metal mine survey

*both respondents indicated no tailings deposition on site.

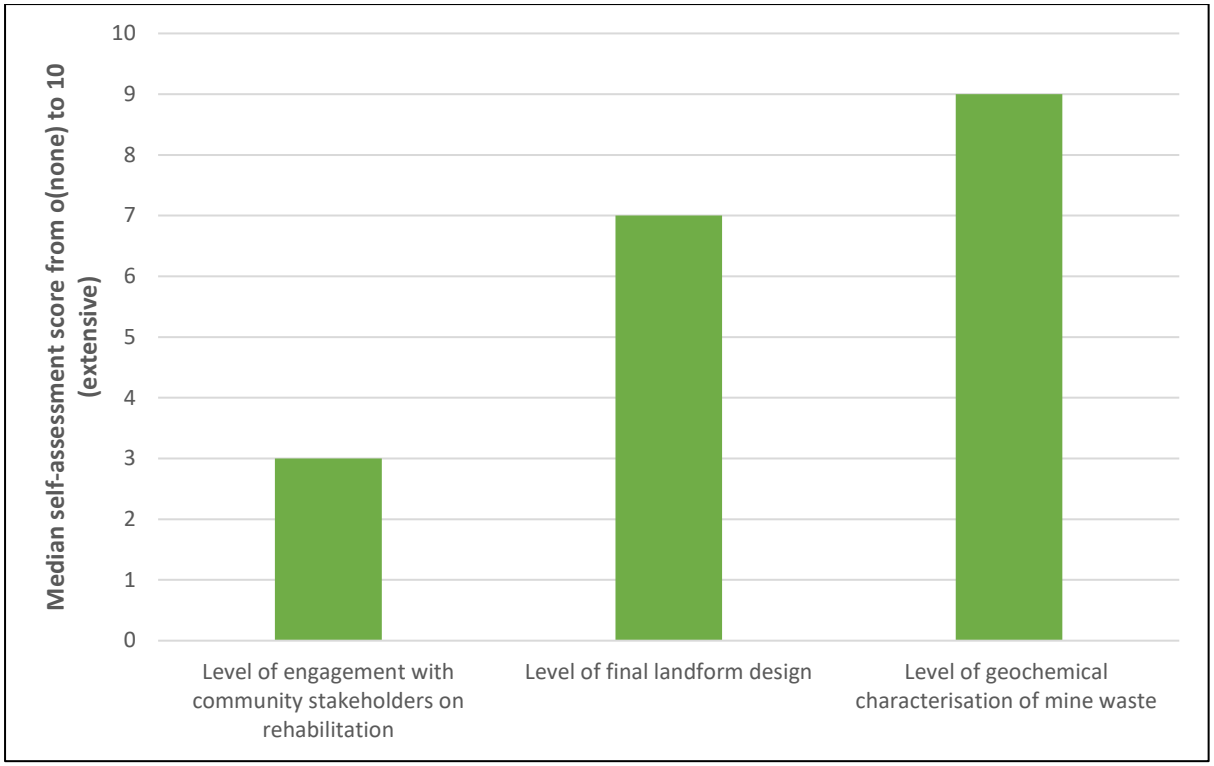

Figure B7. Median self-assessment for level of rehabilitation stakeholder engagement, level of landform design and level of geochemical characterisation on site, on a scale of 0 (none) to 10 (extensive) – responses from the QMRC metal mine survey

Appendix C – Glossary

AGE	Australasian Groundwater and Environmental Consultants Pty
AMD	Acid or metalliferous drainage
Commissioner	Queensland Mine Rehabilitation Commissioner
CY	Calendar year
DES	Department of Environment and Science
Dist.	Disturbance
EHP	Department of Environment and Heritage Protection
EP Act	*The Environmental Protection Act 1994*
ERC	Estimated rehabilitation cost
HLP	Heap leach pad
ICMM	International Council on Mining and Metals
MERFP Act	The *Mineral and Energy Resources (Financial Provisioning) Act 2018*
Minister	Minister for the Environment and the Great Barrier Reef and Minister for Science and Youth Affairs
PMLU	Post-mining land use
PRC plan	Progressive Rehabilitation and Closure Plan
Resources sector	Mining, petroleum and gas activities (excludes quarries)
QMRC	Queensland Mine Rehabilitation Commissioner
QMRC Team	The Commissioner and staff of the Office of the Commissioner
QRC	Queensland Resources Council
Rehab.	Rehabilitation
TSF	Tailings storage facility
WRD	Waste rock dump
WRM	WRM Water and Environment

References

DES (2018) *A Biodiversity Planning Assessment for the Brigalow Belt Bioregion version 2.1 Summary Report*. Brisbane: Department of Environment and Science, Queensland Government.

Doley D and Audet P (2013) 'Adopting novel ecosystems as suitable rehabilitation alternatives for former mine sites', *Ecological Processes*, 2(1):22, doi:10.1186/2192-1709-2-22.

Doley D, Audet P and Mulligan DR (2012) 'Examining the Australian context for post-mined land rehabilitation: Reconciling a paradigm for the development of natural and novel ecosystems among post-disturbance landscapes', *Agriculture, Ecosystems and Environment*, 163:85–93, doi:10.1016/j.agee.2012.04.022.

EHP (2014) *Biodiversity Assessment and Mapping Methodology*. Brisbane: Department of Environment and Heritage Protection, Queensland Government.

ICMM (2019) *Integrated Mine Closure Good Practice Guide*. 2nd edn. International Council on Mining and Metals.

ICMM (2020) *Key Performance Indicators: Tools for closure*. International Council on Mining and Metals.

INAP (2020) *Rock Placement Strategies to Enhance Operational and Closure Performance of Mine Rock Stockpiles Phase 1 Work Program – Review , Assessment & Summary*. INAP (International Network for Acid Prevention).

Queensland Government (2017) *Better Mine Rehabilitation for Queensland: Discussion Paper*. Queensland Government.