2023–24 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

This 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 Innovation) with an annual report about the operations of the Commissioner, within four months of the end of the financial year.

Translating and interpreting assistance

The Queensland Government is committed to providing accessible services to Queenslanders from all cultural and linguistic backgrounds. If you have difficulty understanding this publication, you can phone us on 1800 512 451 and we will arrange an interpreter to effectively communicate the report to you.

Disclaimer

This document has been prepared with all due diligence and care, based on the best available information at the time of publication. The Office of the Queensland Mine Rehabilitation Commissioner holds no responsibility for any errors or omissions within this document. Any decisions made by other parties based on this document are solely the responsibility of those parties.

Queensland Mine Rehabilitation Commissioner 2023–24 Report

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1 Introduction

This is the third report of the Queensland Mine Rehabilitation Commissioner (the Commissioner). The report describes our engagement on mine rehabilitation, summarises our leading practice rehabilitation research and analysis, and presents the performance and trends in progressive mine rehabilitation in Queensland.

1.1. The Commissioner's role

The Commissioner is an independent person, appointed under the *Environmental Protection Act 1994* (EP Act) to provide advice to the responsible Minister on mine 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 practices and trends, raises awareness of rehabilitation management matters, and provides advice and reports 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, Torres Strait Islander peoples, resources industry, environmental and scientific groups, communities and government. See Appendix A for details on the administration of the Commissioner's responsibilities.

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.
- 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.
- Undertake research in collaboration with stakeholders.
- Identify opportunities and challenges to achieving leading practice mine rehabilitation.

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 leading practice mine rehabilitation.
- Publish advice, reports and guidance.
- Report on rehabilitation performance and trends in Queensland.

2 Stakeholder engagement

The Commissioner and QMRC team consulted with a broad range of stakeholders in 2023–24. We held 183 consultation meetings with First Nations organisations, academia, professional associations, peak bodies, conservation stakeholders, resource companies, local governments and government agencies. We also visited 40 mine sites and wish to acknowledge the cooperation of the industry in affording access.

Stakeholders used these opportunities to express a wide range of views regarding progressive rehabilitation, closure planning and post-mining land uses. We will continue to engage with all parties to better understand aspirations and perspectives to inform our advice and publications.

2.1. Workshops and conferences

We presented five papers at conferences this year. Two papers were presented at the Life of Mine Conference 2023 in Brisbane. The first explored barriers to shared tailings disposal for Queensland's Bowen Basin coal mines. The second drew on work completed by a higher degree industry placement student on Queensland open-cut coal mine void rehabilitation planning practices. The papers can be viewed on the QMRC website[1].

Two papers were presented at the Mine Closure 2023 conference in Nevada, USA. The first was presented by the Commissioner on the status of 'successful' mine closure. The second, presented by our Principal Technical Advisor, described how social and environmental factors have influenced regulatory systems to manage and report on rehabilitation in Brazil and Queensland. Both papers were published in the Proceedings of the 16th International Conference on Mine Closure and can be viewed on the QMRC website[1].

Our final paper was presented by the Commissioner at the Australian Energy Producers Conference 2024 in Perth. This paper canvassed two emerging issues for the onshore petroleum industry and its regulators: mitigating risk during well decommissioning and managing the size of the rehabilitation task for surface and near-surface facilities. This paper was published in the Proceedings of the Australian Energy Producers Conference 2024 and can be viewed in the subscription-only Australian Energy Producers Journal[2].

The Commissioner also attended Victoria's Mined Land Rehabilitation Authority's Mine Closure Workshop 2024 in Melbourne. The Commissioner gave a presentation on the mining industry's rehabilitation task and the complex challenges associated with closing mines.

2.2. East Weipa mine closure

In 2024, Rio Tinto closed its East Weipa operations, and its Andoom mine may follow suit within the next decade (the Amrun mine will continue to operate for decades). Many Queensland Government agencies are involved in closure discussions and decisions. A coordinated, whole-of-government approach is an important step in a smooth transition to post-mining futures for the Western Cape.

In November 2023, the QMRC team supported the then Department of State Development, Infrastructure, Local Government and Planning (DSDILGP) and the Department of Treaty, Aboriginal and Torres Strait Islander Partnerships, Communities and the Arts (DTATSIPCA) to convene an East Weipa and Andoom Alignment Workshop.

[1] https://www.qmrc.qld.gov.au/research/other-publications
[2] https://www.publish.csiro.au/EP/EP23049

The workshop brought together ten Queensland Government agencies to support post-mining futures for Weipa and the Western Cape. Early information sharing is key to understanding mine closure issues and complexities for resource communities. The workshop established whole-of-government protocols for communicating information related to the closure of the mines. Government leaders in Far North Queensland will take carriage of these communication pathways to ensure coordinated support to Western Cape communities during the transition.

3 Research on leading practice

The QMRC team continues to conduct research on leading practice, based on three focus areas:

- post-mining land uses
- final landforms
- water management.

This year, our research focused on post-mining land uses and final landforms. The following sections provide a brief overview of our research. Links to our papers and further information on our partners and contract award dates are in Appendix B – Key QMRC research topics.

3.1. Post-mining land uses

A self-sustaining post-mining land use is a key requirement of successful rehabilitation.

Grazing as a post-mining land use

The QMRC team partnered with Highlands Environmental to develop leading practice advice on grazing. We published two technical papers on the suitability of rehabilitated land for grazing and attributes necessary to achieve a grazing post-mining land use.

We also identified several agricultural tools to manage pasture on rehabilitated land and demonstrate that land has achieved a stable condition. We published this work as a third paper. Grazing enterprises on rehabilitated land will require responsible stewardship, particularly to ensure newly constructed anthropogenic landforms remain in a stable condition.

Aquatic ecosystems as a post-mining land use

Water infrastructure, such as clean water storages or pit lakes in mine voids, may remain in place after mining. The development of an aquatic ecosystem has sometimes been proposed as a post-mining land use. The QMRC team prepared a technical paper with assessment criteria for determining if a rehabilitated system meets the benchmark for an aquatic ecosystem post-mining land use. The criteria are based on the concept of ‘ecosystem health’.

There are limited circumstances where mine water infrastructure will provide valuable habitat in dry landscapes after mining. A leading practice benchmark for these systems to be regarded as a viable post-mining land use is to demonstrate they can sustain all elements of a healthy ecosystem including adequate community structure, ecosystem function and resilience to stressors over time. This includes maintaining stable water quality that is the same or better than local unimpacted systems, mirroring local aquatic ecosystems, and excluding exotic pest species. Rehabilitated aquatic ecosystems should aim to be representative of local unimpacted systems, have stable water quality and not host exotic pest species.

Mapping biodiversity corridors and rehabilitation opportunities

We engaged the Centre for Mined Land Rehabilitation (University of Queensland) to assess the potential for mine rehabilitation areas in the Fitzroy Basin to connect high value ecosystems and enhance biodiversity. The work found that biodiversity benefits can result from improved connectivity using rehabilitated mined land. The project applied an innovative

approach and resulted in an academic paper published in the Journal of Environmental Management. It can be viewed on the QMRC website[3].

3.2. Final landforms

A critical feature of successful rehabilitation is the establishment of a stable landform. This includes aspects of geotechnical or erosional stability, which are influenced by landform design, mine waste management and provision of a growth medium suitable for vegetation establishment.

Modelling to predict long-term stability

A variety of modelling tools are available to predict long-term stability of land and inform the design of post-mining landforms. Modelling studies consider key aspects of stability, such as slope length and gradient, material characteristics and climatic events. We engaged Aquaterra International Pty Ltd to develop leading practice advice on landform assessment using erosion and landscape evolution models. This project is ongoing.

Mine waste cover system research trials

Metals mines and some coal mines may host sulphidic material that carries the risk of acid and metalliferous drainage (AMD). Management of such material requires an integrated approach, including adequate characterisation of materials, and material handling practices that inform final landform design and construction. To abate seepage of AMD into the environment, one mitigation strategy is the application of a cover system across the surface of final landforms. Designing an appropriate cover system requires a range of technical studies and trials. We engaged EGi and Affinitas ODI to provide leading practice advice on designing, implementing and reporting field-scale cover system trials. Further information about the project is in Section 4.5 of this report.

Addressing topsoil deficits

Rehabilitation at many mines is made difficult by a lack of topsoil. Successful rehabilitation of vegetated landscapes requires topsoil, or an alternative growth media, of sufficient quantity and quality. We hosted a post-graduate student from the University of Queensland to undertake a review of ways to address topsoil deficits in open-cut coal mines in the Bowen Basin. The review identified approaches to topsoil deficit and described the attributes of growth media needed to support successful rehabilitation. Where an alternate growth medium is used, the review highlighted the importance of site-specific assessments of the growth medium's physicochemical properties to identify constraints. These assessments are needed to ensure the alternate growth medium can support vegetation growth.

[3] https://www.qmrc.qld.gov.au/research/other-publications

4 Rehabilitation performance and trends

This section describes rehabilitation performance and trends for all mines subject to a progressive rehabilitation and closure (PRC) plan in Queensland. Appendix C explains the prioritisation and grouping of different sectors of the mining industry for the purpose of performance reporting in this document.

We used calendar year (CY) annual return data (provided by companies to the Department of Environment, Science and Innovation by 31 March each year) to analyse progressive rehabilitation and area of disturbance. Our analysis included land reported by companies in the annual return as ‘area disturbed’, ‘rehabilitation certified’ or ‘rehabilitation completed’. We excluded land reported as ‘rehabilitation commenced’ as the interpretation of this term differs widely across the industry. Our analysis relied on the accuracy of the data provided by companies in their annual returns.

Challenges to measuring rehabilitation performance

As we have stated in previous reports, 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. Technology, commodity prices and other factors heavily influence the commercial viability of extracting resources, which can change rapidly. Today’s waste may become tomorrow’s resource.

Shallow strip mining and open cut highwall methods remain best suited to progressive rehabilitation—land becomes available for rehabilitation as the working face of the mine moves across the landscape. By contrast, deep open cut and underground mines are less suited to progressive rehabilitation and present a different set of challenges for assessing performance and trends. Usually, waste rock dumps (WRD), tailings storage facilities (TSF), heap leach pads (HLP) and the active mine itself are unsuitable for rehabilitation during the mine’s life (although old mine features or distinct unused areas may be suitable for progressive rehabilitation).

Industry feedback highlighted the potential shortcomings of ‘rehabilitation against disturbance’ as a performance measure, given the challenges raised by the term ‘…as land becomes available…’ in section 126D of the EP Act. For example, an exhausted pit may need to remain open for years due to the sequencing of operations. However, the void may be used later 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. New technologies, regulatory requirements and commercial and economic drivers influence rehabilitation decisions. Much fixed infrastructure is also required until the end of the mine’s operational life.

Our approach

For this report, we allocated the 207 Queensland mines subject to PRC plan requirements (as at 30 June 2024) into sectoral groupings:

- metallurgical and thermal coal
- large-scale strip mining other than coal (for example, bauxite, phosphate, silica and mineral sand)
- base and precious metals

- smaller strip operations (for example, monument stone and clays).

These groupings are the same as in previous QMRC reports. See Appendix C – Sectoral mine groupings in this report for details and section 4.7 for the status of PRC plans as at 30 June 2024.

The primary focus of this report remains large scale mining operations that are required to prepare PRC plans. Such operations have been identified as the highest priority for reporting on trends and performance in progressive rehabilitation. Other mining activities have a smaller land disturbance footprint and present a much lower potential environmental impact. As such, smaller strip operations, small mining claims, seismic lines and other exploration activities are not a priority for evaluation in this report. However, the Minister has requested that the Commissioner investigate issues pertaining to estimated rehabilitation costs and administrative procedures for small resource operators. More detail on this request is included in Appendix A – Administration.

While we continue to include large scale metals mines in this report, our analysis of progressive rehabilitation was limited in comparison with large scale strip mines. This is due to the nature of metal mining operations and limited ability to undertake progressive rehabilitation. The 29 sites described as ‘other resource activities’ subject to PRC plan requirements are included in the total rehabilitation analysis (Figure 2) but not presented as a separate grouping.

The sub-sections below present the areas of land ‘disturbed’ and ‘rehabilitated’ for each sectoral grouping. Our analysis is presented in a series of ‘waterfall’ graphs. Historical disturbance up to the end of CY2019 was used as the starting point, calculated as the total disturbance companies reported up to the end of CY2019. Annual data for disturbance and rehabilitation is then presented for CY2020, CY2021, CY2022 and CY2023 as well as net level of disturbance.

We also present the proportion of land reported as rehabilitated against that reported as disturbed as a percentage. This provides a measure of rehabilitation performance for each sectoral grouping and is referred to as the ‘rate of progressive rehabilitation’. It includes historical and recent disturbance and rehabilitation.

We continued to identify a small number of discrepancies in annual reporting and referred anomalies to the regulator for checking with the reporting entities. The number of mines subject to PRC plan requirements also changed year-on-year, as new mines commenced and other mines fell out of the PRC plan framework.

4.1. Rehabilitation liability

We analysed the 207 mines across the sector subject to PRC plan requirements. The most recent data shows continued growth across the mining sector in outstanding rehabilitation liability.

Figure 1 shows the trend of increasing estimated rehabilitation cost (ERC) over the last 30 years for all resource activities. The trend figures are indicative only, as the consistency and rigour of the data points have varied over time. Despite this, the figure provides an indication of the trend in rehabilitation liability over the period.

Several factors explain the change in ERC:

- Area of disturbance—the area of land disturbed by mining yet to be rehabilitated has increased year-on-year (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 rehabilitated land—certified rehabilitation of mined land removes areas from the ERC calculation.
- Schedules of rates—the cost of rehabilitation is subject to market forces and inflation.
- Change in liability calculators—the sector's transition from the previous financial assurance system to one based on ERC in 2019 removed the discount system, introduced a contingency provision and updated unit costings.

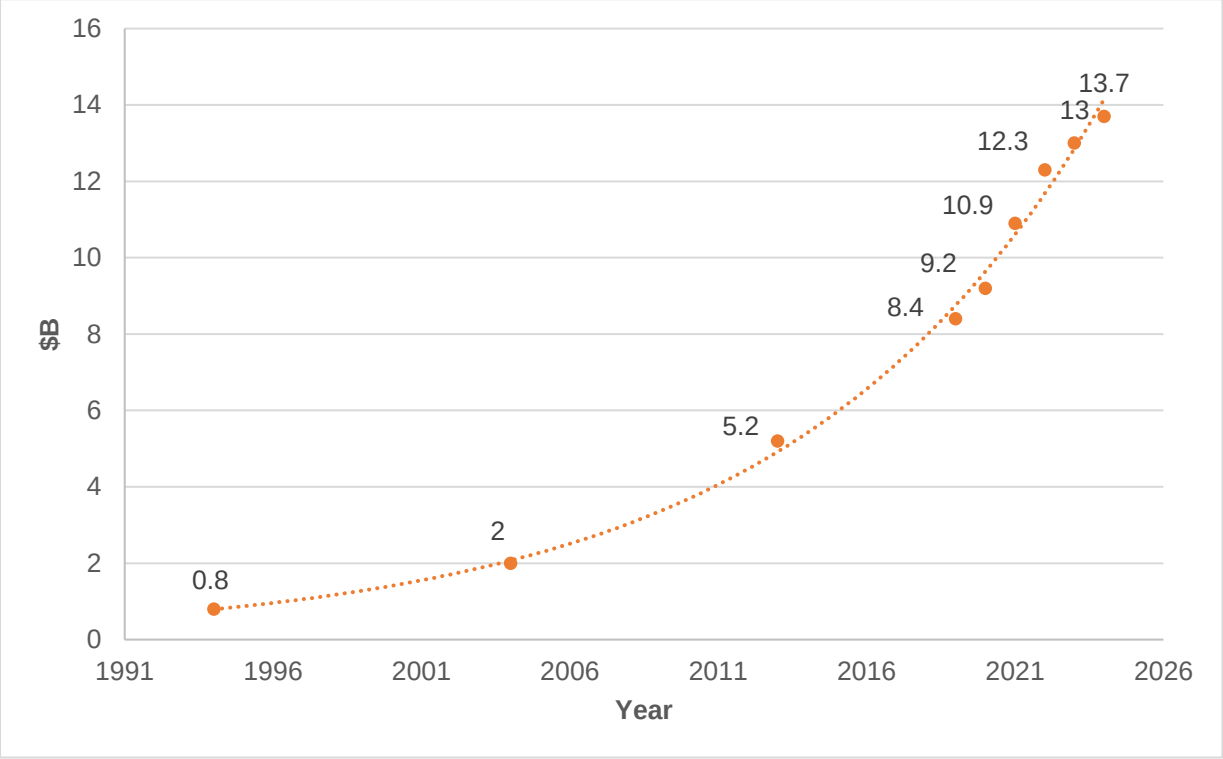

Figure 1. Industry-wide ERC liability (estimated) in Queensland 1994–2024

4.2. Mining industry-wide

Figure 2 shows the cumulative areas of disturbance and rehabilitation for the 207 mines subject to PRC plan requirements to the end of CY2023, from data provided by companies in their annual returns.

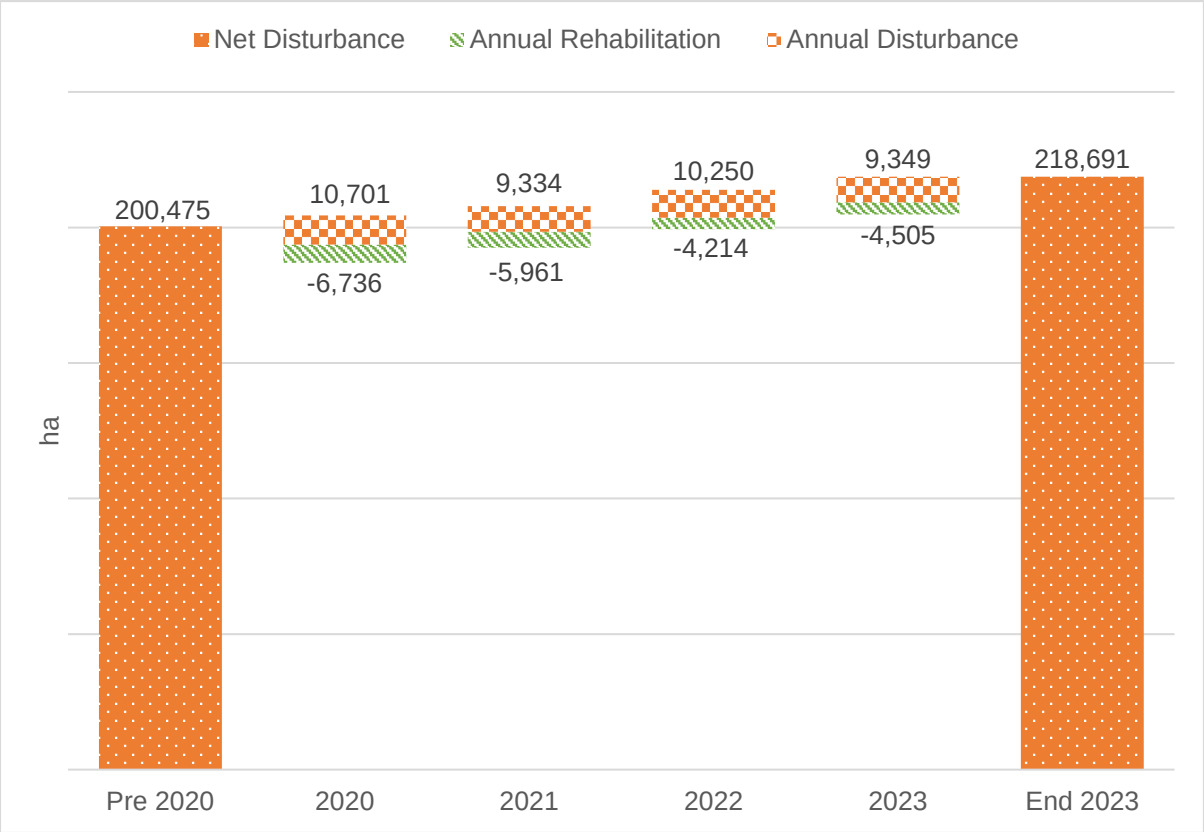

Figure 2. Progressive rehabilitation for all mines required to prepare a PRC plan

Figure 2 shows that the total net disturbance remaining after rehabilitation was 218,691 hectares at the end of CY2023. This is an increase of 18,216 hectares (9 percent) since 2019. The rate of progressive rehabilitation (historical to end CY2023) is 28 percent.

Figure 3 shows the industry's total rehabilitation by land that is 'rehabilitation certified' and land reported by miners as 'rehabilitation completed' (not certified).

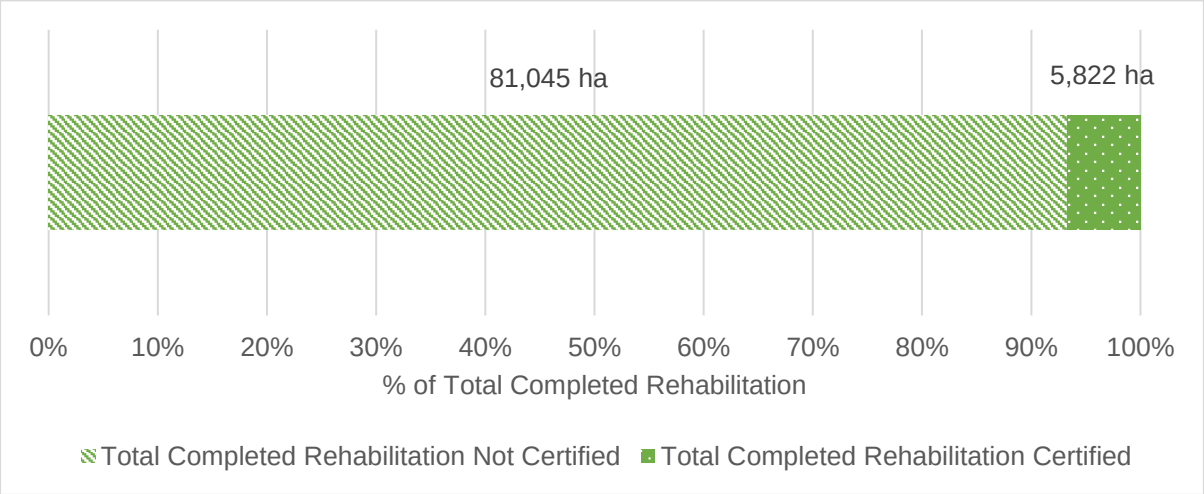

Figure 3. Completed rehabilitation for all mines required to prepare a PRC plan to end CY2023

Figure 3 shows that of the 86,867 hectares of total rehabilitation (historical to the end of CY2023), 5,822 hectares is certified (7 percent) and 81,045 hectares is reported by miners as completed but not certified. Certified rehabilitated land represents less than 2 percent of all land disturbed. Of the total area of certified rehabilitation, 44 percent relates to underground mining operations and 56 percent relates to above ground mining operations. In CY2023, 909 hectares of additional rehabilitation was certified, 95 percent of which related to underground mining operations.

4.3. Metallurgical and thermal coal

We analysed 90 mines and related infrastructure that extract metallurgical and thermal coal and are subject to PRC plan requirements. Figure 4 shows the cumulative areas of disturbance and rehabilitation to the end of CY2023, from data provided by companies in their annual returns. Open cut and underground operations are included together, as some mines have a combination of methods operating simultaneously.

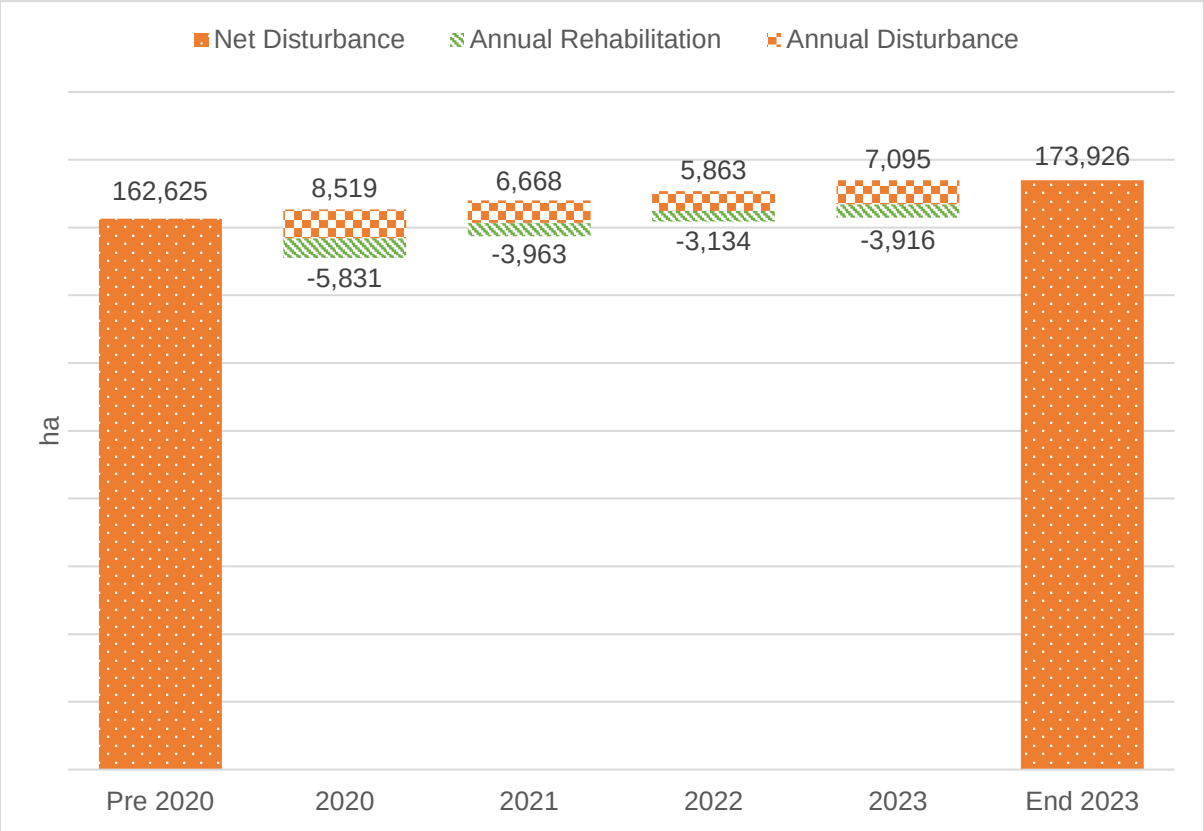

Figure 4. Progressive rehabilitation for metallurgical and thermal coal mines to end CY2023

Figure 4 shows that net disturbance remaining after rehabilitation has increased by 11,301 hectares to 173,926 hectares between CY2019 and CY2023. The rate of progressive rehabilitation (historical to end CY2023) is 24 percent. The rate of progressive rehabilitation for metallurgical and thermal coal mines has increased year-on-year, shown in Figure 5 below.

Figure 5 shows the rate of progressive rehabilitation over the past three reporting years (historical to the end of that CY) as well as the ‘spread’ of progressive rehabilitation performance across companies.

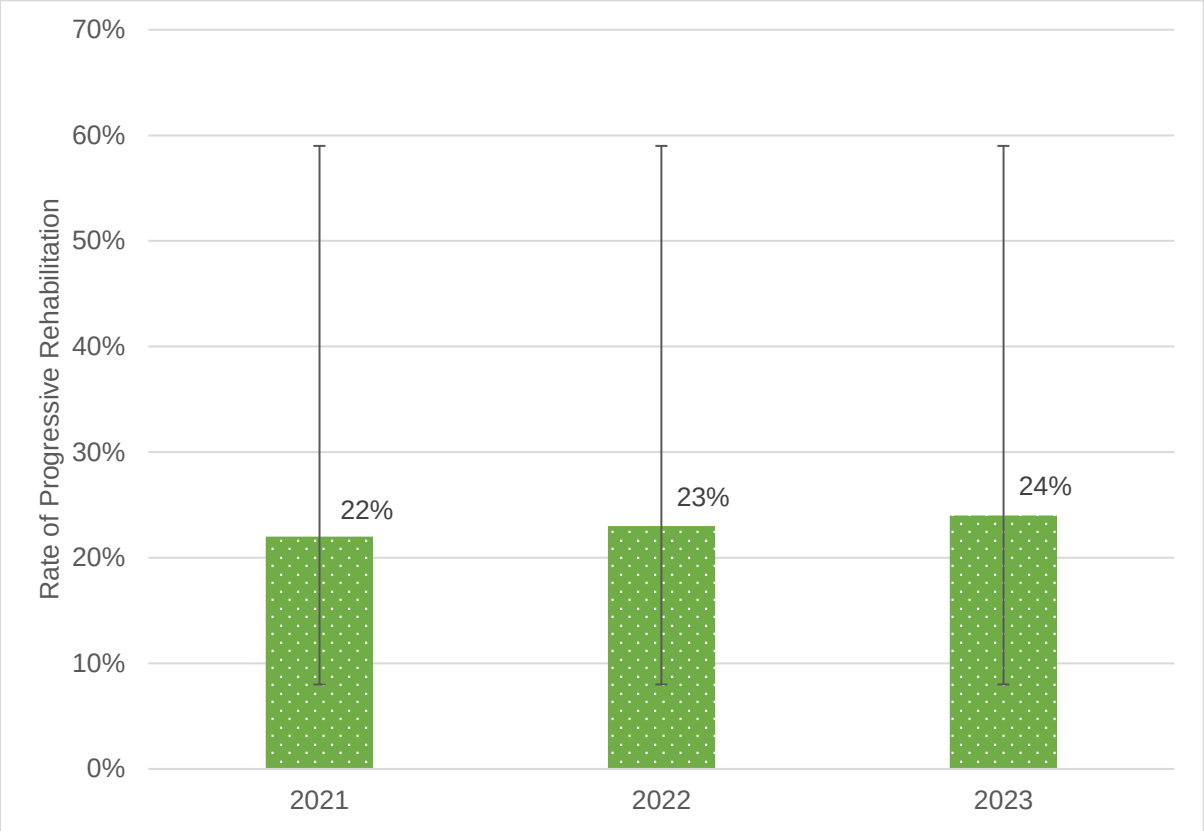

Figure 5. Changes to the rate of progressive rehabilitation for metallurgical and thermal coal mines

Figure 5 shows that the rate of progressive rehabilitation for metallurgical and thermal coal mines has increased from 22 percent to 24 percent over the three years CY2021 to CY2023. Figure 5 also indicates the highest and lowest rates of progressive rehabilitation for multi-asset coal companies in Queensland: the highest rate was 59 percent while the lowest was 8 percent. These upper and lower limits have not changed since CY2021 and reflect a large diversity in the progressive rehabilitation performance of individual companies in the sector.

Of the 90 facilities extracting metallurgical and thermal coal that we analysed, 59 mines primarily extract metallurgical coal and 31 mines primarily extract thermal coal. Mines that extract both types of coal were grouped according to the predominant coal type extracted.

For metallurgical coal mines, the net disturbance remaining after rehabilitation at the end of CY2023 was 145,447 hectares. The rate of progressive rehabilitation was 21 percent (compared with 20 percent at the end of CY2022).

For thermal coal mines, the net disturbance remaining after rehabilitation at the end of CY2023 was 28,479 hectares. The rate of progressive rehabilitation was 37 percent (compared with 36 percent at the end of CY2022).

Comparison with Wyoming

In October 2023, the Commissioner and Principal Technical Advisor visited several coal mines in the Powder River Basin, Wyoming to observe and consider key similarities and differences with the industry in Queensland. In the United States, mine rehabilitation is governed at the Federal level under the *Surface Mining Control and Reclamation Act 1977* (SMCRA). In Wyoming, SMCRA is administered by the state Department of Environmental Quality.

Queensland and the United States both require rehabilitation to be undertaken progressively. In the United States, 'contemporaneous reclamation' is required to occur for area (i.e. open cut) mining. This is similar to Queensland's requirement in the EP Act that land 'available for rehabilitation' must be rehabilitated.

Although not identical, coal mining in Wyoming and Queensland has certain similarities: both industries are large-scale (approximately 200 Mtpa), multi-decadal, predominantly open cut operations, which face similar rehabilitation challenges. This allows for some comparison between the two jurisdictions. However, there are also substantial differences. For example, Wyoming has very thick, shallow seams with low strip ratios. The coal does not require washing and coal seams have less groundwater inflows.

The long-standing requirements in the United States to return mining areas to their 'approximate original contour' means that coal mine voids are routinely backfilled in Wyoming (apart from some technical exceptions and where pre-existing wetlands or waterbodies are re-established). This contrasts with Queensland where many residual voids from open cut coal mines will remain, with pit lakes likely to form.

While some voids have historic approvals to remain after mining, amendments to the EP Act (s126D(3)) now require mines proposing excavations in floodplains to rehabilitate those voids to a stable condition by, for example, backfilling voids to grade. Outside a floodplain, any mines that propose leaving a residual void post-mining with no post-mining land use must substantiate this via a public interest evaluation or meet the other requirements in section 126D(2).

Rehabilitation figures reported by the Wyoming government for financial year 2023 state the rate of progressive rehabilitation for coal mines in Wyoming was 53 percent of land disturbed. Historically, Wyoming has approved the termination of jurisdiction on approximately 51,000 hectares of mined land, which is similar to the concept of 'surrender' in Queensland. If the surrendered areas are included in progressive rehabilitation rates, the rate in Wyoming is higher than the 53 percent reported.

Figure 6 shows the year-on-year changes to the rate of progressive rehabilitation for metallurgical and thermal coal mines in Queensland and Wyoming.

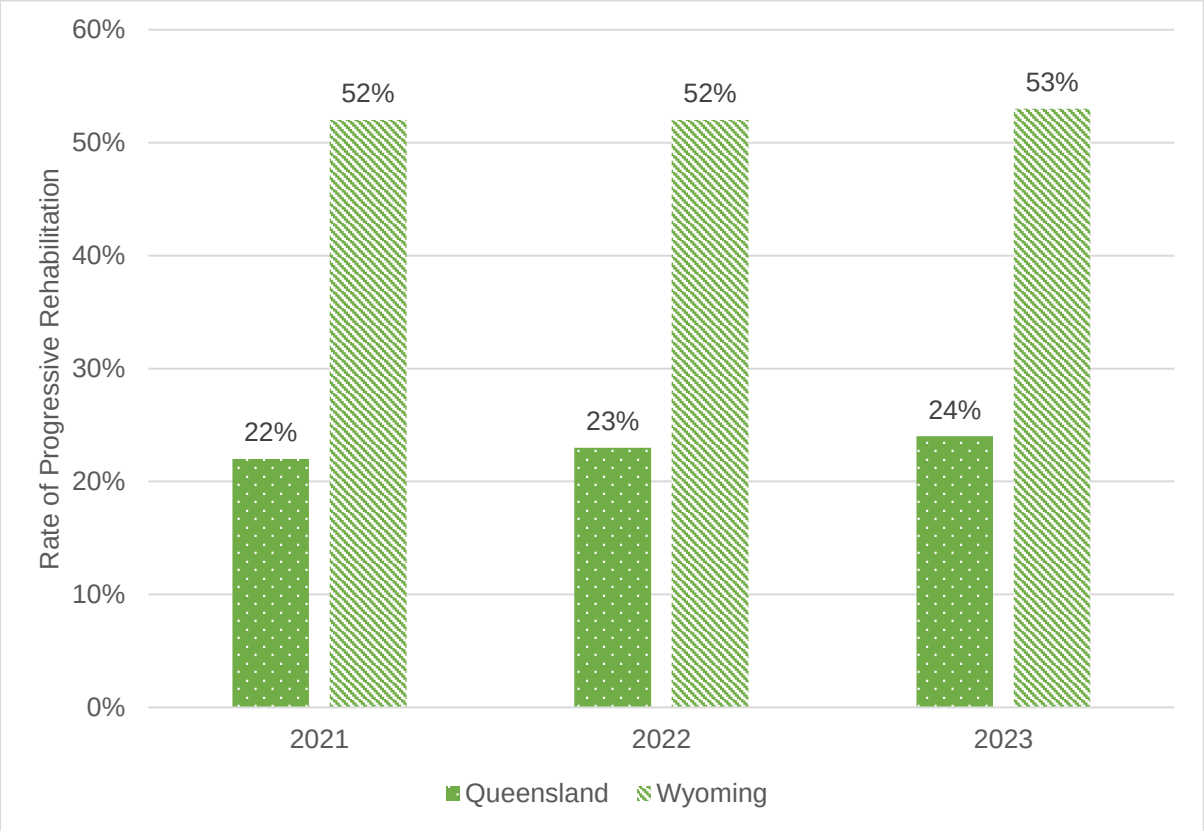

Figure 6. Rates of progressive rehabilitation for coal mines in Queensland and Wyoming[4]

Several Queensland mining companies already undertake progressive rehabilitation at rates comparable to Wyoming. However, as can be seen in Figure 5, there are companies with progressive rehabilitation rates as low as 8 percent. As more PRC plans are approved, the rates of progressive rehabilitation will be 'locked in' to scheduled commitments and overall progressive rehabilitation rates for Queensland metallurgical and thermal coal mines should increase steadily over time.

[4] Wyoming data taken from *Annual evaluation report for the regulatory program administered by the Department of Environmental Quality – Land Quality Division of Wyoming for evaluation year 2023* (p.13), by OSMRE, 2023

4.4. Large-scale strip mining (other than coal)

We analysed 19 mines extracting bauxite, phosphate, silica and mineral sands. Figure 7 shows the cumulative areas of disturbance and rehabilitation to the end of CY2023, from data provided by companies in their annual returns.

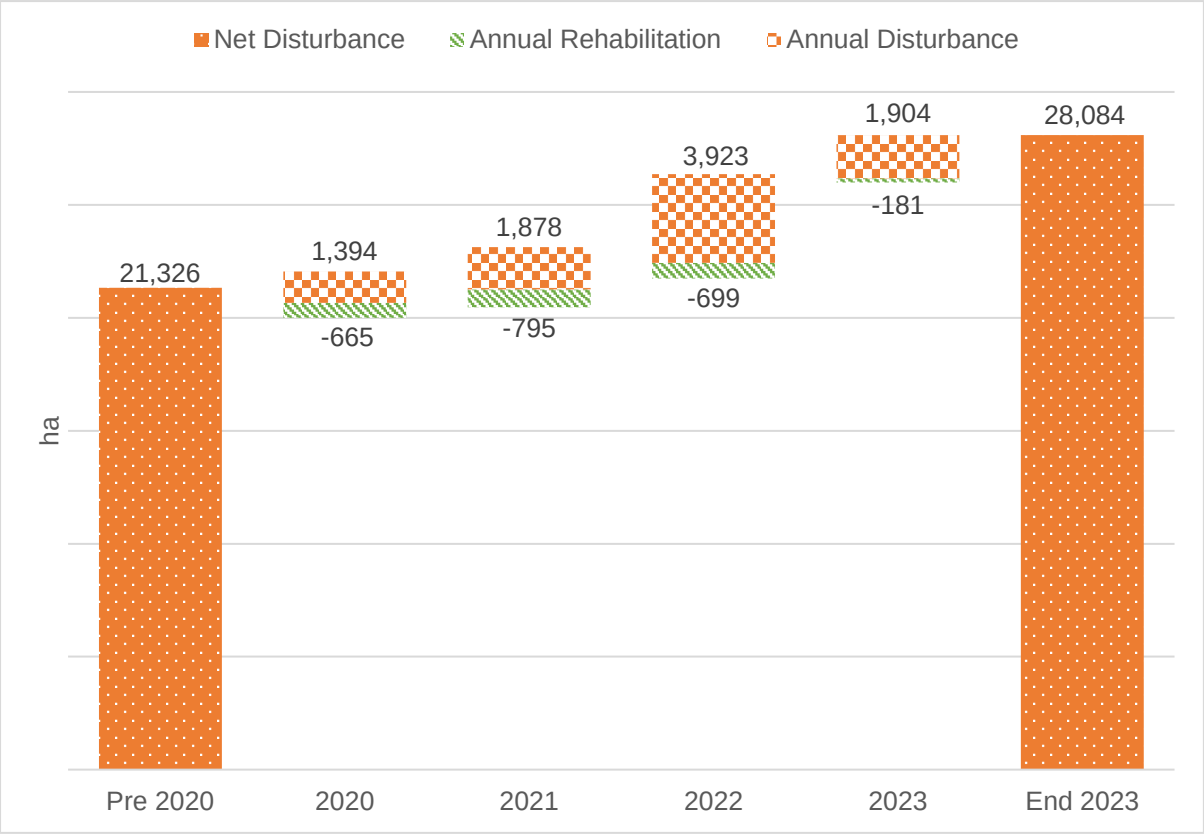

Figure 7. Progressive rehabilitation for strip mining other than coal to end CY2023

Figure 7 shows that net disturbance remaining after rehabilitation has increased by 6,758 hectares to 28,084 hectares between 2019 and 2023. The 32 percent increase in net disturbance since the end of CY2019 can be mainly attributed to the expansion of the bauxite industry in western Cape York Peninsula. The rate of progressive rehabilitation (historical to end CY2023) is 46 percent (compared with 48 percent reported at the end of CY2022).

4.5. Base and precious metals

We analysed 69 mines extracting base and precious metals. Figure 8 shows the cumulative areas of disturbance and rehabilitation to the end of CY2023, from data provided by companies in their annual returns.

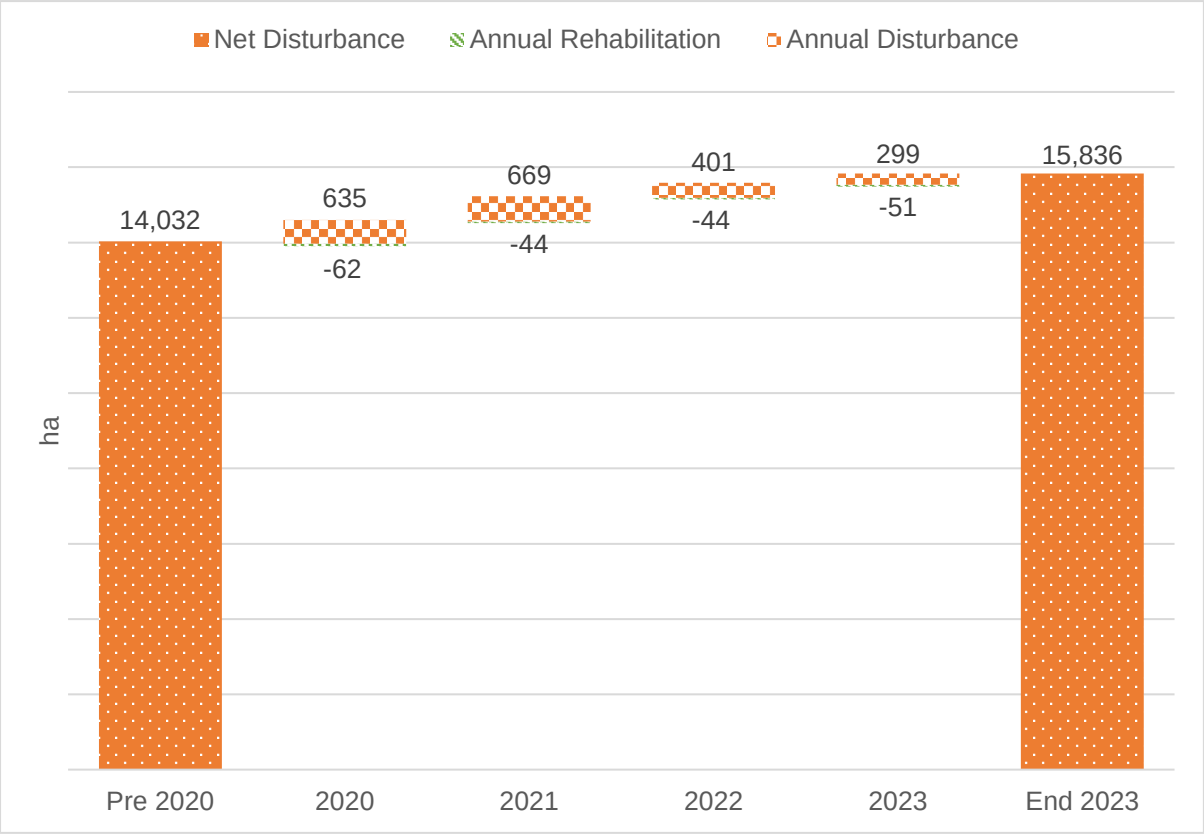

Figure 8. Progressive rehabilitation for base and precious metals mines to end CY2023

Figure 8 shows that net disturbance remaining after rehabilitation increased by 1,804 hectares to 15,836 hectares between 2019 and 2023. The rate of progressive rehabilitation (historical to the end of CY2023) is 17 percent, which is unchanged from that reported at the end of CY2022.

Mine waste cover system trials

We have previously reported on the challenges associated with meaningful reporting on progressive rehabilitation trends for metals mines. Metals mines typically operate within a fixed disturbance footprint and much of the disturbed land is not available for progressive rehabilitation. Consequently, in our 2022–23 report we provided an assessment of the readiness of base and precious metals operations to rehabilitate and close their mine waste structures. Our analysis focused on whether sites with a mine waste structure had prepared a current rehabilitation or closure planning document related to those structures.

A key aspect of rehabilitation at base and precious metals operations is the mitigation and management of AMD. There are strategies that can be used to prevent AMD, which can be deployed throughout the life of the mine. For many sites, the application of a bespoke cover system across the surface of the mine waste structure is critical for inhibiting AMD generation and seepage of contaminants into the surrounding environment.

Designing the most appropriate cover system for a mine waste structure is a complicated and multi-disciplinary task. The process often includes a cover system trial, undertaken at field scale, to test alternative designs. We reviewed publicly available datasets and benchmarked six Australian jurisdictions to collate a sample of sites. We selected 59 metals mines across Australia where covers have been installed on mine waste structures or where field-scale trials have been undertaken or are underway.

Our review revealed several opportunities for improvement:

- Considering the number of metals mines in Queensland with potential AMD, the number of cover system trials to validate a site-specific design is low and trials appear to occur intermittently.
- The performance of constructed covers is difficult to ascertain as this relies on a site undertaking a robust monitoring program—this is often challenged by issues with monitoring sensors and equipment, remoteness, hostile conditions, budget constraints, a changing workforce and the many years it may take to collect a robust dataset.
- Any learnings regarding the choice or performance of a cover system are not widely shared with industry or government and are only occasionally reported in the literature or presented at conferences.

Similar trends and challenges were reported by other Australian jurisdictions.

This preliminary analysis was undertaken with a view to develop more comprehensive technical guidance on cover system trials and monitoring regimes. We will continue this work into 2025.

4.6. Other mining activities

A total of 29 of the 207 mines subject to PRC plan requirements fall into the ‘other resource activities’ grouping. They mine commodities such as bentonite, limestone, sandstone and clays. Mines in this group 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 previously stated, the primary focus of this report is large-scale mining operations, which have been identified as the highest priority sites for more and better rehabilitation.

4.7. Progressive rehabilitation and closure plans

Of the 207 mines required to produce a PRC plan on 30 June 2024, 196 were existing mines that are transitioning into the PRC plan framework, of which 170 do not have an approved PRC plan yet. Therefore, it remains difficult to assess the impact of the framework on progressive rehabilitation at an industry level. 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 9 shows the PRC plan status of the 207 mines required to produce a PRC plan.

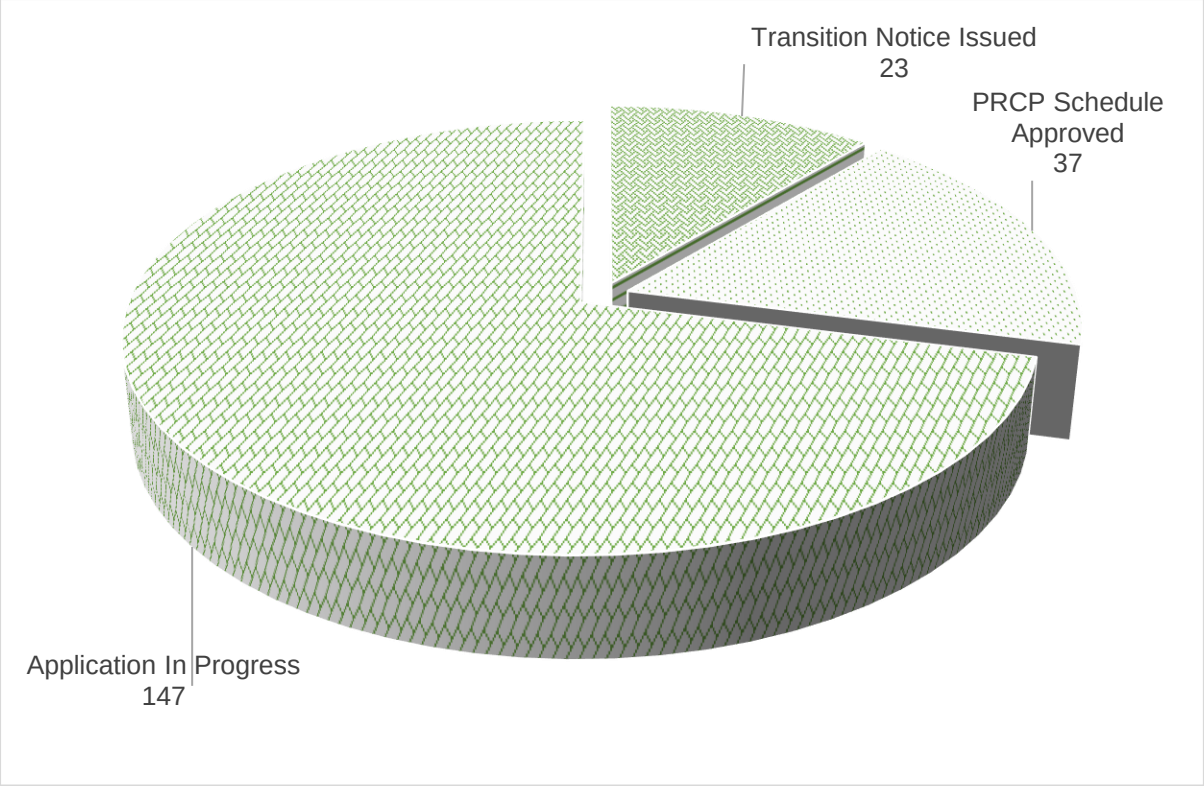

Figure 9. Status of PRC plan delivery as at 30 June 2024

4.8. 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 complete public interest evaluations have been submitted to the administering authority. Should public interest evaluations be submitted in future, the Commissioner will assess the process and performance as required.

4.9. Petroleum

While progressive rehabilitation of large-scale mining operations continues to be the focus of the QMRC team, we have started examining key rehabilitation issues associated with the petroleum (oil and gas) sector. During 2023–24, we undertook site visits and rehabilitation discussions with the four largest coal seam gas (CSG) operators in Queensland.

Development of a CSG field requires installation of infrastructure across numerous discrete parcels of land. Surface disturbance is geographically spread across the CSG field. Many thousands of small, discrete well pads are linked by gathering lines. They draw the resource into compression and water treatment facilities before transmission to domestic or export users. Other ancillary areas of disturbance also exist across the field, such as access tracks, high voltage transmission lines, transmission pipelines, offices, camps and lay-down areas.

According to the Department of Resources, as at 24 November 2023, there were 18,819 petroleum wells in Queensland, including 15,297 completed wells and 3,522 decommissioned wells (about 20 percent). It is paramount that wells are decommissioned, such that coal seams and other aquifers are effectively sealed, and adequate provisioning is in place for the task.

Rehabilitation of surface disturbance is a relatively straightforward procedure linked to the surrounding land use, typically pasture, farming land or forest. The process may take several years to complete. However, apart from the issues associated with brine disposal, rehabilitation of CSG sites is less technically challenging than rehabilitation of large-scale mining sites. Instead, the challenge for CSG field rehabilitation lies in the logistic requirements that flow from relinquishing thousands of individual parcels of disturbed land.

Industry and government need to work together to develop a cost-effective and robust process of ensuring the timely surrender of authorities and relinquishment of tenures. The QMRC team will continue to monitor rehabilitation processes in the CSG and conventional petroleum sectors.

5 Looking forward

The QMRC team will continue to develop and publish leading practice advice to support innovation in mine rehabilitation. To understand the value and practicality of our work, we will continue to engage with stakeholders and publish work that compares Queensland's rehabilitation record with relevant national and international examples.

Next year we aim to complete work and communicate the results of the cover system trials and landform modelling projects, including hosting a workshop on the results of erosion modelling in stable post-mining landform design. We will also continue working on trials to assess and compare alternative mine waste covers. From these projects we will distil implications for leading practice to guide industry towards good rehabilitation outcomes.

As for future projects, stakeholders have identified several topics associated with the roll out of PRC plans, such as how to manage non-use management areas and demonstrate that these areas have achieved 'sufficient improvement'. The QMRC team will engage with stakeholders on the priorities for work on these and other issues as they emerge and initiate suitable projects.

6 Appendix A – Administration

6.1 Corporate support

The Department of Environment, Science and Innovation provided support for the establishment of the Better Rehabilitation Team in June 2020, which became the QMRC team in October 2021. This included the secondment of six staff, as well as financial and human resources support. The department continues to provide corporate support to the QMRC team.

6.2 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.

6.3 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 Transformations in Mining Economies through those studies.

6.4 Directions from the Minister

The Minister has sought advice from the Commissioner regarding small resource operators and the administration of financial assurances for this sector. While rehabilitation reforms to date have focused on larger operators, it is now timely to review the administrative processes for approximately 4,000 small resource operators in the state. This work will continue into 2025.

7 Appendix B – Key QMRC research topics

Research Topic	Contract Award Date	Partner	Status
Post-mining land uses			
Native ecosystem rehabilitation in Queensland	(internal)	QMRC team	Implications for leading practice document published— https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0015/323052/implications-leading-practice-native-ecosystem-rehab-qld.pdf
Identifying a post-mining land use for residual voids	(internal)	QMRC team	Implications for leading practice document published— https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0030/318558/implications-leading-practice-identifying-residual-void-pmlu.pdf
Grazing as a post-mining land use	28 March 2023	Highlands Environmental	Delivered. Two technical papers published— https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0026/325466/grazing-as-a-pmlu-land-suitability.pdf https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0027/325467/land-planning-management.pdf
Grazing as a post-mining land use	(internal)	QMRC team	Technical paper published— https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0023/335615/review-research-tools-for-grazing-pmlu-in-queensland.pdf
Aquatic ecosystems as a post-mining land use	(internal)	QMRC team	Technical paper published— https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0023/341483/aquatic-ecosystems-in-post-mining-landscapes.pdf
Aquatic ecosystems as a post-mining land use	(internal)	QMRC team	Implications for leading practice document published— https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0022/343930/implications-leading-practice-aquatic-ecosystem-rehabilitation-qld.pdf

Research Topic	Contract Award Date	Partner	Status
Mapping biodiversity corridors and rehabilitation opportunities	2 March 2022	Centre for Mined Land Rehabilitation, Sustainable Minerals Institute, University of Queensland	Delivered. Link to academic journal article available— https://www.qmrc.qld.gov.au/research/other-publications
Final landforms			
Modelling to predict long-term stability	13 October 2023	Aquaterra International Pty Ltd	Draft technical paper submitted.
Mine waste cover system research trials	3 May 2024	EGi and Affinitas ODI	Commenced.
Addressing topsoil deficits	3 July 2023	Higher Degree Industry Placement student, University of Queensland.	Delivered. Student report published— https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0019/336043/review-techniques-address-topsoil-deficit-coal-mines-qld.pdf
Water management			
Modelling residual mine voids for rehabilitation planning	(internal)	QMRC team	Implications for leading practice document published— https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0026/319049/implications-leading-practice-modelling-residual-mine-voids-for-rehabilitation-planning.pdf

8 Appendix C – Sectoral mine groupings in this report

Groupings / number of mines	Description	Example commodity
Metallurgical and thermal coal (90 mines)	Major coal operations that predominantly mine in a horizontal direction (i.e. shallow deposit or pre-strip operations) such that land can be progressively rehabilitated. 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
Base and precious metals (69 mines)	Major operations that predominantly mine in a vertical direction such that land cannot be progressively rehabilitated as readily.	Copper, gold, lead, silver, zinc
Other large-scale strip mining (19 mines)	Major operations that predominantly mine in a horizontal direction (i.e. shallow deposit or pre-strip operations) such that land can be progressively rehabilitated.	Bauxite, phosphate, silica, mineral sands
Other resource activities (29 mines)	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).		

9 Appendix D – Glossary

AMD	Acid and metalliferous drainage
Commissioner	Queensland Mine Rehabilitation Commissioner
CSG	Coal seam gas
CY	Calendar year
DESI	Department of Environment Science and Innovation
Dist.	Disturbance
EP Act	*Environmental Protection Act 1994*
ERC	Estimated rehabilitation cost
HLP	Heap leach pad
Minister	Minister for the Environment and the Great Barrier Reef and Minister for Science and Innovation
PMLU	Post-mining land use
PRC plan	Progressive rehabilitation and closure plan
Resource activities	Mining, petroleum and gas activities (excludes quarries)
QMRC	Queensland Mine Rehabilitation Commissioner
QMRC Team	The Commissioner and staff of the Office of the Commissioner
Rehab.	Rehabilitation
TSF	Tailings storage facility
WRD	Waste rock dump

10 References

OSMRE. (2023). *Annual evaluation report for the regulatory program administered by the Department of Environmental Quality – Land Quality Division of Wyoming for evaluation year 2023*. Office of Surface Mining Reclamation and Enforcement. https://www.odocs.osmre.gov/