

Environmental, social and governance influences on closure cost provisioning and why we need a global standard for reporting closure financial liability

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Abstract

The term ‘environmental, social and governance’ (ESG) refers to a framework of indicators for ethical investment used by companies to communicate to investors their position on a range of environmental, community, and corporate risks and opportunities. Experience has shown that those companies that understand and report clearly on how these factors impact or influence their business are more appealing to those that want to invest in an ethical manner than companies that do not have this awareness or do not communicate effectively in this regard.

Mining companies are responsible for ensuring adequate financial provisions are available to meet their environmental and social obligations when ore-extraction activities and company profits cease, i.e. at mine closure. It seems logical that the estimation of projected closure costs and the mechanisms in place to ensure that sufficient funds are available for closure activities would form part of ESG disclosures, i.e. sustainable finance. However, a review conducted in 2023 found that few of the corporate public reports assessed during that review provided closure cost estimates or information on financial assurance.

Using the same mine plan and environmental and social values, this paper explores how different ESG frameworks can influence the way in which a company perceives the materiality of, and communicates, closure risks and associated costs. The paper then highlights inherent difficulties in performing due diligence of closure costs for active mines and mines undergoing feasibility studies. The paper concludes by recommending that a global standard for closure cost reporting be developed to strengthen ESG reporting practice to better inform investor and other stakeholder decision-making activities.

Keywords: closure costs, provisioning, ESG, due diligence, closure reporting, financial assurance

1 Introduction

The term ‘environment, social and governance’ (ESG) refers to a framework of indicators for ethical investment used to assess the way in which environmental, social and governance factors can affect a company’s business risk profile and value as an investment (Finucane & Bibby 2023). The target audience for ESG disclosures includes investors, employees, regulators and customers, with these reports documenting the way in which environmental, social and governance factors can affect, or are affecting, business performance and other aspects. In addition, investors often also refer to corporate sustainability reports which address the way in which environmental, social and economic factors are affected by a business or operation. Even though sustainability reports are intended for external stakeholders such as non-government organisations (NGOs) (Patel 2022), investors review these because the way in which a company addresses the sustainability impacts of its business can present both business risk and opportunity.

Companies seen as strong ESG performers are better investment targets than those that are not so strong, even if the latter are, or have previously been, strong financial performers (Nel et al. 2020). Improving ESG

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performance helps mitigate financial risks for mining companies by, for example, alleviating financing constraints, enhancing risk control and mitigating agency problems with large shareholders (Fu et al. 2024). Conversely, if a company is at risk due to environmental, social and/or governance factors, investors are likely to be more cautious about providing capital to that company (Willard 2022; Finucane & Bibby 2023). Further, companies with poor ESG ratings often have the most volatile stock price, which in itself is a major risk for investors (Nel et al. 2020).

Investors are increasingly prioritising ESG in their investment appraisals, with PricewaterhouseCoopers (PwC) reporting that more than 60% of people base their purchasing behaviours on sustainability and ethical criteria, and that this is growing by 10% each year (PwC 2023). However, investors can only reward solid ESG performance if they can access the right information to inform due diligence assessments and investment decisions (Finucane & Bibby 2023).

The number of mining companies publishing ESG disclosures is on the rise (Huang & Ge 2024), with these organisations often reporting against multiple frameworks, usually because each framework is different in terms of topics and approaches (Finucane & Bibby 2023). However, the lack of a single format to follow often makes it difficult to compare reports by different companies, and there are significant inconsistencies in the way that data are collected and reported (Erickson 2021). In relation to mine closure and rehabilitation, review by Finucane & Bibby (2023) of 12 corporate sustainability reports and ESG disclosures issued by mining companies for 2021–2022 found that the type and quality of data varied across organisations, but tended to be limited to the reporting of rehabilitation footprints. In addition, it was found that few of these documents provided closure cost estimates or information on financial assurance. Further, this research showed that even if mine closure was deemed a material risk, companies did not usually disclose how annual performance targets for closure aligned with the reported closure risk.

This paper builds on the themes discussed in Finucane & Bibby (2023) by exploring the ways in which different sustainability reporting and ESG disclosure frameworks can influence how a company perceives the materiality of, and communicates, closure risks and associated costs. To do so, a hypothetical mine plan was assessed against the six reporting and disclosure frameworks discussed in Finucane & Bibby (2023). The assessment methodology is presented in Section 2, with key findings discussed in Section 3. The discussion provided in Section 4 includes commentary on the need for a global standard for closure cost reporting.

2 Methodology

2.1 Hypothetical case study

For the purposes of this paper, we envisaged a hypothetical project which comprises a quartzite mine located in the southwest of Western Australia. The mine is currently three-quarters through its operational mine life, anticipating another eight years of production before mine closure.

Current mining operations consist of two pits and one in-pit waste rock dump (Figure 1). However, the mine started as a small silver mine located on the western side of the creek (Pit 1) which was then abandoned. The original mine included development of the access road from the highway to the east and a water supply borefield located on the eastern side of the creek. To develop the quartzite mine, Pit 1 was expanded to the west and a new pit (Pit 2) was developed on the eastern side of the creek. Sensitive to the local water resource demands and drying climate, the company committed to only abstracting groundwater as needed to operate the mine and no surplus water was generated. When the watertable in the Pit 2 area was lowered (dewatered) sufficiently, ore that would otherwise be located below the watertable became accessible.

The ore is transported a short distance from the mine for processing at an already exhausted quartz mine where the processing plant continues to operate.

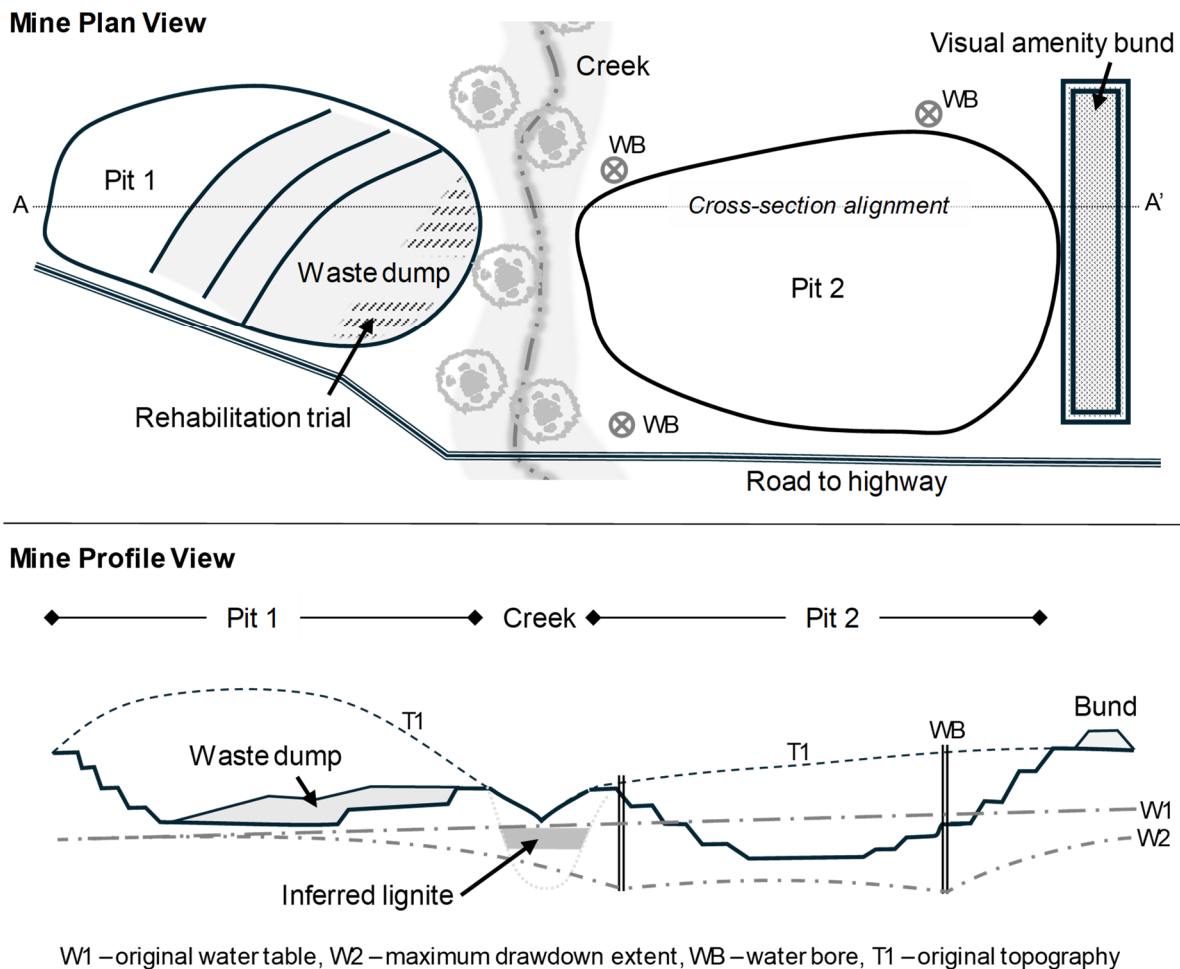


Figure 1 Conceptual site layout for the hypothetical case study

The quartzite mine owners are considerate of the Aboriginal heritage values associated with the local creek system and its biodiversity values. They have agreed buffer zones to avoid direct impacts to the creek riparian zone, and a surface water management plan is in place to minimise sediment and hydrocarbon loads into the creek at the creek crossing. The company has proactively sought to increase the buffer between the mine and the creek system by rehabilitating a corridor along the edge of the still active waste rock dump next to the creek. The company is very proud of the success of its rehabilitation effort, which has almost completely stopped dust from the waste dump reaching the local creek.

When seeking approval for the Pit 2 development, environmental regulators requested that a visual amenity bund be established along the eastern perimeter of the mine and parallel to the main highway to control dust, noise and visual impact of the mine in this otherwise idyllic natural forest setting. This bund, which is a permanent feature in the landscape, was successfully vegetated with local trees and woodland vegetation. As the mine is close to a highway and rural community, the mine frequently hosts visiting scientists who come to admire the two successful revegetation projects.

When the mine closes, the company intends to leave Pit 2 to form a pit lake. Geochemical analysis of the quartzite rock and waste rock indicate that the total leachable constituents are at low concentrations and the potential for acid mine drainage is low. Other than the creek, there are no local pools or groundwater-dependent ecosystems in the local area, and the company anticipates the pit lake will add value to the local area by providing a new freshwater ecosystem post-closure. The cost to close the site has been provisioned at AUD 50 million to include vegetation of the waste rock dump, access roads and borefield, using the cost from the rehabilitation trial as the basis for the estimate. This closure strategy is accepted and endorsed by the local community and the environmental regulator.

Following a wetter than usual winter, the company noticed and reported a significant drop in pH of the water in the bores next to the creek, from pH 7.1 down to pH 4.5. As the pH in the water from the eastern bores remained high, the waters were mixed to provide a suitable water supply and no further action was required. The water returned to a pH of around 7 a few months later and the drop has not been observed again. In the subsequent triennial aquifer review, a consultant speculated on the cause of the pH decrease. The consultant suggested that there may be a layer of acid-generating lignite beneath the creek as similar geological sequences had been observed in the wider region. When the creek flooded for an extended period of time during the unusually wet winter, water could have moved from the creek through the acid-generating lignite layer and into the groundwater system.

2.2 Selected reporting frameworks

Numerous frameworks and standards are used by the mining and mineral processing industry to prepare ESG disclosures and sustainability reports. For the purposes of the study reported in this paper, the six frameworks used in this study are the same as those used by Finucane & Bibby (2023). The intent of the frameworks and the way in which they address mine closure is discussed at some length in Finucane & Bibby (2023) so this information is not repeated here, but a summary is provided below. It is recognised that changes have been made to some of these standards since Finucane & Bibby (2023) was published. As most of these new requirements are not yet obligatory, the 2023 versions of these standards have been used for this study. However, comment on how the updates could affect ESG disclosures and sustainability reporting is also provided in Section 3 and Section 4.1, where relevant.

In addition, it is recognised that the International Sustainability Standards Board (ISSB), which is an initiative of the International Financial Reporting Standards Foundation (IFRSF), is building on and consolidating the work of market-led, investor-focused reporting initiatives including the Sustainability Accounting Standards Board (SASB) Standards (IFRSF 2024) and the Task Force on Climate-related Financial Disclosures (TCFD) Recommendations (TCFD 2017). For comparative purposes, this paper refers to both the SASB Standards and the TCFD, with the IFRSF⁷ influence on the reporting of closure cost estimates, provisions and assurances discussed in Section 5.1.

The frameworks and standards used in this study are as follows:

- The Global Reporting Initiative (GRI) Sustainability Reporting Standards. These standards build on guidance and schemes for responsible mining such as those of the International Council on Mining and Metals (ICMM) and others, and comprise three categories: Universal Standards, Sector Standards and Topic Standards. The Mining Sector Standard identifies topics likely to be material for mining organisations on the basis of the sector's most significant impacts on the environment, economy and people (including their human rights). It was updated in early 2024, with the updates coming into effect in 2026 (see Section 5.1).
- The ICMM Sustainable Development Framework. This framework comprises 10 Principles for Sustainable Development which set a standard for ethical performance for its member organisations and 39 performance expectations supported by eight position statements.
- The SASB Standards. Despite the name, these are ESG rather than Sustainability standards as they guide the disclosure of financially material sustainability information by companies to their investors. These standards identify and standardise disclosure for sustainability issues most relevant to investor decision-making for 77 industries including mining.
- The TCFD, which aims to improve the quality, consistency and comparability of climate-related disclosures to help companies, investors and other stakeholders make informed decisions on climate-related risks and opportunities, and comprises recommendations regarding governance, strategy, risk management, metrics and targets.
- The Carbon Disclosure Project (CDP). The CDP comprises a global disclosure system for environmental information including carbon emissions, forestry and water usage.

- The Kunming-Montreal Framework, which is otherwise known as the Post-2020 Global Biodiversity Framework (GBF). This framework comprises four goals for 2050 and 23 targets for 2030 related to the preservation and restoration of biodiversity value.

The main metrics required under these frameworks are summarised in Table 1.

Table 1 Selected reporting frameworks

Standard	2023 closure and rehabilitation reporting and disclosure requirements
GRI Sustainability Reporting Standards	<p>If an organisation in the coal sector (GRI 12: Coal Sector 2022) determines closure and rehabilitation to be a material topic, report whether each coal mine site has a closure and rehabilitation plan in place, has been closed, or are undergoing closure activities</p> <p>Report the total monetary value of financial provisions made by the organisation for closure and rehabilitation (including environmental and socioeconomic post-closure monitoring and aftercare for operational sites), and provide a breakdown of this by project</p> <p>Describe non-financial provisions made by the organisation to manage the local community's socioeconomic transition to a sustainable post-mining economy, including collaborative efforts, projects and programs</p> <p>(There were no closure and rehabilitation disclosure requirements for mineral or metal commodities in 2023)</p>
ICMM Sustainable Development Framework	<p>Public disclosure by member organisations of their validation activities is required on an annual basis on the organisation's website or in a sustainability or corporate report (ICMM 2023)</p> <p>Principle 6 (Environmental Performance) requires that member organisations 'plan and design for closure in consultation with relevant authorities and stakeholders, implement measures to address closure-related environmental and social aspect, and make financial provision to enable agreed closure and post-closure commitments to be realised' (ICMM 2023)</p>
SASB Standards	<p>Closure is addressed in the relevant industry-specific standards. For example, the SASB Standards (2023a) require disclosure of information on the policies and procedures including emergency preparedness and response plans for an entity's active and inactive tailings facilities for all phases of their lifecycle including closure and post-closure. Disclosure may include the frequency of review to confirm that adequate financial capacity is available for planned closure, early closure, reclamation and post-closure of these facilities and their appurtenant structures</p> <p>Similar disclosure requirements are included in the Coal Operations Sustainability Accounting Standard (SASB 2023b)</p>
TCFD	<p>None of the TCFD recommendations relate specifically to closure, but the TCFD may influence closure, e.g. applying the TCFD's Strategy requirement to mine closure could enable a company to identify and assess climate-related risks associated with closure activities while applying the Governance requirement could assist in aligning mine closure planning with climate goals and sustainability objectives (Finucane & Bibby 2023)</p>
CDP	<p>Mine closure requirements are specified in the CDP's questionnaire for the mining sector. Disclosure requirements include relevant information on company policies, practice and financial provisions for mine closure and rehabilitation (Finucane & Bibby 2023)</p>
Post-2020 GBF	<p>Target 15 requires that businesses assess, disclose and reduce biodiversity-related risks and negative impacts. The headline indicator for Target 15 comprises the number of companies reporting on disclosures of risks, dependencies and impacts on biodiversity, and the component indicator for Target 15 is based on Task Force for Nature-related Financial Disclosures, with complementary indicators including species threat abatement and restoration metrics (Convention on Biological Diversity 2024)</p>

2.3 Case study assessment

In the case study assessment developed for this paper we join the mine after 24 years of operations. The site has an impeccable sustainability and ESG record. The company has an approved closure plan for the mine that the local community has endorsed based on successful rehabilitation efforts completed early in the mine life, and it believes it has provisioned appropriately for the closure of the mine in eight years. As mine closure is approaching, the environmental regulator has requested that the closure plan be reviewed and modernised to align with contemporary standards.

As a result of this request, a pit lake water balance and salinity model is developed for the updated mine closure plan. While reviewing the historical water quality data from the water supply bores, the consultant notices the pH 4.5 event and integrates assumptions regarding a lignite layer made in the triennial aquifer review into the model. The consultant concludes that if a lignite layer is present, the pit lake water would become acidic under current climate conditions. Considering climate change under a drying climate scenario, the modelling suggests that the pit lake will become a groundwater sink, the watertable will not recover and the lake water will become saline regardless of whether lignite is present. Closure strategies to achieve the agreed freshwater ecosystem include water treatment and/or backfill to above the lignite level. These options are estimated to cost approximately another AUD 100 million. If left to form an acidic or saline pit lake, local biodiversity values would progressively decline over time.

As the presence of the lignite or the full extent of a drying climate cannot be substantiated at this point and a new closure strategy has not been agreed with stakeholders or the environmental regulator, the closure provision continues to carry the original AUD 50 million liability. The company rationalises that the likelihood of lignite being present and an acidic lake forming is, in its opinion, around 10%. On this basis, the company chooses to increase the closure provision by 10% of the potential AUD 100 million to AUD 60 million (prior to the application of any accounting treatments, e.g. discounted cash flow).

With this scenario in mind, we considered what aspects and information would be material to the company's ESG disclosures and sustainability reporting in relation to the GRI Sustainability Reporting Standards, the ICMM Sustainable Development Framework, SASB Standards, the TCFD, the CDP and the GBF.

3 Results

To explore how ESG and sustainability frameworks can influence how a company perceives the materiality of, and communicates, closure risks and associated costs, we assessed our hypothetical case study against the frameworks listed in Table 1. Table 2 provides commentary on whether these aspects would be material under these frameworks and explains how closure planning studies and the updated closure provision would be disclosed in ESG reports, based on the requirements of those standards (as described in Table 1). The key issues arising from our assessment are discussed in Section 4.

Table 2 Case study findings

Standard	Materiality of the topic of closure and data to be reported
GRI Sustainability Reporting Standards	With reference to GRI 3: Material Topics 2021, the company considers whether closure and rehabilitation are material topics for its mine. The company concludes that closure and rehabilitation pose a low risk. The GRI-compliant report volunteers that a closure plan has been developed for the mine and endorsed by the local community to support the conclusion that closure and rehabilitation are not material issues. The mine continues to voluntarily report, as it has done for decades, on the progress of its rehabilitation to showcase its commitment to biodiversity and leading practice environmental management.
ICMM Sustainable Development Framework	The requirements of Principle 6 (Environmental Performance) of the ICMM Framework include planning and designing for closure in consultation with key stakeholders and making financial provision to enable achievement of agreed closure and post-closure commitments. In accordance with Principle 6, the ICMM-compliant report mentions that the closure plan is being reviewed pending planned mine closure in eight years, and that financial provisions for the mine have been revised in accordance with company policies. The report also continues to showcase its commitment to progressive rehabilitation, highlighting improvements in biodiversity metrics after 20 years of monitoring. However, the report is not required to disclose the provision value or reasons for the changes to the provision.
SASB Standards	The SASB-compliant report concludes closure and rehabilitation are not material issues as the mine has no tailings dam, acid mine drainage management or other significant environmental issues. The company volunteers that a closure plan has been developed and approved by regulators and that financial provisioning has been provided in accordance with that plan.
TCFD	In a TCFD-compliant report, the company voluntarily reports that it is assessing climate-related risks as part of its closure planning activities. However, it is not required to report the outcomes of the pit lake models nor any future climate-related risks that may occur post-closure.
CDP	Under the CDP, companies are required to disclose information related to their mine closure and rehabilitation policies and practices. Although the CDP supports identification of potential risks and opportunities associated with mine closure, the company systems and policies have not changed, so the text within a CDP-compliant report also remains unchanged, unaffected by future water or biodiversity issues or the modified closure provision.
GBF	A GBF-compliant report highlights the biodiversity achieved with the rehabilitation areas. However, the company is not required to disclose the new findings regarding the potential acidic/saline pit lake, the associated negative biodiversity implications or the closure provision changes.

4 Discussion

4.1 Materiality

In ESG disclosures and sustainability reports, a topic or aspect is considered ‘material’ (i.e. relevant) if it could influence the decisions that stakeholders make in relation to the company providing the report. In other words, materiality is used to filter the information to be included in ESG disclosures and sustainability reports (GRI 2022). There are two main facets to materiality — financial materiality and impact materiality — which

together make up the concept of double materiality (Figure 2). While financial materiality focuses on the ESG factors that can affect a company’s business risk profile and value as an investment, impact materiality focuses on the way in which environmental, social and economic factors are affected by a business or operation (i.e. sustainability impacts). However, these concepts do not necessarily exist in isolation as the sustainability impacts of an organisation usually become financially material over time (GRI 2022).

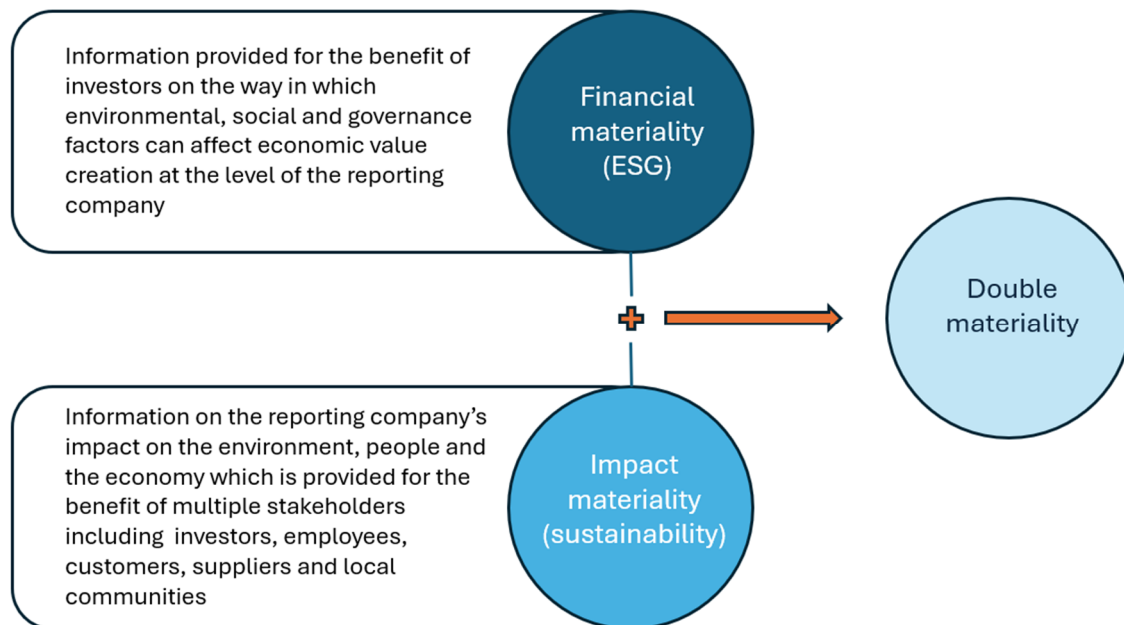


Figure 2 The concept of double materiality adapted from GRI (2022)

It is important to note that not all commonly used reporting standards and frameworks have the same perspective on materiality. For example, the GRI Standards take the impact materiality approach, requiring disclosure of the sustainability topics that ‘represent an organisation’s most significant impacts on the economy, environment and people including impact on their human rights’ (GRI 2021). In contrast, the TCFD takes the financial materiality approach and supports lenders, investors and insurance underwriters in appropriately assessing and pricing climate-related risks and opportunities (Finucane & Bibby 2023). However, the European Sustainability Reporting Standards have adopted a double materiality approach, requiring that organisations disclose information that could have financial effects on the organisation (financial materiality) or affect the organisation’s impacts on the environment and social factors (impact materiality), or both (Integrated Reporting Committee of South Africa [IRCSA] 2024).

An organisation’s leadership is responsible for determining which matters and information are material, with materiality being strongly influenced by an organisation’s unique circumstances. These include its geographic setting, stakeholder expectations and other factors (IRCSA 2024). Standards such as the GRI provide step-by-step guidance for organisations on how to determine material topics (GRI 2021), but if materiality is applied inappropriately then it can result in too much, too little or non-disclosure on information (IRCSA 2024).

In our case study, the company considered the potential impacts to the environment from the closure and rehabilitation of its operation to be minimal, supported by its environmental track record and the absence of any notable ‘high-risk’ mine features such as a tailings dam. We also note that the financial implications of a potentially acidic or saline pit lake were considered by the finance team. Although guidance was provided on a potential AUD 100 million cost to remediate these uncertain, negative impacts, the finance team used its own judgement to assess the likelihood of the event occurring (i.e. low) and concluded that the new outcomes were not material.

For both facets of materiality, technical staff in our case study relied on their personal experience and published guidance to draw conclusions. Historically, there have been few regulatory or other guidelines

available that defined acceptable, legally binding rehabilitation standards (i.e. completion criteria) or how to facilitate the transfer of ongoing liability and land management to the landowners (Young et al. 2019), and almost no case studies explaining the financial costs that were incurred to achieve that outcome (Neubauer 2022). Without published guidance, professional development opportunities are also limited. As a result, it is not uncommon for companies to use staff with limited experience in mine closure to define the financial provision 'best estimates'.

4.2 Disclosure of emerging closure risks

In many jurisdictions, legacy environmental approval processes allow mining to commence with only a general understanding of potential mine closure risk. Closure plans are expected to evolve during the life of the mine using the knowledge companies develop to address operational issues through the application of adaptive management practices (i.e. learning while doing) as the mine expands. When negative impacts that cannot be avoided are encountered, measures such as rehabilitation are the usual recourse.

None of the reporting standards utilised in this study include requirements to report on the emerging closure risks, yet identification of emerging closure issues is a challenge for most closure practitioners prior to mine closure. The process requires a practitioner to envisage the future mine layout and all potential variations of those plans. The practitioner then tries to identify possible issues that might arise with consideration of how well the mine is currently managing similar issues, what issues have arisen at neighbouring mines and what issues are trending in published literature in closed mines, using the environmental information collected by the company to date. Further work programs are then developed to explore and test hypotheses, and evaluate the risks, before site-specific management and mitigation strategies can be developed, costed and included in the provision.

It can take many years of study to move from an emerging issue to a provisioned mitigation strategy. When mitigation solutions are eventually resolved and costed, it is common for financial provisions to suddenly increase (Neubauer 2022). This can lead to unmitigated material ESG and financial risks when the situation arises at the end of the mine life.

4.3 Disclosure of closure costs and provisioning mechanisms

Mining companies are responsible for ensuring adequate financial provisions are available to meet their environmental and social obligations when ore-extraction activities and company profits cease (i.e. at mine closure), so it seems logical that ESG disclosures would refer to projected closure costs and the mechanisms in place to ensure that sufficient funds are available for closure activities. However, Finucane & Bibby (2023) found that few of the ESG disclosure reports they reviewed provided specific information on these aspects. In fact, of the 12 ESG disclosure reports reviewed by Finucane & Bibby (2023), only two disclosed rehabilitation and mine closure costs (Pilbara Minerals Limited 2022; Regis Resources Ltd 2022).

In our hypothetical case study, we provide an example of how a company might use probabilistic tools to address emerging closure risk within a financial provision. In this case, the closure provision increased by AUD 10 million to address an emerging non-conforming pit lake outcomes risk. While this increase represented a significant (20%) increase on the previous provision of AUD 50 million, and a significant potential increase in the total projected life of asset closure cost of AUD 100 million, none of the ESG reporting frameworks considered in our hypothetical case study required the change or the emerging risk to be reported.

Similar challenges are faced when performing due diligence of closure costs for mines undergoing feasibility studies and active mines. Feasibility studies focus on designing a profitable mine and collecting/analysing baseline data for environmental approvals. At the feasibility stage, complex issues and interactions with the local environment, such as the influence of an undefined lignite body on pit lake water quality in our case study, are difficult to resolve. At best, these complex issues are recorded as a potential risk requiring future study within closure plan risk registers, while the feasibility study attempts to define the operational risk management needs. Experienced closure practitioners will provide a conceptual cost range during a

feasibility study, inclusive of the costs to manage these yet-to-be-verified potential closure risks. However, these value ranges are often averaged down to a single value in the project financial evaluation (Lilforda & Haqueeb 2023).

Once the mine is active, resolving complex issues and interactions with the local environment is conceivable. The challenge instead turns to the paucity of support to continue environmental (and social) studies. With approvals in hand, few mining companies are willing or able to stretch beyond the demands of the existing ESG reporting requirements to actively challenge assumptions inherent within their mining approvals before the impending closure of the mine. Consequently, due diligence completed on active mines is often limited to the same assumptions, and therefore the same conclusions, as those proposed during mine feasibility and approval phases. So while the closure provision may be refined, becoming progressively more precise over the mine life, it remains notoriously inaccurate (Neubauer 2022; Lilforda & Haqueeb 2023).

5 Future directions

5.1 New standards and changes coming

As discussed in Section 2.2, changes to the ESG and sustainability reporting landscape have occurred since Finucane & Bibby (2023) was published. In particular, the ISSB has issued its inaugural Global Sustainability Disclosure Standards. This release marked a major move towards ‘a new common language and global baseline for sustainability reporting. The standards aim to enhance transparency, comparability and reliability in sustainability reports while tying such information into financial reports’ (Pierce 2024, in Persefoni 2024).

The two new global standards comprise the General Requirements for Disclosure of Sustainability-related Financial Information (IFRSF S1) and Climate-related Disclosures (IFRSF S2). Despite being introduced only recently (they are effective from annual report periods beginning on or after 1 January 2024), these standards are already shaping mandatory and voluntary reporting practices in many countries (Pierce 2024). For example, the CDP Climate Change Questionnaire, which is considered to be the gold standard for voluntary reporting, was changed in February 2024 to reflect the ISSB’s guidance (CDP 2024). Further, the International Organisation of Securities Commissions has endorsed the new global standards and has called on its 130 members (who represent 95% of the global financial markets) to consider how the ISSB’s framework could be applied (Pierce 2024).

IFRS S1 and IFRS S2 build on and consolidate the TCFD recommendations, SASB Standards and other frameworks to streamline sustainability disclosures. This consolidation reduces duplicative reporting (particularly for companies subject to multiple jurisdictional requirements) and improves global comparability for financial markets (KPMG International Limited 2024). As the ISSB Standards focus exclusively on capital markets, the only information required is that which is material, proportionate and decision-useful to investors (IFRSF 2024).

A noteworthy change to the GRI Sustainability Reporting Standards is the release of a Mining Sector Standard, which includes a materiality disclosure requirement for closure and rehabilitation. Table 3 compares differences between the 2023 draft and the final version of the standard, which is known as GRI 14: Mining Sector 2024. The GRI Sustainability Reporting Standards list the same 25 topics as likely being material to mining as those listed in the draft standard. However, the reporting requirements where closure and rehabilitation are material issues have changed with the inclusion of a new requirement to report the total land disturbed and not yet rehabilitated, as well as the total land disturbed and rehabilitated (including progressive rehabilitation, if applicable) for mine sites. There has also been an increase in the amount of information to be reported by organisations regarding financial provisions for closure and rehabilitation, expanding on the information previously only required for the coal sector, including the total estimated (undiscounted) closure costs, the methodology used to calculate closure costs, and environmental and socio-economic post-closure monitoring and aftercare for mine sites. The numerous changes between the 2023 draft and final version in 2024 reflect the growing expectation for increased disclosure of closure and

rehabilitation progress within ESG reporting. GRI 14: Mining Sector 2024 is effective for reports or other materials published on or after 1 January 2026.

Table 3 GRI Mining Sector Standard draft reporting requirements in 2023 and as updated in 2024

Draft reporting requirements (2023)	Updated reporting requirements (2024)
For each mine site, report whether it: <ul style="list-style-type: none"> • has a closure and rehabilitation plan in place • is undergoing closure and rehabilitation activities • has been closed and rehabilitated 	Unchanged
For each closure and rehabilitation plan: <ul style="list-style-type: none"> • report whether the plan has been approved by relevant authorities • report the dates of the most recent and next reviews of the plan 	Unchanged
N/A	<i>New requirement</i> For each mine site: <ul style="list-style-type: none"> • report in hectares the total land disturbed and not yet rehabilitated • report the total land disturbed and rehabilitated (including progressive rehabilitation, if applicable)
For each mine site, report the estimated life of mine	Unchanged
For financial provisions made by the organisation for closure and rehabilitation, including environmental and socio-economic post-closure monitoring and aftercare for mine sites, report: <ul style="list-style-type: none"> • the total undiscounted monetary value and a breakdown of this total by mine site • the methodology used to calculate undiscounted financial provisions for closure and rehabilitation 	<i>Changed requirement</i> For financial provisions made by the organisation for closure and rehabilitation, including environmental and socio-economic post-closure monitoring and aftercare for mine sites, report: <ul style="list-style-type: none"> • the total estimated closure cost (not discounted), whether the financial provision covers the full amount of the current estimated closure cost, and whether the financial provision made is in line with the applicable regulatory requirements, by mine site • the methodology used to calculate the estimated closure cost • the financial instruments used or developed to guarantee adequate financial provisions for closure and rehabilitation
Describe non-financial provisions made by the organisation to manage the local community's socio-economic transition to a sustainable post-mining economy, including collaborative efforts, projects and programs	Unchanged

5.2 The need for a global standard for closure cost reporting

Investors can only reward solid ESG performance if they can find the right information (Finucane & Bibby 2023), but investors and other stakeholders have become increasingly frustrated as they try to make sense of the tangle of different reporting and disclosure frameworks. This suggests that current sustainability reporting is, or risks becoming, inefficient for companies and insufficient for investors.

It is promising to see that some best practice governance aspects in financial assurance for mine closure (Hattingh et al. 2021), discussed in Section 5.1, have been integrated into some revised ESG reporting standards and guidelines, including disclosure of the:

- year when closure is anticipated
- full (undiscounted) life of asset closure cost estimate
- current provision and whether financial assurance mechanisms are in place.

Understanding the ‘accuracy and precision’ of the disclosed costs will, however, continue to be an issue for investors and other stakeholders, as will the use of cost terminology between standards, e.g. ‘life of asset’ versus ‘provision’ or ‘financial liability’ cost estimates.

The challenges associated with developing accurate cost estimates are not unique to mine closure. Cost estimation practice standards and guidelines have been established by professional associations (e.g. AACE International) to ensure consistent use of terminology and methodology when it comes to defining cost estimate class (e.g. detailed/definitive/preliminary/order of magnitude, or Class 1 to Class 5/Class 10 [AACE International 2022]). These cost estimate classes are designed to reflect the quality of the information available to undertake the estimate and can be tied to quantitative risk analysis to quantify the cost estimate accuracy. If we assume that the scope of the planned closure is comprehensive and management for all potential issues have been resolved, what class of cost estimate should be achieved and by what stage in the mine life? Currently there is no guidance provided within the updated ESG guidance as to the cost estimation standards to be adopted when disclosing provisions or closure costs.

While Hattingh et al. (2021) contend that ‘the accuracy of the estimate for any one mine will be dependent on the ability to apply site-specific conditions and good cost estimating principles’, the diligence of individual mining companies in tracking and tracing potential closure issues, and their willingness to develop and cost site-specific mitigation strategies, may be stronger influencing factors on the accuracy of the disclosed closure cost. As reviewed in Section 4.2, the identification of emerging closure issues and risks is potentially more art than science and is not a requirement under ESG reporting frameworks. Further, there is no standardised classification system to communicate the maturity of the closure to reflect the likelihood of new issues and risks arising (i.e. scope change). Investor and stakeholder confidence in the estimate can only be resolved if these aspects are also disclosed.

In addition to the anticipated changes to ESG reporting, we contend that ESG reporting standards should also be designed to provide investors and stakeholders with an awareness of the:

- maturity of the closure plan
- magnitude of a potential cost increase for emerging and unresolved issues and risks.

In our hypothetical case study, the closure plan used as the basis of the cost estimate and provision was immature, as evidenced by the request from the regulator to update the plan and the discovery that the expected closure outcome of a freshwater pit lake was unlikely to be achieved with the current management approach. Further, while closure costs were not required to be reported under existing ESG reporting frameworks, if the provision only was to be reported (AUD 60 million) then the potential for the total life of asset closure costs increase to AUD 160 million would continue to go undisclosed and could lead investors and stakeholders to believe that the cost to resolve the pit lake issue was only AUD 10 million.

While some may argue that knowledge gaps and ‘known unknowns’ can be managed within the cost estimate through judicious application of contingency, the application of contingency is subject to controls established within cost estimation practice standards and guidelines that generally prohibit the application of contingency for undefined, out-of-scope items. ICM (2019) also recommends that contingency allocations be excluded from financial liability closure cost estimates unless the reporting standard has given specific directions regarding the inclusion of uncertainty and risk contingency allocations.

6 Conclusion

Mining companies are responsible for ensuring that adequate financial provisions are available to meet their environmental and social obligations when ore-extraction activities and company profits cease, i.e. at mine closure. Historically, ESG reporting frameworks have not required companies to disclose the estimated cost for mine closure, information on financial assurance or emerging closure issues, even when mine closure was deemed a material risk (Finucane & Bibby 2023).

Through the development of a hypothetical case study, this paper has demonstrated how companies can mistakenly conclude that closure and rehabilitation are not material risks due to the financial treatment of the closure provision and immaturity of the closure plan, influenced by the directions within the ESG reporting frameworks themselves.

Closure cost estimates are notoriously inaccurate for a variety of reasons (Neubauer 2022), leading to sudden and significant cost increases at or towards the end of the mine life at the same time as company profits cease. Recent improvements in the ESG reporting frameworks to acknowledge and/or address closure and rehabilitation may improve the transparency of reported closure planning progress and financial risks. However, failure to address common closure planning challenges, such as emerging issues and cost estimation terminology, could negate this progress.

With the introduction of new costing terminology to ESG standards, and challenges in developing closure costs for environmental (and social) risks of undefined scope, the industry could also benefit from the provision of additional guidance on how to assess materiality and report on issues. This could best be achieved through the introduction of a global standard for closure cost reporting.

From our hypothetical case study, we conclude that there are five key aspects of closure planning that should be disclosed to investors and other stakeholders during due diligence and other decision-making activities to improve transparency of ESG and financial (and potential double materiality) risk:

- the maturity of the closure plan
- the current (undiscounted) closure cost provision
- the year of closure and (undiscounted) life of asset (or projected) closure cost at that projected date
- the magnitude of potential closure cost increase(s) associated with unresolved risk or emerging issues
- financial assurance mechanisms.

We suggest these aspects of closure cost estimation be included and defined within the recommended global standard for closure cost reporting, and that they also be considered in future ESG framework revisions when evaluating closure and rehabilitation governance.

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