



# Comparative legal solution for rehabilitating legacy mines through financial provision in South Africa and Western Australia

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## Abstract

One understudied area of environmental law is the socio-ecological impact of ownerless mines. This impact is particularly pronounced in resource-dependent regions like South Africa and Western Australia, creating significant rehabilitation challenges. This article hypothesises that effectively managed financial provision could be valuable for rehabilitating legacy mines.

Using a qualitative, comparative methodology, the article analyses the financial provisions for mine rehabilitation in South Africa and Western Australia, focusing on statutory provisions, funding mechanisms, and rehabilitation outcomes. Key themes, such as context, measures, and outcomes, are explored to assess the effectiveness of each financial model. Purposive sampling is used to select case studies from both regions, and thematic analysis is applied to interpret the data.

The analysis highlights the financial rehabilitation measures in both regions, providing a structured framework for ownerless mine rehabilitation. South Africa's approach, guided by the Mineral and Petroleum Resources Development Act (MPRDA) of 2002, depends on state budget allocations, leading to funding inconsistencies and slow rehabilitation progress. In contrast, Western Australia's Mine Rehabilitation Fund Act (MRFA) of 2012 uses a levy-based system, ensuring continuous financial support for mine rehabilitation.

South Africa's state-dependent model has led to delays in rehabilitating derelict and ownerless mines, while Western Australia's funding model has facilitated steady progress. The article recommends that South Africa adopt a levy-based financial mechanism, strengthen legislative enforcement, improve financial oversight, and integrate proactive mine closure strategies to accelerate rehabilitation, reduce environmental hazards, and promote sustainable development in mining-affected communities.

## Keywords

South Africa, Western Australia, legacy mine, mine rehabilitation, financial provision

## Introduction

Mine rehabilitation is a central pillar of sustainable mining governance, ensuring that environmental harm caused by extraction is effectively remediated and that degraded landscapes are restored for future use (Joseph, 2025). Yet, despite its clear socio-ecological benefits, rehabilitation remains one of the most persistent regulatory challenges in resource-dependent jurisdictions such as South Africa and Western Australia. The most acute difficulty concerns legacy or abandoned mines, which continue to generate severe and long-lasting environmental and public health impacts. These sites commonly require state intervention, raising questions about whether statutory financial mechanisms can provide a reliable and effective basis for long-term rehabilitation. Financial provisioning, funds that mining right holders must secure in advance for closure, rehabilitation, and water treatment, is intended precisely to prevent environmental liabilities from shifting to the state.

Historically, however, mining operations in both jurisdictions were frequently abandoned without reclamation obligations, leaving behind hazardous pits, tailings, contaminated soils, altered hydrological systems, and land instability. The scale of the resulting legacy is substantial: South Africa has approximately 6,100 derelict and ownerless mines (Auditor-General South Africa, 2021), while Australia has around 60,000 abandoned sites dating to the 1800s, including more than 138,000 hectares in Western Australia alone, of which only 39,674 hectares have been rehabilitated (Callari, 2020). Because many original operators no longer exist, cannot be traced, or lack financial capacity, accountability gaps are pervasive (Feris, Kotzé, 2014). Government-led rehabilitation is also constrained by limited budgets and

capacity, resulting in thousands of sites continuing to pollute the environment for decades (Fowler-Puja, Barbanell, 2025).

Empirical data underscore the magnitude of the challenge. In South Africa, rehabilitating five abandoned mines cost R42 million (Auditor-General South Africa, 2009), and the remaining 229 alone are projected to require R3.86 billion by 2033 (Auditor-General South Africa, 2021). South Africa's legal framework embeds the polluter-pays principle, reflected in section 28 and section 24R(1) of the National Environmental Management Act (NEMA) 107 of 1998, and expressly provides that environmental costs should not be shifted to communities, as articulated in the White Paper on Environmental Management Policy for South Africa (Republic of South Africa, 1998a). However, an effective liability regime presupposes identifiable and solvent operators, conditions generally absent in the context of legacy mines. Section 46 of the Mineral and Petroleum Resources Development Act (MPRDA) 28 of 2002 (Republic of South Africa, 2002) accordingly obliges the state to rehabilitate mines where the operator is deceased, untraceable, or dissolved. Parliament has also proposed introducing an environmental levy on operating mines to offset rehabilitation costs (Department of Water and Sanitation & Chamber of Mines, 2014), raising concerns that the financial burden may ultimately fall on taxpayers (Lombard, 2018).

In contrast, Western Australia's Mine Rehabilitation Fund Act (MRFA) of 2012 establishes a dedicated, industry-funded pooled levy that provides stable, long-term financing for abandoned and legacy sites while limiting fiscal risk to the state (Government of Western Australia, 2021). Although Klopper and Wessels (2017) recommend adopting Western Australia's pooled fund approach in South Africa, their analysis does not fully interrogate key components of financial rehabilitation, such as levy design, fund sustainability, long-term liability coverage, and actual rehabilitation performance. This article advances the debate by offering a deeper comparative assessment of the two financing models, drawing on audit data, policy instruments, and institutional performance.

Against this backdrop, the paper first reviews the conceptual and empirical literature on legacy mines and their socio-economic and environmental impacts. Second, it outlines the regulatory frameworks of the two jurisdictions and evaluates the structure and performance of South Africa's and Western Australia's financial rehabilitation systems, identifying the core strengths, weaknesses, and governance implications of each. Third, it describes the research methodology. The fourth section presents the comparative findings and distils key lessons for reform. Section five discusses the policy implications, and the final section offers recommendations and a conclusion.

### Literature review

#### Overview of legacy mines

A legacy site refers to a former mining area where the rights or titles have expired, leaving no party accountable for rehabilitation (Oberle et al., 2020). Such sites often comprise abandoned or orphaned mines and residual waste facilities. The term 'orphaned' is employed when no owner can be identified, while 'abandoned' applies when the owner is known but lacks the financial means or willingness to undertake rehabilitation work (Oberle et al., 2020). Derelict and ownerless mines are those that have ceased operations, lack safety management and maintenance, and for which the owners, as defined by the MPRDA (section 56), have abandoned the mine and cannot be traced (Auditor-General South Africa, 2021). The government of Western Australia defines abandoned mine sites as

areas affected by former mining activities for which no individual, company, or organisation can be held accountable for rehabilitation (Bennett, Kim, 2016). According to Fowler-Puja and Barbanell (2025), the Good Samaritan Remediation of Abandoned Hardrock Mines Act of 2024 introduces a new legal definition for abandoned mines, classifying them as sites deserted before 11 December 1980. In this article, the terms legacy mines and historically abandoned mines are used interchangeably to refer to mine sites that were closed or ceased operations before the enactment of key mining rehabilitation legislation, such as the MPRDA and NEMA of South Africa. Consequently, the responsibility for their rehabilitation now rests with the government.

Derelict and ownerless mines have significant environmental impacts. These include acid mine drainage (AMD) and toxic metal leaching, which contaminate soil and water sources degrades stream quality and leads to biodiversity loss (McCarthy, 2011). To address this issue, the Department of Water and Sanitation established three AMD treatment plants in the Witwatersrand Basin by 2016, investing R2.59 billion to treat contaminated water and manage waste (Auditor-General South Africa, 2021). Unrehabilitated post-mining landscapes also harm air quality by releasing hazardous dust that affects ecosystems and human health (Bennett, 2016). Mine dust is associated with respiratory diseases, lung cancer, and other illnesses, particularly among vulnerable groups. Communities near abandoned asbestos dumps face ongoing exposure to fibres that cause asbestosis, lung cancer, and mesothelioma, a disease with the highest global incidence rate in South Africa (Auditor-General South Africa, 2021). Radioactive uranium from gold mining further contaminates ecosystems, leading to genetic mutations and cancers. Coal dumps, prone to spontaneous fires, emit sulphur, mercury, and arsenic, further degrading air quality and endangering nearby communities. Mine dust also diminishes soil quality, hindering vegetation growth (Auditor-General South Africa, 2021). Another critical environmental concern is land subsidence caused by collapsing underground mines, which pollutes water sources, threatens human safety, damages infrastructure, and permanently alters landscapes (Auditor-General South Africa, 2021).

Beyond environmental concerns, a significant social issue associated with legacy mines in South Africa is the rise of illegal small-scale mining, commonly known as Zama-Zama activities (Ledwaba, Nhlengetwa, 2016). These illicit mining practices, including hand-dug and mechanised excavations, often destabilise old shafts and excavated cavities, increasing the risk of collapse, especially after heavy rainfall. The consequences of such activities are extensive, with profound social and economic implications for the government, the mining sector, and society at large. Furthermore, illegal mining undermines the effectiveness of the government's shaft-sealing programme, as previously closed shafts are frequently reopened (Auditor-General South Africa, 2021). Notably, the South African government has spent over R49 billion in efforts to combat illegal mining (Hlati, 2024).

A pressing concern is the loss of agricultural land and livelihoods, as mining companies frequently neglect to restore mined areas once leases expire or resources are depleted (Ocansey, 2013). This loss of land disproportionately affects vulnerable groups, particularly those whose access to land and rights are disrupted (Vermeulen, Cotula, 2013). Mining-induced land dispossession extends beyond the loss of farmland to include the erosion of access to shared resources such as forests (utilised for firewood, hunting, and medicinal plants), grazing areas, fishing zones, and pathways that connect farmers to water sources for irrigation (Amponsah et

al., 2021). Oxfam Australia (2024) indicates that large-scale mining projects frequently result in the displacement of local communities, often necessitating their resettlement in unfamiliar areas. While it is incumbent upon governments and developers to safeguard the welfare of resettled communities, these procedures are frequently involuntary and inadequately managed, leading to heightened vulnerability and increased impoverishment. Resettlement may precipitate the loss of livelihoods and limit access to vital resources such as food and water. In instances where resettlement programmes are poorly designed or executed, affected families may encounter substantial challenges in resuming agricultural practices or identifying alternative income sources. Furthermore, resettlement locations are often remote, situated at considerable distances from urban centres, markets, and critical services, thereby exacerbating the hardships encountered by displaced communities (Oxfam Australia, 2024).

Legacy mines in South Africa largely stem from over 120 years of gold mining in the Witwatersrand Basin, according to the Commission for Human Rights, a region historically responsible for approximately one-third of global gold production. In rural South Africa, where mining typically occurs under customary land tenure, abandoned mines raise serious concerns about intergenerational equity. Land that has been passed down through generations may become permanently inaccessible, thereby undermining the potential for future generations to maintain their livelihoods. As Weiss (1992) notes:

We look at the earth and its resources not only as an investment opportunity but as a trust passed to us by our ancestors for our benefit and to be preserved for future generations.

The aforementioned highlights the need to view land as an intergenerational asset with cultural, economic, and environmental implications that extend well beyond the present (Amponsah et al., 2021).

### Financial rehabilitation models of legacy mines

#### *South African model*

##### *Financial rehabilitation measures*

In South Africa, mining is regulated by an extensive legal and policy framework centred on the Constitution of the Republic of South Africa (1996), the NEMA, and the MPRDA, among other statutes. The Constitution, as the supreme law (s 2), provides the foundational normative framework for all environmental and mining legislation. Section 24 guarantees everyone the right to an environment that is not harmful to health or well-being and obliges the state to enact reasonable measures to prevent environmental degradation. Although mine rehabilitation is not expressly mentioned, the severe socio-ecological risks posed by abandoned mines fall squarely within the protective mandate of section 24, thereby creating a strong constitutional justification for state- and industry-led rehabilitation interventions.

The NEMA operationalises the environmental right through a comprehensive suite of regulatory obligations relevant to mining rehabilitation. Section 24P requires mining operators to make adequate and annually reviewed financial provision for rehabilitation, verified through independent audits and secured through approved financial instruments such as trust funds or guarantees. Sections 24 and 24P, therefore, function together to ensure that environmental authorisations impose enforceable rehabilitation conditions backed by secured financial resources.

Additionally, section 28 introduces a broad duty of care requiring any person who causes, has caused, or may cause environmental degradation to take reasonable remedial measures, including addressing latent or residual impacts. Section 24 further prohibits listed activities without prior environmental authorisation, typically supported by an environmental impact assessment (EIA) and an Environmental Management Programme (EMP), which collectively guide rehabilitation and long-term monitoring responsibilities.

The MPRDA, which governs the granting of prospecting and mining rights, reinforces these obligations through a parallel set of financial mechanisms. While the Act does not explicitly codify a general rehabilitation obligation, section 41(1) requires applicants for prospecting rights, mining rights or permits to provide financial provision for environmental rehabilitation before approval of their environmental management plan. Section 42(2) authorises the Minister to utilise these funds where a mining operator fails to meet rehabilitation obligations. Section 46(1) further empowers the Minister to intervene directly to remedy environmental harm, particularly where the responsible party is untraceable, deceased, or in liquidation. Where no responsible party exists, section 45 assigns the state residual responsibility for rehabilitation.

This framework must be read in light of the principle of legality, including the prohibition on retroactive imposition of criminal or civil liability. The doctrines of *nullum crimen sine lege* (no crime without law) and the general non-retrospectivity of legal obligations ensure that individuals and entities cannot be punished or burdened for conduct that was lawful at the time it occurred (Binder, 2002; Johnston, 1996). As Hart and Green (2012) emphasise, laws must be prospective, clear, and accessible. Echoing Dicey's classical formulation: "no man is punishable... except for a distinct breach of law established in the ordinary legal manner" (Lawteacher.net, 2024). Against this backdrop, section 46(1) of the MPRDA appears normatively coherent: it allows state intervention where no prior legal obligation required the operator to rehabilitate. At the same time, however, the provision raises tensions with the polluter-pays principle, which holds that those who cause pollution should bear its costs (Kenehan, 2022), and with the broader duty of care principle requiring reasonable preventive measures (Australian Government Department of Health and Aged Care, 2023). It also conflicts with the White Paper on Minerals and Mining Policy for South Africa (1998a), which unequivocally states that environmental costs should not be shifted to the public.

Rehabilitation liability in South Africa is quantified under section 24P of NEMA and the Financial Provisioning Regulations, 2015 (GN R1147). These regulations require mining companies to secure the full cost of environmental rehabilitation across three components. First, progressive rehabilitation entails annual, site-specific costs related to reshaping, stabilisation, and revegetation, as required under Regulation 6(a). Second, decommissioning and closure obligations cover demolition, soil remediation, and landform stabilisation, costing on the assumption that work is undertaken by an independent contractor in accordance with Regulation 6(b) (2015). Third, latent and residual impacts include long-term liabilities such as acid mine drainage, water treatment, and post-closure monitoring, calculated using long-term projections and present-value methodologies in line with Regulation 6(c) (Department of Environmental Affairs, 2015). The sum of these components forms the total financial provision, which must be secured through authorised instruments, including bank guarantees, insurance products, or rehabilitation trusts (Regulations 8–10) (DEA 2015).

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### Observed performance outcomes

The Auditor-General reports indicate that 2,908 of the identified DOMs do not require rehabilitation. In 2010, the government planned to repair approximately 2,000 DOMs by 2021 because of their significant dangers and far-reaching consequences for society and the environment. The goal was to rehabilitate 6,100 DOMs by 2038 (Auditor-General South Africa, 2021). However, as of 31 March 2021, there has been relatively limited progress. Apart from asbestos mines, none of the 2,322 high-risk commodity DOMs had undergone rehabilitation (Auditor-General South Africa, 2021). Among the 1,170 identified holdings, 507 (43%) were recorded as closed in the DOMs database. Of the 261 asbestos mines, only 32 (12%) had been rehabilitated since the programme's launch in 2006–2007, with the remaining 229 mines earmarked for rehabilitation by 2033 (Auditor-General South Africa, 2021). Generally, rehabilitation efforts in South Africa have shown modest progress over the past 12 years (31 March 2010–31 March 2021), with the average annual percentage of rehabilitated mines increasing from 1.67% in 2009 to 2.25% in 2021 (Auditor-General South Africa, 2021).

Figure 1 provides an overview of mining rehabilitation progress in South Africa as of 31 March 2021, serving as a valuable tool for stakeholders to monitor, evaluate, and improve their efforts towards environmental sustainability in the mining sector. The sectors are asbestos, holdings, and high-risk commodity mines. Rehabilitation progress is further categorised into three groups: sites not rehabilitated or closed (depicted in dark blue), sites rehabilitated between 2009 and 2021 (orange), and those rehabilitated up to 2009 (green). For asbestos sites, a total of 261 sites is recorded, of which 229 (88%) remain unrehabilitated, 27 (10%) were rehabilitated between 2009 and 2021, and only 5 (2%) were rehabilitated before 2009. This indicates a slow pace of progress, with the vast majority still requiring attention. In the holdings sector, out of 1,170 sites, 663 (57%) remain unrehabilitated, while 507 (43%) have been rehabilitated between 2009 and 2021, reflecting comparatively better performance than asbestos sites, though over half still await rehabilitation. The most alarming section is that of high risk commodity mines, comprising 2,322 sites, all of which remain unrehabilitated, with no progress reported either before 2009 or between 2009 and 2021. This points to a complete lack of action in addressing these particularly hazardous sites. This lack of progress in the high-risk commodity mines underscores an urgent need for targeted funding, enhanced policy enforcement, and accelerated

implementation of rehabilitation programmes to safeguard public health and mitigate long-term environmental damage.

Since the inception of the rehabilitation programme in 2010, the National Treasury has failed to provide adequate annual funding to ensure the complete rehabilitation of all DOMs by 2038 (Auditor-General South Africa, 2021). This failure is concerning, given that the funding allocated through the Medium-Term Expenditure Framework (MTEF) was primarily directed toward rehabilitating DOAMs and the holdings programme, without considering the budget required for the remaining 2,322 high-risk commodity DOMs (Auditor-General South Africa, 2021). The 2021 valuation report revealed a rehabilitation cost of roughly R3,860,741,741 for the remaining 229 DOAMs by 31 March 2033. However, the current funding level would only allocate 44% of this amount (R1,696,528,316) to the asbestos rehabilitation programme by that date. Hence, the necessary funding to complete the rehabilitation of the remaining 229 DOAMs would not be accessible until 2043 (Auditor-General South Africa, 2021). In parallel to the issue of insufficient funding, the timeline for rehabilitating the remaining 229 DOAMs do not reflect the actual pace at which the Council for Mineral Technology (Mintek), the department's executing agent for asbestos rehabilitation, plans and implements these projects (Auditor-General South Africa, 2021). This reveals a profound implementation gap, underscoring a persistent disconnect between planning and execution. The contrast between projected timelines and actual progress illustrates chronic underfunding, weak institutional capacity, and an evident lack of urgency. Without decisive intervention, the remaining asbestos sites will continue to pose serious environmental and public health risks for decades. This makes it imperative to strengthen funding mechanisms, accelerate implementation, and adopt more efficient rehabilitation strategies to protect affected communities. Equally troubling is the apparent lack of political will by the minister and the state to address mining impacts in line with the constitutional right to an environment not harmful to health or well-being, as stipulated in section 24 of the South African Constitution (Republic of South Africa, 1996). This aligns with broader observations that, despite South Africa's sophisticated environmental governance framework, implementation, not legislation, is the primary obstacle. As Ashukem (2024) cautions, laws do not implement themselves. Effective enforcement and administrative commitment are therefore essential if rehabilitation obligations are to translate into tangible environmental outcomes.

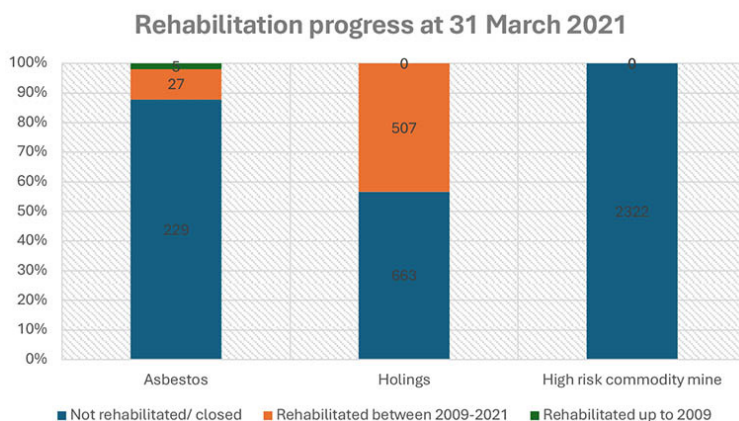


Figure 1—Rehabilitation progress on 31 March 2021 — Source: Auditor-General South Africa (2021)

### Expected year of completing rehabilitation of 229 asbestos

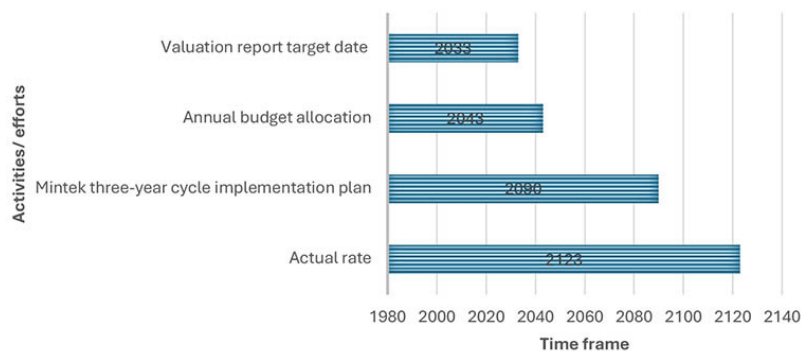


Figure 2—Expected year of completion for the remaining 229 DOAMs across actual, strategic, and operational plans and funding levels (from 1 April 2021)  
Source: Auditor-General South Africa (2021)

Figure 2 highlights the discrepancy between the projected and actual completion timelines for rehabilitating the remaining 229 DOAMs, considering funding allocation levels and operational implementation plans. Among the key elements, the Valuation Report Target Date (2033) stands as the most optimistic estimate, reflecting the early planning milestone aimed at assessing the scope and cost of rehabilitation. The Annual Budget Allocation (2043) projects completion based on current funding trends, suggesting a delay from the valuation target and revealing potential limitations in resource mobilisation. The Mintek Three-Year Cycle Implementation Plan (2090) extends the timeline considerably, likely due to a phased implementation strategy that rolls out the rehabilitation in cycles, indicating slow progress. Most concerning is the Actual Rate (2132), which shows that if the current pace continues, full rehabilitation will not be achieved until more than a century from now.

#### Western Australia model

##### Financial rehabilitation measures

In Western Australia, mining activities are regulated by various laws and policies, including the Constitution of the Commonwealth of Australia (CACA) 1900, the Environment Protection and Biodiversity Conservation Act (EPBCA) 1999, the Mining Act (MA) 1978, and the Environmental Protection Act (EPA) 1986. The EPBCA mandates EIA for significant projects, including mining, to assess potential impacts on matters of national environmental significance, such as threatened species and world heritage properties (1999 (Cth), s 18). Section 18 regulates actions likely to significantly affect these protected areas.

The MA governs mining activities in Western Australia, including the granting of mining leases and ensuring compliance with environmental laws. Section 58 of the Act outlines the requirements for granting mining leases, while section 82 of the Act mandates the rehabilitation of land after mining activities, although no dedicated funding scheme is provided (Mining Act 1978 (Western Australia) (WA), ss 58, 82). The EPA establishes the Environmental Protection Authority, which assesses the environmental impacts of mining proposals. Section 48 requires the Environmental Protection Authority to recommend conditions to mitigate adverse effects, but, like the MA, it does not include a formal funding scheme for rehabilitation (Environmental Protection Act 1986 (WA), s 48).

However, the exclusive authority for ensuring financial provisions for mine rehabilitation resides with the MRFA 2012 (WA). The Authority oversees the administration of the Fund and ensures that mining companies fulfil their obligations regarding land restoration as per the MRFA 2012 (WA, ss 6–10). Section 5(1) of the Act creates the Mining Rehabilitation Fund (MRF), a designated account as required under section 16 of the Financial Management Act 2006 (WA), the MRFA 2012 (WA), s 5(1), and the Financial Management Act 2006 (WA), s 16.

The primary purpose of the Fund is to provide financial resources for the rehabilitation of abandoned mine sites and other land adversely affected by mining activities. Under section 8(1) of the Act, monies in the MRF, including investment income, may be used to: (a) support the rehabilitation of (i) abandoned mine sites that were previously subject to mining authorisations with a levy obligation, and (ii) land affected by such sites; and (b) cover refunds required under Part 4 of the Act MRFA 2012 (WA), s 8(1)). In addition, section 8(2) provides that investment income may also be applied for other purposes, including supporting the rehabilitation of abandoned mine sites not covered under subsection 1(a)(i), financing associated affected land rehabilitation, and funding programmes, information dissemination, and administrative and enforcement activities related to rehabilitation efforts (Mining Rehabilitation Fund Act 2012 (WA), s 8(2)).

The levy in Western Australia is calculated using the formula:  $Levy = RLE \times FCR$ , where the rehabilitation liability estimate (RLE) reflects the notional cost of rehabilitating disturbed land and the fund contribution rate (FCR) is set at 1% under Regulation 4 of the Mining Rehabilitation Fund MRFA Regulations 2013 (WA) (MRF Regulations 2013 (WA), reg 4). To determine the RLE, tenement holders must classify all disturbed areas according to the Schedule 1 disturbance categories, including pits, waste dumps, tailings storage facilities, plant sites, roads, camps, and other infrastructure footprints, each of which carries a standard unit rehabilitation rate (MRF Regulations 2013 (WA), Sch 1). The RLE is calculated by multiplying the hectares in each disturbance category by its corresponding unit rate and summing the results. In terms of Regulation 5(2), if the total RLE is AUD50,000 or less, no levy is payable for that assessment year, thereby exempting very small or low-disturbance operations (MRF Regulations 2013 (WA), reg 5(2)).

##### Observed performance outcomes

For the financial year 2022–2023, mining rehabilitation levies amounting to AUD42.8 million were assessed based on information

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submitted up to 15 September 2023, compared to AUD40.1 million reported in the previous 2022 (Government of Western Australia, 2023). This represents a 9.2% increase from the 2021–2022 period (Government of Western Australia, 2023). As of 15 September 2023, 97.5% of these levies had been collected (Government of Western Australia, 2023). As of 30 June 2023, Western Australia's pooled fund had a net balance of AUD291.2 million, including AUD3.1 million in net interest (Government of Western Australia, 2023). The Government of Western Australia (2023) further assert that projects funded by interest, including those targeting legacy mines, focus on mitigating environmental impacts and promoting sustainable mining site management.

According to the Government of Western Australia (2023), examples of legacy mine projects financed through this interest include:

- *Safer Shafts for Towns* (Nyamal, Wajarri Yamatji, Yungun-Nya, Yamatji Nation): Launched in 2022, this initiative aims to reduce the risk of exposure to abandoned mine shafts, particularly for children. The project follows a staged approach, with plans for expansion to other regional areas as additional funding becomes available.
- *Donnybrook Shafts* (Gnaala Karla Boodja): This project focuses on rehabilitating eleven mine shafts in the state forest, in collaboration with the Department of Biodiversity, Conservation and Attractions (DBCA). The rehabilitation has been completed, and monitoring efforts are ongoing.
- *Silicate Minerals*: Currently under development, this project involves a partnership with Landgate to leverage hyperspectral data in assessing the presence, extent, and density of crocidolite associated with legacy mining operations.
- *Collieries* (Gnaala Karla Boodja): This project aims to compile data and establish a framework for mapping and prioritising areas affected by ground subsidence and carbonaceous shale from legacy underground coal mining.
- *Northampton Shafts* (Yamatji Nation): Following a staged progression, this project supports the Department of Planning, Lands and Heritage (DPLH) Northampton Lead Programmes. Heritage surveys are underway, with geotechnical investigations planned for the next phase.
- *Legacy Tailings*: In development, this project seeks to detect and monitor changes in constructed landforms using next-generation satellite synthetic aperture radar (InSAR) data.

Figure 3 presents the levies paid annually (AUD) over ten years. The data reveal a steady upward trend in levy payments, indicating improved compliance, increased levy rates, or economic growth in the sectors being levied. In 2014, the amount paid stood at AUD26.73 million, with slight annual increases until 2017, when it reached AUD28.89 million. A more noticeable rise begins from 2018 onwards, where payments increased to AUD30.33 million, followed by consistent year-on-year growth: AUD32.62 million in 2019, AUD35.55 million in 2020, AUD37.26 million in 2021, and AUD39.79 million in 2022. The peak is observed in 2023, with AUD42.78 million paid, marking a 60% increase from the 2014 figure. This consistent rise suggests strengthened enforcement mechanisms, expanded taxable activities, or broader economic expansion contributing to higher levy collections. The data also points to effective revenue mobilisation strategies over the decade. Overall, there is a positive trajectory in fiscal performance regarding levies, with 2023 being the highest point in the reporting period.

In the financial year 2022–2023, the land area reported as 'under rehabilitation' (indicating ongoing rehabilitation efforts) increased by approximately 1,835 hectares to 43,876 hectares, marking a 4.4% rise from the previous year (Government of Western Australia, 2023). During the same period, the area of 'active' disturbance expanded by around 10,681 hectares (6.2%) to 182,059 hectares (Government of Western Australia, 2023).

Consequently, land under rehabilitation accounted for 19.6% of all disturbed land (including land undergoing rehabilitation) and 24.1% of the active disturbance area. These findings suggest that while the land area undergoing rehabilitation experienced its most significant increase since 2019–2020, the pace of rehabilitation continues to lag behind the rate of new disturbance (Government of Western Australia, 2023). The reported extent of 'active' disturbance in 2022–2023 exceeded the area classified as 'under rehabilitation' by more than fourfold, continuing a trend that had steadily risen since 2014–2015, when the ratio stood at 3.1 (Government of Western Australia, 2023).

### Research methodology

This article adopts a comparative qualitative case-study design, relying exclusively on secondary sources and desktop-based research. It is not an empirical investigation; rather, it draws on legislation, policy frameworks, and authoritative reports, including those of the Auditor-General of South Africa and the Government of Western Australia's Department of Mines, Industry Regulation

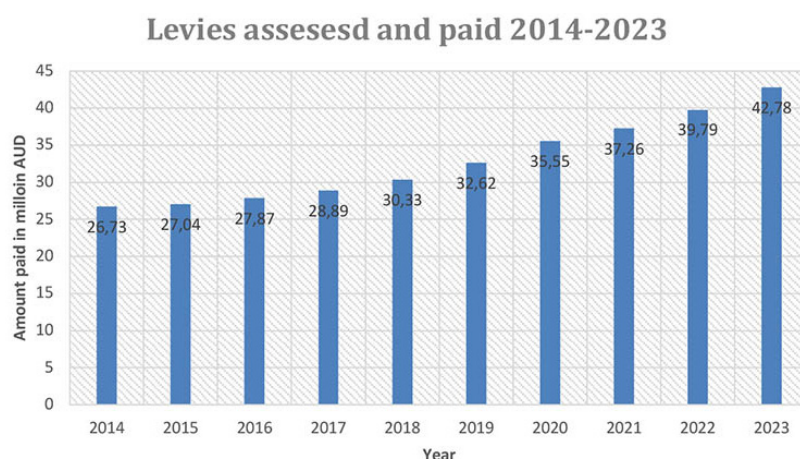


Figure 3—Levies assessed and paid 2014–2023 — Source: (Government of Western Australia, 2023)

and Safety (DMIRS) and Department of Mines and Petroleum (DMP), to examine how South Africa and Western Australia finance the rehabilitation of legacy mines. Through this desk-based approach, the study critically evaluates the strengths and limitations of each model and advances evidence-informed recommendations to strengthen South Africa's rehabilitation framework.

Purposive sampling guides the selection of the two jurisdictions due to their contrasting regulatory architectures and the relevance of their experiences to South Africa's policy debates. Western Australia is selected because it faces a similarly extensive legacy mine challenge. Australia has an estimated 60,000 abandoned mines, with Western Australia accounting for approximately 138,203 hectares of abandoned mine land, only a small portion of which is under rehabilitation (Callari, 2020). Its transition from unconditional performance bonds (UPB) to the levy-based MRFA provides a valuable counterpoint to South Africa's state-funded approach (Government of Western Australia, 2021). To ensure conceptual clarity, legacy mines in this study refer to pre-MPRDA and pre-NEMA abandoned sites that never made financial provision and therefore constitute a direct state liability.

Data are analysed through a thematic approach structured around two themes. The first theme, financial rehabilitation mechanisms, examines how each jurisdiction designs and implements financial provisioning systems, including levy structures, cost calculations, fund architecture, and long-term liability measures. The second theme, observed performance outcomes, assesses empirical evidence of rehabilitation progress, budget adequacy, institutional effectiveness, and implementation gaps using audit reports, government datasets, and official evaluations. These themes inform an assessment of the legislative and policy effectiveness of each framework, NEMA's 24P, MPRDA's ss 41, 45–46, and the MRFA ss 5–8, based on criteria such as statutory clarity, financial reliability, enforcement capacity, alignment with the polluter-pays principle, and overall sustainability.

### Results: Comparative rehabilitation finance models

#### *Financial rehabilitation measures*

As discussed in the aforementioned, both South Africa and Western Australia have enacted legislation to regulate the financing of mining rehabilitation, though they do so through distinctly different institutional and fiscal arrangements. While both jurisdictions acknowledge the severe environmental and public health risks posed by abandoned and unrehabilitated mines, South Africa's MPRDA and Western Australia's MRFA diverge significantly in their operative mechanisms, scope, and enforcement effectiveness.

In South Africa, section 46(1) of the MPRDA authorises the Minister of Mineral Resources and Energy to intervene directly to address environmental damage caused by mining activities, particularly when the responsible operator cannot be identified or has ceased to exist. Section 41(1) of the Act further requires mining right applicants to make financial provision for rehabilitation, decommissioning, and closure before the commencement of operations (MPRDA 2002, ss 41(1), 46(1)). These provisions embed rehabilitation obligations into the Act's environmental management framework and ostensibly provide the state with the authority and resources to act where operators fail. However, in practice, financial provisions are frequently underestimated, inconsistently managed, or rendered insufficient when rehabilitation becomes due. Enforcement under section 46(1) has also been constrained by institutional capacity limitations, leaving the state unable to

operationalise its residual liability under section 45 (MPRDA 2002, s 45). Although the legislative framework signals a strong policy commitment to environmental remediation, the persistent backlog of abandoned mines demonstrates that the state-led intervention model has not been effectively implemented.

This gap between legislative intent and practical outcomes is starkly illustrated by the rehabilitation data presented in Figure 1. Progress in rehabilitating DOMs remain far below national targets set for 2030 and beyond. The magnitude of this deficit raises serious questions about whether the Minister is fully complying with the statutory mandate to ensure rehabilitation where no responsible party exists (MPRDA 2002, s 46(1)). Given the well-documented socio-ecological harms associated with legacy mines, the failure to utilise these legislative tools more effectively undermines the protective purpose of the MPRDA and NEMA compromises intergenerational environmental justice.

By contrast, Western Australia's MRFA establishes a more coherent and financially sustainable architecture for managing rehabilitation liabilities. Section 8(2) of the Act establishes the MRF, financed through annual levies paid by active mining companies (MRFA 2012 (WA), s 8(2)). Unlike South Africa's mine-specific, full-cost liability model, the Western Australian system is based on a disturbance-based levy calculated using the formula: "Levy" = "RLE" × "FCR", with standardised rehabilitation rates for disturbance categories set out in Schedule 1 of the MRF Regulations 2013 (WA) (MRF Regulations 2013 (WA), Sch 1). This pooled fund structure ensures that resources are consistently available to address rehabilitation needs, regardless of whether the original operator remains extant. The MRFA also permits the use of investment income for additional purposes, including rehabilitating sites not initially listed in the Act, public education activities, and administrative costs associated with the Fund's management (MRFA 2012 (WA), s 8(2)). This flexibility enhances the Fund's ability to respond to emerging rehabilitation priorities and reinforces long-term financial sustainability.

Taken together, South Africa's model places strong normative emphasis on individualised liability and comprehensive coverage of long-term environmental risks, including acid mine drainage, post-closure monitoring, and water treatment obligations (NEMA 1998, s 24P; MPRDA 2002, s 41). Western Australia, in contrast, prioritises risk pooling, administrative efficiency, and secure funding for abandoned and legacy sites (MRFA 2012 (WA), s 8).

#### *Observed performance outcomes*

As noted previously, although the South African government set an ambitious target in 2010 to rehabilitate approximately 2,000 DOMs by 2021, within a broader objective of addressing all 6,100 DOMs by 2038, progress has been markedly slower than anticipated. Despite longstanding recognition that DOMs pose significant environmental hazards and far-reaching socio-economic consequences, rehabilitation efforts remain fragmented, inconsistently coordinated, and inadequately resourced. By 31 March 2021, none of the 2,322 high-risk commodity DOMs, arguably the most hazardous category, had been rehabilitated. Even asbestos mines, which present acute and well-documented public health dangers, show minimal progress: only 32 of the 261 identified sites (12%) have been rehabilitated since the programme began in 2006–2007, leaving 229 sites requiring urgent intervention. At the current rate, achieving the asbestos rehabilitation target by 2033 appears highly unlikely without substantial changes in strategy, resource allocation, and political prioritisation.

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Similarly, while 507 of the 1,170 holings (43%) recorded in the s database have been closed, such administrative closure does not necessarily translate into physical rehabilitation or reduced environmental risk. The incremental increase in annual rehabilitation rates, from 1.67% in 2009 to 2.25% in 2021, signals procedural rather than structural improvement and remains disproportionate to the magnitude and urgency of the challenge. This slow pace raises fundamental concerns regarding institutional effectiveness, financial resourcing, and the seriousness with which the DOMs crisis is being addressed. The widening gap between policy commitments and practical outcomes suggests that, without significant institutional reform, the 2038 rehabilitation target will remain aspirational rather than achievable. A comprehensive reassessment of the current rehabilitation framework is therefore critical, including consideration of stronger enforcement, deeper public-private collaboration, and innovative financing arrangements capable of accelerating rehabilitation outcomes.

Since the inception of the DOMs rehabilitation programme, the National Treasury's persistent failure to allocate adequate funding has deepened the disconnect between statutory obligations and fiscal prioritisation. This chronic underfunding is particularly concerning given the substantial risks DOMs pose to public health, environmental integrity, and local socio-economic stability. The tendency to direct MTEF allocations primarily towards asbestos rehabilitation and the holings programme, while overlooking the 2,322 high-risk commodity DOMs, reflects a narrowly focused and fragmented funding strategy. By neglecting a comprehensive, long-term fiscal approach, the state is effectively deferring an expanding environmental liability and escalating the eventual cost

of rehabilitation. This approach undermines the constitutional duty in section 24 of the Constitution to safeguard the environment for present and future generations.

The 2021 valuation report's estimate that R3.86 billion is required to rehabilitate the remaining 229 asbestos mines by 2033, of which only 44% (R1.69 billion) is currently available, highlights serious deficiencies in fiscal planning and commitment. The projection that full funding will only be secured by 2043 renders the 2033 target practically unattainable. That asbestos rehabilitation alone requires a 20-year timeline under current conditions casts significant doubt on the realism of the broader target to rehabilitate all 6,100 DOMs by 2038. Compounding the financial challenges is the misalignment between budget allocations and Mintek's technical and operational capacity to design and implement rehabilitation projects. This gap reflects broader institutional inefficiencies, including weak coordination, insufficient integration of financial and operational planning, and the absence of adaptive management practices. The resulting discrepancies between projected and actual completion timelines, as illustrated in Figure 2, raise serious concerns about the overall feasibility of the DOMs rehabilitation programme.

Turning to Western Australia, and recalling the reported AUD42.8 million in mining rehabilitation levies collected in 2022–2023, a 9.2% increase from the previous year, appears encouraging in terms of financial mobilisation. Levy compliance is high at 97.5%, and the Mining Rehabilitation Fund (MRF) holds a total of AUD291.2 million, including AUD3.1 million in interest earnings. However, several structural challenges warrant attention. The reliance on interest earnings to support legacy mine

*Table 1*

### A comparison of South African and Western Australian models for financing the rehabilitation of legacy mines

Dimension	South Africa – NEMA financial provision (FP) & MPRDA	Western Australia – MRF Act 2012
<b>Legal basis</b>	NEMA s 24P; FP Regs 2015; MPRDA ss 41, 45, 46.	MRFA; MRF Regs 2013.
<b>System type</b>	Mine-specific, full-cost financial provisioning.	Industry-wide pooled levy system.
<b>Primary purpose</b>	Secure full rehabilitation, closure, and long-term liabilities per mine.	Fund rehabilitation of abandoned and legacy sites.
<b>Funding model</b>	State-funded for pre-MPRDA and pre-NEMA sites; budget constrained.	Self-sustaining levy based on annual disturbance.
<b>Fund structure</b>	No pooled fund: state assumes costs where operators are absent.	Principal for authorised sites; interest in legacy sites.
<b>Calculation basis</b>	Detailed costing of progressive, closure, and latent impacts.	Levy = 1% of RLE (hectares × Schedule 1 rates).
<b>Rehabilitation scope</b>	Site-specific measures: demolition, remediation, AMD, monitoring.	Standard categories: pits, dumps, tailing storage facilities, plant areas.
<b>Responsibility model</b>	Individual operator liability (polluter-pays).	Shared industry responsibility via a pooled fund.
<b>Performance</b>	Slow rehabilitation; large unfunded backlog.	Strong levy compliance, but rehabilitation lags new disturbance.
<b>Governance challenges</b>	Fragmented administration; weak enforcement.	Reliance on investment income.
<b>Strengths</b>	Strong long-term liability provisions.	Simple, predictable, and sustainable funding.
<b>Limitations</b>	Financially unstable for legacy mines.	Levy insufficient for full-cost closure; diluted polluter-pays.

Source: Authors' compilation (2025)

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rehabilitation introduces a degree of financial volatility. While innovative, this approach exposes rehabilitation funding to market fluctuations, creating uncertainty during periods of economic downturn or low interest rates. Given the enduring nature of environmental risks associated with abandoned mines, the stability of rehabilitation financing should not depend on financial market performance alone. Additionally, although the Fund has supported targeted initiatives, such as the Safer Shafts for Towns and Legacy Tailings programmes, the thematic scope of these projects appears narrow and does not address systemic issues such as large-scale contamination, land degradation, and ecosystem restoration. The limited range of funded initiatives suggests that rehabilitation efforts may be proceeding in a piecemeal fashion rather than through a coordinated, landscape-level strategy. Table 1 presents a comparative overview of the South African and Western Australian financing models for the rehabilitation of legacy mines.

### Lessons for South Africa

The comparative financial models demonstrate that South Africa can draw several important lessons from Western Australia's approach to mine rehabilitation, particularly regarding the design of a sustainable, accountable, and efficient funding system. As shown in the comparative table, South Africa's current regime under section 24P of the NEMA, the Financial Provisioning Regulations, 2015 (GN R1147), and section 46(1) of the MPRDA places full-cost rehabilitation liability on individual operators (NEMA 1998, s 24P; Financial Provisioning Regulations 2015; MPRDA 2002, s 46(1)). However, where companies are untraceable or liquidated, the state assumes responsibility under section 45 of the MPRDA (MPRDA 2002, s 45). This state-funded model has proven financially unstable, particularly given the National Treasury's persistent failure since 2010 to allocate adequate funding to meet the national target of rehabilitating all DOMs by 2038.

In contrast, Western Australia's MRFA and MRF Regulations 2013 (WA) establish a self-sustaining, industry-wide pooled levy that generates predictable revenue for abandoned and legacy

sites (MRFA 2012 (WA); MRF Regulations 2013 (WA)). The legislation provides a clear fund architecture, section 6 establishes the Mining Rehabilitation Fund Authority, section 8 outlines fund utilisation, and Schedule 1 of the Regulations sets standardised disturbance categories and rehabilitation rates (MRFA 2012 (WA), ss 6, 8; MRF Regulations 2013 (WA), Sch 1). The distinction between principal contributions and investment income further enhances financial stability by allowing interest revenue to be applied to older or unlisted sites. South Africa could therefore benefit from introducing a mandatory industry levy, supported by explicit legislative provisions governing levy collection, fund administration, transparency requirements, and independent oversight. Such a model would reduce reliance on unstable state budgets, enhance financial independence, and ensure continuity of DOMs rehabilitation.

The comparison also highlights the need to improve accountability, transparency, and administrative efficiency in South Africa's system. Western Australia's high levy collection efficiency (97.5%), simplified disturbance-based calculation method, and transparent fund reporting processes provide valuable benchmarks (MRFA 2012 (WA); MRF Regulations 2013 (WA)). By contrast, South Africa's financial provisioning system remains administratively complex, financially burdensome for smaller operators, and weakened by persistent enforcement challenges. Introducing a streamlined, industry-wide funding mechanism with mandated reporting and external oversight could help prevent mismanagement and strengthen rehabilitation outcomes.

Additionally, performance trends from Western Australia indicate that newly created mining disturbances can outpace rehabilitation progress, reinforcing the need for South Africa to integrate proactive mine closure planning, enforce progressive rehabilitation, and embed stringent post-closure monitoring obligations to prevent growing backlogs. Finally, the strengths and weaknesses of the two systems underscore the importance of balancing environmental protection with financial feasibility: South Africa's approach provides comprehensive long-term liability

Category	Lessons for South Africa
Sustainable financing	Introduce a mandatory levy to establish a self-sustaining rehabilitation fund, reducing reliance on limited government budgets and ensuring predictable funding for DOMs.
Legislative enforcement	Strengthen enforcement of NEMA s 24P, FP Regulations, and MPRDA s 46(1) through clear guidelines on levy collection, fund use, and accountability.
Accountability and efficiency	Enhance fund governance by implementing transparent reporting and efficiency benchmarks, similar to Western Australia's high levy collection rate.
Rehabilitation capacity	Increase capacity and funding to accelerate rehabilitation of abandoned mines and reduce community and environmental risks.
Balancing disturbance and rehabilitation	Implement proactive closure planning and stricter progressive rehabilitation to prevent new mining disturbances from exceeding rehabilitation progress.
Responsibility model	Shift towards a shared industry responsibility system, reducing pressure on state budgets for abandoned mines.
Long-term liabilities	Maintain strong long-term liability coverage (e.g., AMD and water treatment) supported by more reliable funding mechanisms.
Sustainable development	Promote a well-funded, long-term rehabilitation system to support environmental recovery and socio-economic stability in mining areas.

Source: Authors' compilation (2025)

coverage, particularly for acid mine drainage, water treatment, and residual impacts, but its instability regarding abandoned mines demonstrates the value of a pooled industry responsibility model similar to Western Australia's.

By adopting these lessons, South Africa can accelerate DOMs rehabilitation, strengthen long-term environmental governance, and support sustainable development in mining-affected communities. Table 2 presents a summary of key lessons for South Africa drawn from Western Australia's model for financing legacy mine rehabilitation.

### Discussion

The findings of this study demonstrate clear contrasts between the financial rehabilitation models of legacy mines in South Africa and Western Australia, reflecting broader patterns highlighted in the environmental governance literature. South Africa's framework, grounded in the Constitution's environmental right (Republic of South Africa, 1996), NEMA's full-cost financial provisioning requirements (NEAMA 1998, s 24P; DEA 2015), and the MPRDA's provisions for state intervention (MPRDA 2002, ss 41, 45, 46), is normatively strong and closely aligned with the polluter-pays and duty-of-care principles discussed by Kenehan (2022) and Ashukem (2024).

However, the empirical evidence reveals severe implementation shortcomings: despite commitments to rehabilitate 2,000 DOMs by 2021 and 6,100 by 2038, virtually no high-risk mines and only 12% of asbestos mines have been rehabilitated, while annual progress has stagnated at under 3% (Auditor-General South Africa, 2021). The chronic underfunding by the National Treasury, combined with limited institutional capacity and slow implementation by Mintek, has produced a growing gap between planned and actual rehabilitation timelines, now extending into the next century, which undermines South Africa's constitutional obligations and confirms broader governance observations that legislative ambition without effective implementation yields limited environmental outcomes (Ashukem, 2024).

In contrast, Western Australia's model, anchored in the Mining Rehabilitation Fund Act 2012 (WA) and the Mining Rehabilitation Fund Regulations 2013 (WA), implements a pooled, levy-based system in which mining operators contribute 1% of their rehabilitation liability estimate (MRF Regulations 2013 (WA); MRFA 2012 (WA)). This disturbance-based model, supported by standardised Schedule 1 rates and investment income, has generated stable revenue, with a 97.5% levy collection efficiency and a fund balance of AUD291.2 million (Government of Western Australia, 2023). Yet, despite the financial strength of the MRF, the area of active disturbance has expanded more rapidly than the area under rehabilitation, revealing a structural imbalance that aligns with scholarly concerns regarding the limits of financial instruments when not paired with strong closure-enforcement mechanisms.

These comparative findings have important practical, theoretical, legal, and policy implications. Practically, they show that South Africa's reliance on state-funded rehabilitation for legacy mines is unsustainable and inconsistent with its ambitious legal framework, while Western Australia illustrates the advantages of a predictable, ring-fenced funding model. Theoretically, the comparison deepens understanding of environmental liability frameworks by contrasting South Africa's strict, individualised polluter-pays model, reflected in section 28 and section 24P of the NEMA (NEMA 1998, ss 28, 24P), with Western Australia's shared-responsibility approach through a pooled industry fund.

Legally, the analysis underscores that South Africa's regime is comprehensive but lacks a statutory pooled mechanism for financing legacy mine rehabilitation, leaving the state financially exposed under section 45 of the MPRDA (MPRDA 2002, s 45). In contrast, Western Australia's MRFA demonstrates how clear statutory authority, structured fund governance, and detailed investment income provisions enhance long-term financial sustainability, particularly section 8(2), which authorises the use of investment income for additional rehabilitation-related purposes (MRFA 2012 (WA), s 8(2)). Policy-wise, the study highlights the need in South Africa for greater administrative simplicity, improved cross-departmental coherence, stronger enforcement of progressive rehabilitation, and more realistic rehabilitation target setting.

The study acknowledges several limitations, including reliance on secondary data, a limited two-jurisdiction comparison, and incomplete disclosure of long-term rehabilitation liabilities. Future research should incorporate empirical fieldwork with regulators, companies, and communities; expand comparisons to additional jurisdictions; model fund sustainability under different levy rates; and examine the socio-ecological implications of alternative rehabilitation funding architectures.

### Conclusion and recommendations

This article successfully unpacked the different approaches and strategies of DOMs rehabilitation in South Africa and Western Australia. It was observed that South Africa's efforts to rehabilitate DOMs faced significant challenges because of financial constraints, administrative inefficiencies, and inconsistent government funding. Even though the MPRDA empowered the state to address these issues, the reliance on direct government allocations has hindered sustainable progress. In contrast, Western Australia's MRF provides a more structured and financially self-sustaining model, ensuring continuous rehabilitation efforts through a levy-based system.

To improve the rehabilitation of abandoned mines, this article argues that South Africa should consider adopting a dedicated rehabilitation fund like the MRF, funded through mandatory levies on mining companies. This approach would help create a predictable and sustainable financial mechanism, reducing reliance on discretionary state funding. Additionally, strengthening enforcement measures and improving interdepartmental coordination would enhance efficiency in South Africa's rehabilitation efforts. By implementing these reforms, South Africa can accelerate ownerless mine rehabilitation, mitigate environmental and socio-economic risks, and promote sustainable land use in mining-affected communities. Acknowledgement

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### Credit author statement

F.A. and J.C. contributed equally to all aspects of the research except for funding acquisition, which was undertaken solely by FA. Both authors contributed to:

- Conceptualisation
- Methodology
- Investigation
- Data curation
- Writing – original draft
- Writing – review and editing
- Formal analysis
- Supervision

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