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# Evaluating regulatory approaches to mine closure in Kenya, Western Australia and Queensland

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# **Evaluating regulatory approaches to mine closure in Kenya, Western Australia and Queensland**

## **Abstract:**

Many countries have been burdened with a legacy of unplanned mine closure. Inadequate and ineffective regulatory approaches to mine closure have resulted in legacy of abandoned mine sites, which rehabilitation costs are substantial liabilities to governments and communities. Although governments have been reviewing mine closure regulations to enhance their effectiveness, achievement of successful closure outcomes still remains a challenge.

The purpose of this study was to evaluate how well existing regulatory approaches for Kenya, Western Australia and Queensland incorporate various aspects of mine closure. This is the first study to do this type of evaluation for regulatory approaches to mine closure. This study reviewed published literature to identify characteristics of mine closure success, and subsequently developed an analytical framework based on this review. Regulatory documents such as Acts, Bills, regulations, policies, guidelines and government reports were then assessed for inclusion of these characteristics in each case study area. The study found that regulatory approaches in the three case study areas do not incorporate all the aspects identified as requirements for successful mine closure. The study found that Western Australia and Queensland regulations were more comprehensive than Kenya. In addition, requirements that address socio-economic impacts of mine closure need to be incorporated in regulatory approaches in all study areas.

This study indicates there is need to improve the existing regulatory approaches to mine closure in each study area, particularly Kenya, so that the regulation is more likely to have the desired effect of improved mine closure outcomes and success.

**Keywords:** Mine closure, Regulation, Criteria, Aspects, Integrate, Evaluation, Successful

**JEL classifications:** N57, K32, L72, Q38

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# **Evaluating regulatory approaches to mine closure in Kenya, Western Australia and Queensland**

## **1. Introduction**

Mine closure planning is an integral component of mine planning (Finucane, 2008; Government of Western Australia, 2015). Integrating closure into project planning in a way that takes environmental, economic and social considerations into account from commencement of operations ensures long-term environmental, community and economic sustainability (Finucane, 2008). In the past, mine closure planning was not given priority and was often considered as an afterthought at the cessation of mining operations (Warhurst and Noronha, 1999). Moreover, there appears to have been little attention for the environment and socio-economic impacts associated with mine closure (Centre for Social Responsibility in Mining, 2007). As a consequence, there has been an increase in the number of abandoned mining operations that have not mitigated their environmental impacts. The clean-up costs of these abandoned sites generate substantial environmental liabilities to governments and local communities (Kahn et al., 2001).

Many historic legacy sites exist throughout Australia and overseas where mining companies have ceased operations and abandoned the site without adequate disposal of mine waste materials, in some cases even with the equipment left in place (Mulvey et al., 2012). In Australia the number of abandoned mine sites is estimated to be 50,000 with 17,000 of these in Queensland (Department of Mines and Natural Resources, 2014; Unger et al., 2012), and more than 10,000 in Western Australia (Sansom, 2014). Cleaning up the 17,000 abandoned mine sites was estimated to cost the Queensland State government 1 billion dollars (Sansom, 2014). The total closure costs for all mines in WA have been estimated to be between 4 and 6 billion dollars (Leybourne, 2014). In addition, mine closures have resulted to serious economic and social impacts on the local communities whose economy is largely dependent on mining (Robertson and Blackwell, 2014).

However, consideration of mine closure as an afterthought by mining companies is no longer the case. There is now more focus on mine closure due to increased public awareness of, and involvement in, environmental issues associated with mine development, as well as increased focus on sustainable development (Allen et al., 2001; Laurence, 2006; Mulvey et al., 2012). As a

result of this growing environmental awareness, miners are now expected to meet local laws, be compliant with environmental regulations and address community expectations. This has led regulating authorities in many countries, particularly in developed countries such as Australia, United States of America, Canada and South Africa, to introduce stringent legislation that will ensure successful mine decommissioning and closure (Kahn et al., 2001).

Over the past decades, mine closure planning in major mining jurisdictions has evolved from the earlier plans that focussed on mined land rehabilitation to a more integrated approach that involves risk assessment, socio-economic impacts, post- mine land use and stakeholder consultation (Welsh, 2007). Consideration of environmental and socio-economic factors, as well as community engagement in mine closure planning, is critical for optimal closure outcome and to ensure that benefits of the projects are used for sustainable development of the region even beyond the closure of the mine (Laurence, 2006; Logan et al., 2007). Since mine closure processes impose environmental, economical, and social impacts on the mining site and its neighbouring region, there is a need for a legislative system that incorporates all these aspects (Flores et al., 2007). Nevertheless, despite existence of many guidelines and frameworks for mine closure and reclamation, determining appropriate criteria for successful mine closure is a challenge for the mining industry and regulators (Copin, 2013). This is mainly because most guidelines tend to set closure criteria based on a single aspect of mine closure (e.g. focussing purely on ecological outcomes).

Previous studies acknowledge that an integrated approach which incorporates all the aspects is fundamental for effective mine closure (Centre for Social Responsibility in Mining, 2007; International. Institute for Environment and Development, 2002; International Council on Mining and Metals, 2003; Jenkins and Yakovleva, 2006; Laurence, 2006). However, integration of all aspects of mine closure has been identified as one of the major challenges facing regulatory authorities (International Institute for Environment and Development, 2002).

Despite studies acknowledging the importance of integrated approach that incorporates environmental, social and economic aspects of to mine closure, there exist no work that has evaluated how well and to what extent do existing regulatory approaches incorporate the various aspects of mine closure.

The first aim of this study was to identify the criteria needed to assess whether mine closure regulations integrate the three broad areas of environmental, social and economic factors. Following these criteria, the study aimed to evaluate how well the existing regulatory approaches to mine closure in Kenya, Western Australia, and Queensland meet these criteria. Regulatory approaches include legislation, government department's guidelines, rules and regulations that govern mine closure process. The overall objective of these evaluations was to highlight aspects of mine closure that are not incorporated in the existing regulatory approaches as per the analytical framework, and determine how the existing regulatory approaches can be improved to meet the evaluation criteria. The study will highlight what an effective mine closure regulation constitutes, and will formulate best practice guidelines that will contribute to achievement of successful mine closure.

## **2. Methods**

This section describes the literature search process and how previous studies on mine closure were evaluated. The development of evaluation criteria is described in Section 2.2. A description of each study area is given in Section 2.3.

### **2.1 Literature search procedure**

Qualitative research methods were used to evaluate how well regulatory approaches to mine closure adopt an integrated approach that incorporates environmental economic and social factors. The criteria needed in order to evaluate how well mine closure regulations integrate these factors were developed through a review of academic literature on mine closure. Literature sources were identified using UWA's One Search, Web of science, Scopus and Google Scholar using the terms "mine closure", "Integrated mine closure," "Mine closure framework", "Mine closure evaluation criteria" and "mine closure criteria". The search produced a total of 55 literature sources. The abstracts of these 55 sources were read and those that included information on mine closure framework were considered to be relevant. This yielded 11 literature sources of which full text was read to determine the usefulness for this study. Three studies that had developed evaluation criteria for mine closure success were considered useful to include in this review.

Based on the available literature an evaluation framework was developed that constituted of characteristics of an integrated approach to mine closure. This framework enabled a

comprehensive assessment context for the regulatory approaches to mine closure in the study areas.

## **2.2 Development of evaluation framework**

### **2.2.1 Previous studies on evaluation framework**

There are a number of theoretical evaluations and empirical studies on mine closure processes. For example, Rao and Pathak (2005), Stacey et al. (2010), Kahn et al. (2001) conducted theoretical evaluations on social economic impacts of mine closure. Swart, (2003), Villas-Bôas and Barreto (2000) evaluated how legal issues and institutional frameworks affect the achievement of successful closure outcomes. They found that lack of a legislative system that integrates various aspects of mine closure impedes achievement of successful mine closure.

There are only a few studies that have developed evaluation criteria for mine closure. Copin (2013), Worall et al. (2008), Logan et al. (2007) developed sets of criteria which included various aspects of mine closure. The mine closure and reclamation success criteria developed by Copin (2013) considered ecological, geochemical, engineering/geotechnical, economic, cultural and social aspects (Table 1), while the framework developed by Worall et al. (2008) considered environmental, economic and socio-political aspects as broad principles which were further broken down into more specific criteria. Logan et al. (2007) included other aspects such as health and safety, statutory and technical achievability in their framework, in addition to environmental, social and economic aspects (Table 1). While these studies provide criteria which would be useful to assess mine closure frameworks, all of them are theoretical studies without application of the criteria against real-world case studies. Copin (2013), pointed out that the criteria would benefit greatly when applied to specific examples, looking at how they are used, difficulties, success and failures.

This study will address the knowledge gap identified above to some extent by first developing a set of criteria that can be used to evaluate how well regulatory approaches incorporate various aspects of mine closure. These criteria will then be applied to evaluate the regulatory approaches to mine closure in Kenya, Western Australia and Queensland.



**Table 1: Summary of mine closure evaluation frameworks**

Criteria	Coppin (2013)	Logan, Murphy & Beale (2007)	Worall et al. (2008)
1.0 Environmental			
1.1 Ecological-	Conservation of biodiversity, ability to support vulnerable or protected species	No net biodiversity loss	Conservation of biodiversity
1.2 Geotechnical / Engineering	Land condition –stable landforms , productive for future	Land condition- stable landforms, sustainable and appropriate rehabilitation	Land condition -Tailings hazardous liquid and solid waste should be appropriately managed
	Structures removal- should be removed or if retained they should be refurbished depending on potential for future land use	Not included in the study	Not included in the study
1.3 Geochemical	Ground contamination, acid rock drainage and leaching should as low as reasonably practical.	no significant unmanaged impacts on surface drainage	No significant off site impacts- such as acid rock drainage, erosion, water contamination, surface water discharge
2.0 Health and safety	Slopes and rock faces access safety and are in condition suitable for future land use. Safety of Public and future occupiers-hazard removal and management of future environmental safety and health	No short/ long term health impacts, contaminated sites are as low as reasonably possible, complies with health and safety standards	Insignificant community safety and health issues related to the site
3.0 Economic	Land utilisation- land values/use based on market valuation, condition suitable for agriculture, forestry ,commercial or industrial use Infrastructure-Access, power capable to support desired land use utilisation	Cost of rehabilitation, equitable wealth sharing, viable non-mining industry contributing to sustainable development	productive land use-, Economic benefit from future plans Cost of rehabilitation -cost for potential offsets, funding sources
4.0 Social community	Community services maintained/ or contribution to alternative employment Demographics- maintaining the correct balance of population and age structure	Community services maintained/ or contribution to alternative employment	Post mining land use planning- through involvement of stakeholders such as Federal, State and local government and consideration of adjacent land use plans to avoid planning conflicts. Ownership- community involvement in order to address their concerns about historic, current and current owners intentions of the land

5.0 Statutory	Not included in the study	Complies with existing legal regulations	Legislation- with compliance Federal, State and local government legislation. Integration of all levels of government to avoid legislative conflicts
6.0 Cultural	Mining historical and cultural value- Retention/ preservation of previous historical value of the site Landscape quality- landforms/ cover that are in harmony with the landscape within which the site fits	Retention / preservation of heritage values	Stakeholder engagement, public participation to address indigenous concerns
7.0 Technical achievability	Not included in the study	Current technology/ Knowledge to achieve option.	Not included in the study.

### 2.2.2 Analytical framework

Based on evaluation framework developed by Coppin (2013), Logan, Murphy & Beale (2007) and Worall et al. (2008) (Table 1), an analytical framework was developed that included various criteria to evaluate regulatory requirements for mine closure processes. These evaluation criteria considered seven characteristics of mine closure: environmental, health and safety, economic, social and community, statutory, cultural and technical achievability (Table 2).

#### *Environmental*

Mining activities can result in large areas of land degradation that without active management or intervention, remain barren thus preventing agricultural, social and economically sustainable development in such areas (Zhang et al., 2011). Rehabilitation of such areas is important for sustainable utilisation, as it allows land previously damaged by mining activities to be restored for future uses (Wassenaar and Yates, 2008). Rehabilitation is a vital characteristic of mine closure since it ensures establishment of ecosystems that have similar diversity and community structure in comparison with reference sites, restoration of indigenous species functional groups necessary for long-term stability, capacity of the physical environment to sustain viable populations, integration with the landscape, resilience to natural disturbances and self-sustainability, safe and stable landforms, agreed post mining land use capability (Chang et al., 2010; Hendrychová, 2008). Regulatory requirement for rehabilitation is essential because it ensures that mining operations mitigate their environmental impacts which otherwise would

generate substantial costs for society through impacts in human health, degraded water quality, loss of biodiversity and foregone opportunities for future land uses (Anderson, 1999). Environmental considerations are a vital evaluation criterion since it provides information on provisions that are there in the legislations, and other rules and guidelines formulated by regulatory authorities regarding rehabilitation, post mining ecosystems, assessment of ecosystems sustainability, post mining land use capability (Table 2:-, 1.1 to 1.5).

### ***Health and safety***

Abandoned mining sites continue to pose potential threat to human safety, health and environment (Logan et al., 2007), thus monitoring of both environmental and human health and safety is crucial. Regulation requirements for health and safety ensure there is no short term or long term health impacts associated with mining closure, disturbed areas are stabilised, hostile materials are covered, erecting fences and warning signs, and post-closure risk assessment is conducted to identify potential post-closure hazards and risks (Logan et al., 2007). Health and safety issues are an important criterion to evaluate what requirements are there in the legislation and other regulatory documents to address health and safety risks associated with mine closure. Are there legal requirements for assessing and identifying post closure hazards and risks? Do the legislations provide guidelines to deal with in-site and off-site and contamination? (Table 2:-, 2.1 to 2.2).

### ***Economic***

Developing an approach to fund rehabilitation and other environmental and social economic objectives is a major challenge for government regulatory agencies (ANZMEC and MCA, 2000). It is important for mining companies to provide financial assurance to ensure that cost associated with reclamation and restoring mined land to subsequent uses, and protecting the public from safety threats such as open pits and shafts are the responsibility on the mine operator (Anderson, 1999). Financial assurance also provides the government and public with protection from assuming the liabilities of any abandoned mine sites in the future. This is an important evaluation criterion to assess whether mine closure regulatory approaches have provisions that require mine companies to provide financial assurances or contribute to environmental protection fund. The criterion also evaluates whether regulatory requirements have any incentives or financial instruments to enhance compliance (Table 2:-, 3.1 to 3.3).

### ***Social and Community***

Closure of a mine raises concerns about continuing environmental management of the mine, unemployment, and continuation of social services (Rao and Pathak, 2005). Post closure impacts of unplanned closing of a mine are severe for the community; hence regulatory approaches should have provisions for stakeholders' consultation and community engagement. Community engagement ensures concerns about provision of alternative livelihoods, sustainability for social services; infrastructural development and maintenance are addressed (Stacey et al., 2010). Community views are very important especially where land capability and final land use decisions are concerned as they are the most likely site users (Rao and Pathak, 2005). Social and community evaluation criteria are important to assess the provisions which are there in the regulation to address the socio-economic impacts associated with mine closure, whether the regulatory approaches provide for stakeholders engagement, and the presence or absence of clearly defined roles of stakeholders (Table 2:, 4.1 to 4.3)

### ***Statutory***

Inadequate and inefficient mine closure policies and legislative controls have resulted to abandoned mine sites, which have substantial environmental liabilities to governments and local communities (Kahn et al., 2001). Statutory requirements ensure that mine operators comply with existing legal regulations. This is an important characteristic since it is critical for mine regulators to have effective legislative framework that ensures successful mine closure process thus minimising closure liability for the government and community. The legislations will be evaluated to identify requirement for submission of closure plans, what level of government are mine closure commitments laid down and who has the legal responsibility for mine closure?(Table 2:-, 5.1 to 5.4)

### ***Cultural***

Mining heritage can highlight aspects of technological, social and regional development (Australian Government, 2006a). Development of appropriate rehabilitation options that ensures retention/ preservation of previous historical value of the site, indigenous concerns about heritage values in the sites, preserving mining heritage for future generations is important. Regulatory requirements that give provisions that address preservation of cultural and mining heritage as well as addressing indigenous concerns are essential in achievement of integrated approach to mine closure. The regulatory approaches will be evaluated for presence or absence

of provisions that require preservation of cultural and historical values and, address indigenous concerns (Table 2: 6)

***Technical achievability***

Despite all the advances in knowledge on mining environments and the improved practices in mine site rehabilitation and mine waste management, there are still limitations in scientific knowledge and technology to deal with tailings, contaminants and the establishment of post-mining ecosystems (Zhang et al., 2011). Since rehabilitating a mine site is more than just planting trees, knowledge and technology to restore and rehabilitate the environment after mining is very crucial in to achieve successful rehabilitation (Chang et al., 2010). This is an important criterion to evaluate whether there regulatory provisions that require mining companies to show their technical capability of achieving mine closure objectives Does the regulation have provisions that require mining companies to show they have the latest technology and scientific knowledge required to achieve successful rehabilitation outcomes? Do regulation require rehabilitation and closure practices be based on best practice and latest technical information? (Table 2:-7.1 to 7.2)

**Table 2: Evaluation framework**

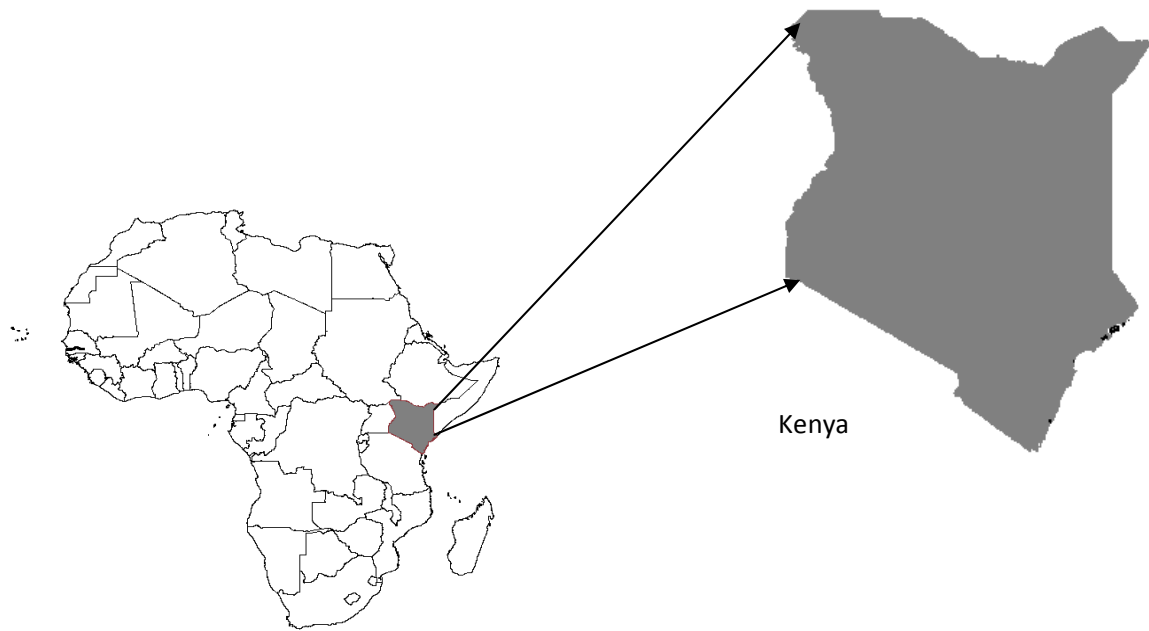
<b>Evaluation criteria</b>	
1	<p>Environmental</p> <p>1.1 Does the regulatory approach have a requirement or incentive for progressive rehabilitation?</p> <p>1.2 Is the regulatory approach broad enough to account for various ecosystems types?</p> <p>1.3 Does the approach address long term ecosystem sustainability</p> <p>1.4 What are the regulatory requirements for post mining ecosystems?</p> <p>1.5 Are there regulatory provisions for post -mining land use suitability assessment criteria?</p>
2	<p>Healthy and safety</p> <p>2.1 Are there regulatory guidelines for post closure risk assessment?</p> <p>2.2 What are the regulatory guidelines for assessment of contaminated site?</p>

**Table 3: Evaluation framework (Cont.)**

<p>3 Economic</p> <p>3.1 Does the regulatory approach have a requirement for mining companies to provide financial assurance to cover closure and rehabilitation costs?</p> <p>3.2 What type(s) of financial instruments are to enhance compliance?</p> <p>3.3 Does the approach have a requirement for mining companies to pay funds to cover the cost of rehabilitation in the event the company does not honour its obligations?</p>
<p>4 Social and community</p> <p>4.1 Is it a requirement of the regulation to involve stakeholders in mine closure process?</p> <p>4.2 Do the regulatory requirements clearly define roles of stakeholders?</p> <p>4.3 Are there any regulatory provisions that address socio-economic impacts of mine closure such as employment loss and sustainability of social services?</p>
<p>5 Statutory</p> <p>5.1 Does the legislation require submission of mine closure plans?</p> <p>5.2 Are mine closure commitments laid down in the legislations?</p> <p>5.3 At what level of government is mine closure commitments laid down; policy or guidelines?</p> <p>5.4 Who has the legal responsibility for mine closure? Is it government? Individual companies?</p>
<p>6 Cultural</p> <p>What are the regulatory requirements in regard to preservation of cultural/heritage values and indigenous concerns?</p>
<p>7 Technical achievability</p> <p>7.1 Are there provisions in the regulatory approach that require mining companies to show their capability to achieve their planned rehabilitation option in terms of knowledge and technology?</p> <p>7.2 Do the regulations specify that rehabilitation and closure practices should be based on best practice and latest technical and scientific information?</p>

### 2.3 Study areas

This study focuses on three study areas: Kenya (Fig. 1), and the Australian states of Western Australia and Queensland (Fig. 2).



Africa

Fig.1. Map of Africa showing Kenya (Grey)



Fig.2. Map of Australia showing Western Australia (Light Grey) and Queensland (Dark Grey)

### **2.3.1 Kenya**

Kenya has a variety of known mineral resources that include soda ash, fluorspar, titanium, rare earth minerals, gold, coal, gemstones, manganese, iron ore, gypsum, diatomite, chromite, silica sand, limestone and dimension stone among others (Government of Kenya, 2013). Historically, Kenya focused on developing farming, tourism, manufacturing and service industries. As a result, the minerals and mining sector currently contributes less than 1 per cent to gross domestic product (GDP) and only 3 per cent to export earnings (Government of Kenya, 2013). However, this is changing. January 2012 saw the commencement of the first gold mine in Kenya, the Kilimapesa Gold Mine. Kenya's first large-scale mine, the Kwale mineral sands project, commenced exports at the end of 2013. It is estimated that this project will triple the country's present mining exports, making it the country's fourth largest foreign exchange earner.

The Kenya Directorate of Mines, which is under the Ministry of Mining, is responsible for developing mining standards and closure guidelines through the *Mining Act 1940* (Government of Kenya, 2013). The National Environmental Management Authority, (NEMA) is responsible for environmental regulation of the industry through the *Environmental Management and Coordination Act, EMCA 1999* (Government of Kenya, 2013). The Environmental Management and Coordination Act (EMCA) addresses "environmental matters that are relevant to sustainable mineral exploration and exploitation by making provisions relevant to regulation of environmental issues arising during exploration, extraction of minerals and closure of mining operations" (Environment Management and coordination Act, 1999). The responsibilities of the regulatory departments are clearly defined under the Acts and, there is no overlap in responsibilities (Fig. 3a).

### **2.3.2 Western Australia**

Western Australia (WA) is one of the great mineral provinces of the world. It hosts 523 commercial mineral projects, which incorporates 1,032 operating mine sites that produce over 50 different minerals (Government of Western Australia, 2013b). About 60 percent of Australia's resources are found in WA. Some of the main Western Australian mineral resources include petroleum, gold, iron ore, diamonds, nickel, base metals, mineral sands and alumina (Government of Western Australia, 2013b).



The resources industry plays a key role in the economic development and prosperity of the State, making up 28 percent of the state's production (ABS, 2012). It contributed \$89 billion in to the WA economy 2011-12 (KPMG, 2013). Over 90 per cent of this value added contribution came directly from resource extraction and services, with the balance from resource-related manufacturing and resource-related construction. On aggregate, the resources sector directly employed 142,752 people or 11 per cent of the total WA employment in 2011-12, being the single largest economic sector in the state in terms of employment (KPMG, 2013).

The Department of Minerals and Petroleum (DMP) is the lead regulator and decision-making authority for mining projects in WA under the *Mining Act 1978* (Government of Western Australia, 2015). DMP has the role of regulating the industry to ensure that closure conditions are applied and commitments made are implemented during the life of the mining project (Government of Western Australia, 2015). The Environmental Protection Authority (EPA) is responsible for environmental regulation of the industry through the *Environmental Protection Act 1986 (EP Act)* (Government of Western Australia, 2015). The EPA conducts environmental impact assessments of significant proposals in WA in accordance with part IV of the EPA Act (Government of Western Australia, 2015). The Department of State Development (DSD) administers projects which the State considers significant under the *State Agreement Acts* (Government of Western Australia, 2015). Although projects under State Agreement Act are not subject to the Mining Act, they are subject to Environment Protection. Act. Rehabilitation and closure of State Agreement Act projects are assessed and regulated by the EPA (Government of Western Australia, 2015) The regulatory framework has clearly defined responsibilities for each department and thus no chances of conflicts resulting from responsibilities overlap ((Fig. 3b)

### **2.3.3 Queensland**

Queensland (QLD) is rich in natural resources with more than 30 billion tonnes of coal deposits along with metallic and non-metallic minerals and petroleum, notably coal seam gas (Government of Queensland, 2015). After coal, metalliferous mining is one of the most significant economic contributors to the State's economy, leading Australia in the production of copper, lead, silver and zinc (Australian Government, 2014).

Queensland's mining and energy resources contribution to the State's economy generates \$26.6 billion or 8.8 percent of gross state product, and represents 72 percent of all State exports, worth

over \$34.6 billion, with direct and indirect employment of over 260 000 people (Government of Queensland, 2015).

The Queensland Department of Natural Resources and Mines (DNRM) is responsible for granting and administrating mining tenure through the *Mineral Resources Act 1989*, while the Department of Environment and Heritage Protection (DEHP) is responsible for the environmental regulation of the industry through the *Environmental Protection Act 1994* (Queensland Mining Council, 2001) (Fig. 3c). The *Environmental Protection Regulation 1998* has key regulatory guidelines which contain various codes of environmental compliance developed under those regulations (Queensland Mining Council, 2001).The regulations require significantly disturbed land to be rehabilitated to meet the conditions of the environmental authority. The regulatory framework has clearly defined responsibilities for each department and thus no chances of conflicts resulting from responsibilities overlap (Fig. 3c).

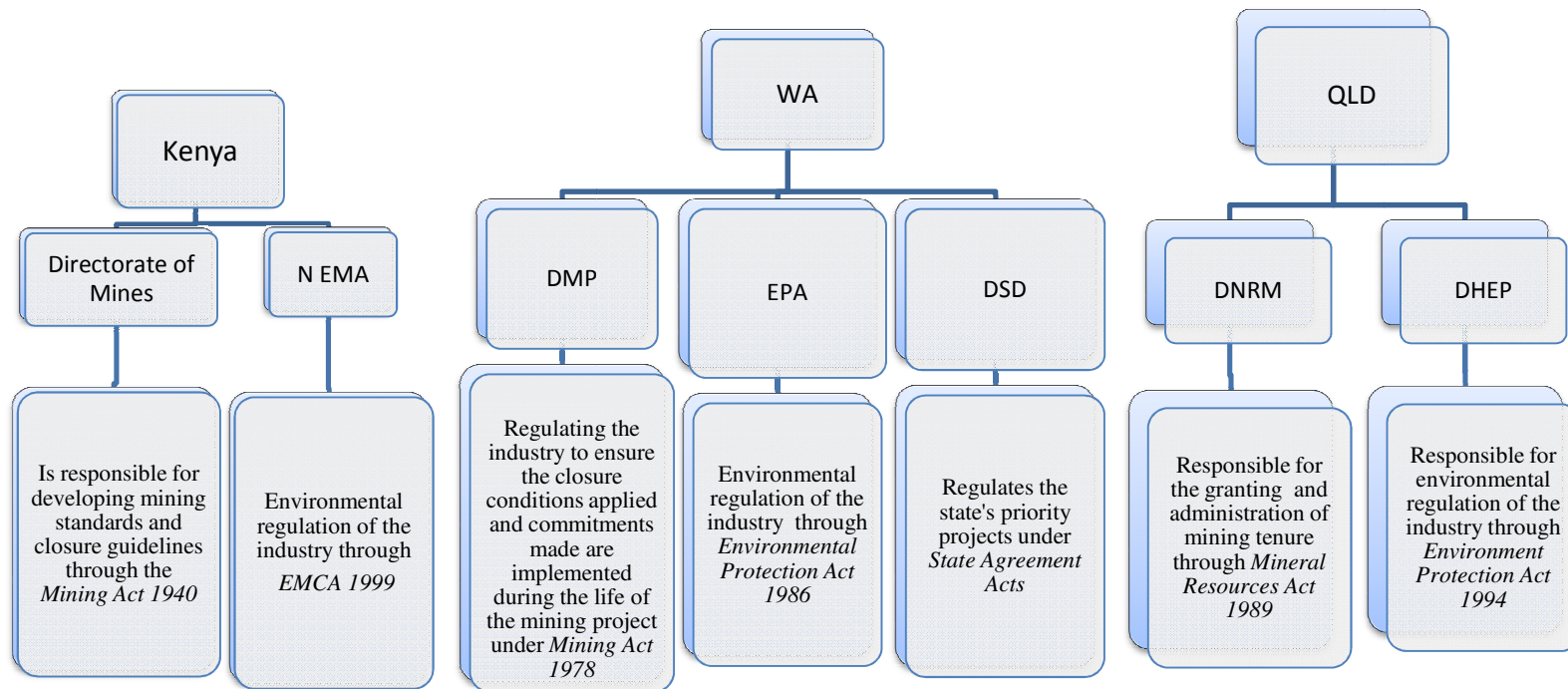


Figure 3a: Kenya's regulatory framework

Figure 3b: Summary of WA's regulatory framework

Figure 3c: Summary of QLD regulatory framework

### **3. Results**

This section summarises the evaluation results for mine closure regulatory approaches in Kenya, Western Australia and Queensland for each criterion in sections 3.1 to 3.7. Appendices A, B, and C provide the detailed evaluation results of mine closure approaches in each study area.

#### **3.1 Environmental**

In all three case study areas, environmental aspect of mine closure is taken into account but the extent to which it is incorporated differs. The Kenyan regulatory approach does not have provisions that address the types and sustainability of post- mining ecosystems. It also does not have provisions for progressive rehabilitation during the life of a mine. However, Part XI Section 152(d) of the *Mining bill 2014* has a requirement for post mining land to be restored to its original status or to an “acceptable and reasonable condition as close as possible to its original state” (Mining Bill, 2014). Western Australia and Queensland both have provisions for progressive rehabilitation, sustainability of ecosystems and assessment of suitability of post mining land use, however, Western Australia lacks provisions that account for various types of ecosystems.

In Western Australia proponents are required to fully integrate progressive rehabilitation activities into the day-to-day mining operations to ensure materials and resources are available to undertake the rehabilitation work (Government of Western Australia, 2015). Rehabilitated sites are required to be ecologically stable and capable of sustaining post-mining land uses (Mining Act, 1978; Environment Protection Act, 1986). Under Section 4.8.1 of the guidelines for preparing closure plans, post mining land use(s) have to be relevant to the environment in which the mine will operate or is operating; achievable in the context of post-mining land capability; acceptable to the key stakeholders; and ecologically sustainable in the context of local and regional environment (Government of Western Australia, 2015).

In Queensland, environmental management is to be undertaken in a way that attains ecologically sustainable development (Environment Protection Act, 1994). Rehabilitation of areas disturbed by mining has to result in sites that are stable and able to sustain an agreed post-mining land use (Government of Queensland, 2014). Assessment criteria for post-mining exist. Section 4.3 of the rehabilitation requirements for mining resource activities specifies prior land capability and use

of the site needs to be considered, as well as the existing uses of adjacent land and the views of landholders when selecting the future land use (Government of Queensland, 2014)

### **3.2 Health and safety**

Kenya's regulatory approach lacks provisions that address health and safety aspect of mine closure. Western Australia and Queensland, on the other hand both have provisions for post closure risk assessments. Western Australia has also provisions for assessment of contaminated sites.

In Western Australia, rehabilitated mines are required to be safe to humans and animals (Mining Act, 1978). In Section 3.2 of the guidelines for preparing mine closure plans, mine operators are required to provide a structured risk management process which will be used to identify assess and manage potential post closure risks. The *Contaminated Sites Act* provides for investigation and assessment of contaminated sites. Section 31(1)(c) of *contaminated site regulations 2006* requires proponents to submit an auditor's report to accompany every assessment, monitoring or remediation report submitted to Department of Environment Regulation (Government of Western Australia, 2006).

In Queensland, mine operators are required under Section 3.4 of the guidelines for rehabilitation of mining resource activities, to provide information on which management controls will be implemented to manage safety hazards that remain at mine closure or inevitably will develop after closure in their application documents (Government of Queensland, 2014).

### **3.3 Economic**

In all the three case study areas, economic aspects of mine closure have been incorporated in the regulatory approaches (Table 4). All three regulatory approaches have requirements for operators to show their capability of meeting closure and rehabilitation costs by providing a financial assurance (Table 3). The operators are also required to pay funds which act as financial security to cover the cost of rehabilitation in the event an operator fails to honour obligations or go bankrupt (Table 3).

The regulatory approaches for the three case study areas use financial incentives to enhance compliance. Both Kenya and Queensland use financial bonds which are refundable when the mining companies meet their rehabilitation obligations (Environment Protection Act, 1994;

Mining Bill, 2014). Western Australia, on the other hand uses a Mining Rehabilitation Fund (MRF). The contribution of the operator to the MRF is calculated per area of degraded land (Government of Western Australia, 2013a; Leybourne, 2014). This encourages mining companies to undertake progressive rehabilitation to reduce area of degraded land which in turn reduces the amount payable to MRF.

Table 4: Requirements for financial assurance and funds payment

<b>Jurisdiction</b>	<b>Financial assurance</b>	<b>Payment of funds</b>
Kenya	Under Section 71 of Mining Act 1940 mining lease applicant are required to show that they possess enough funds to cover all mine operations (Mining Act, 1940). Section 3.5 of mining and minerals policy 2013 mining companies are required also to provide a suitable upfront guarantee to meet rehabilitation and closure obligations (Government of Kenya, 2013).	National Environment Restoration Fund which is levied from projects proponents' acts as a supplementary insurance for the mitigation of environmental degradation where the operator fails to meet closure obligations or is not identifiable (Environment Management and Cordination Act, 1999).
Western Australia	Closure estimates are to be provided at commencement(Government of Western Australia, 2015)	Mining rehabilitation fund is used to cover the cost of rehabilitation where the operator fails to meet rehabilitation obligations (Mining Rehabilitation Fund Act, 2012); Government of Western Australia, 2013a).
Queensland	The holder of an environmental authority is required to provide a financial assurance in form of a bond before commencement of any activity, the financial assurance acts as security for compliance (Mineral Resources Act, 1989; Environment Protection Act, 1994)	The financial assurance bonds provided under Section 292 of EP Act 1994 and section 190 of Mineral resources Act 1989 covers the cost or rehabilitation in the event the company fails to honour its obligations or becomes bankrupt (Mineral Resources Act, 1989; Environment Protection Act, 1994)

### **3.4 Social and community**

Western Australian and Queensland regulatory approaches take into account of some aspects of social community impacts of mine closure through provisions that require stakeholder engagement in mine closure processes. In Western Australia, mine operators are required to provide a stakeholder engagement register giving details of rehabilitation and closure consultation they have conducted (Government of Western Australia, 2015). The responsibilities of stakeholders are provided for in Sections 4.8 and 4.9 of the guidelines for preparing mine closure plans (Government of Western Australia, 2015). Queensland regulations requires mine closure completion criteria be developed in consultation with stakeholders such as the landowner, local government, indigenous groups, community groups and various state departments (Government of Queensland, 2014). The roles of stakeholders are outlined in Section 4.3 of rehabilitation requirements for mining resource activities (Government of Queensland, 2014). The Kenyan regulation does not include provisions that require stakeholder engagement during mine closure process. Furthermore, none of the three regulatory approaches have provisions that address loss of employment and sustainability of social services after mine closure.

### **3.5 Statutory**

In all three case study areas, mine closure commitments are laid down in the legislation. In Kenya, mine closure commitments are laid down under Section 153(1) of *Mining bill 2014* (Mining Bill, 2014). In Western Australia, mine closure commitments are laid down under Section 74(1)(ca) of the *Mining Act 1978* (Mining Act 1978), except for operations that are coordinated by Department of State Development under State Agreement Acts and are not subject to *Mining Act 1978*. The closure and rehabilitation of state agreement projects is regulated under EP Act 1986 (Government of Western Australia, 2015). The guidelines for preparing mine closure plans (2015) issued by the regulator provide detailed commitments guidance to the operators. In Queensland, mine closure commitments are laid down under Section 288 subsection 1(c) (iii) *EP Act 1994* (Environment Protection Act, 1994). Rehabilitation requirements for mining resource activities (2014), issued by regulator give detailed guidelines of mine closure commitments to the operators.

Submission of closure plans is a statutory requirement in all three case study areas. Submission of closure plans gives mining operators the legal responsibility for mine closure. Submission of

closure plans is a condition for approval of mine proposals in all the three case study areas. (Mining Act, 1978; Environment Protection Act, 1994; Mining Bill, 2014)

### **3.6 Cultural**

No provisions were found in Kenya and Western Australia that require preservation of cultural heritage. In Queensland, Section 3.2 of the rehabilitation requirements for mining resource activities specify that at some sites European and indigenous heritage that has been registered for the site has to be preserved. In Australia, heritage values are managed under other legislations that do not regulate mine closure The *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*, which is the Australian Government's key national heritage law, covers situations where the state laws do not offer effective protection of heritage sites (Australian Government, 2006b). Any action that is likely to have a significant impact on a World Heritage property or a national heritage place must be referred to the Commonwealth Environment Minister for further consideration. Preservation and protection of areas and objects in Australia and in Australian waters that are of particular significance to Aboriginals in accordance with Aboriginal tradition is provided for in the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (ATSHP Act)* (Australian Government, 2006b)

### **3.7 Technical achievability**

None of the regulatory approaches had provisions that specify rehabilitation and closure practices should be based on latest technical and scientific information. However, in Western Australia, Section 4.10.1 of the mine closure guidelines require mine closure plans to provide a summary of the best available data on aspects of the physical and biological environments, as well as the social and economic aspects that are critical for successfully meeting mine closure outcomes (Government of Western Australia, 2015). Lack of provisions that require rehabilitation and closure practices be based on latest technical and scientific information impede achievement of successful closure outcomes.



**Table 5: Summary of regulatory approaches evaluation results**

<b>Criteria</b>	<b>Kenya</b>	<b>Western Australia</b>	<b>Queensland</b>
Environmental	Partly met	Partly met	Fully met
Health and safety	Not met	Fully met	Partly met
Economic	Fully met	Fully met	Fully met
Social community	Not met	Partly met	Partly met
Statutory	Fully met	Fully met	Fully met
Cultural	Not met	Not met	Fully met
Technical achievability	Not met	Partly met	Not met

#### **4. Discussion**

This study assessed how well existing regulatory approaches to mine closure incorporate aspects that are necessary for successful mine closure as defined by a set of evaluation criteria. The study demonstrated a number of similarities in the regulatory approaches to mine closure of each of the three case study areas. All have submission of closure plans as a statutory requirement for the licensing of operations. All have a requirement for mining operators to provide financial assurance, and all have mine closure commitments laid down in the legislation. However, the extent to which each adopts other aspects of mine closure differs.

One of the evaluation criteria of this study was on environmental considerations for successful mine closure. It was found that Queensland has integrated environmental aspect into its mine closure regulatory approach considerably well as compared to Western Australia and Kenya (Table 4). It has provisions for progressive rehabilitation, ecosystems and post- mining land suitability. Western Australia's approach lacked provisions that account for various types of ecosystems. Kenya's regulatory approach does not provide for ecosystems restoration and progressive rehabilitation. Lack of provisions for ecosystem restoration potentially represents a

big threat to conservation of biodiversity in Kenya. It also poses a challenge to successful mine closure since a successful mine closure is the one that results in no net biodiversity loss (Copin, 2013). A lack of progressive rehabilitation increases the chances of having an increase in the number of abandoned mine sites. In general, when progressive rehabilitation is not undertaken, remediation will be more difficult and require more resources (both human and financial) to address the problem (Warhurst and Noronha, 2000). Additionally, the demand for financial resources to undertake rehabilitation will occur at a time when the mining firms are experiencing a reduction in cash flows, and in such cases the companies may not be able to meet their rehabilitation obligations.

This study found that both Kenya and Queensland regulatory approaches lack guidelines for the assessment of site contamination. This may hinder achievement of successful closure outcomes since a successful closure outcome should result in minimal contamination therefore low risk to human health (Logan et al., 2007). Kenya's regulatory approach also lacked guidelines for post closure risk assessment. This compromises the health and safety of the community, suitability of future land use and achievement of successful closure outcomes. A successful mine closure should ensure safety of public and future occupiers is not compromised, and address hazard removal and management of future environmental safety and health (Copin, 2013).

Western Australia and Queensland have regulatory requirements for stakeholder involvement during mine closure processes. In both cases, the responsibilities of stakeholders are clearly defined. Involvement of stakeholders in mine closure processes is essential to the community who are post-mining land users. Moreover, community consultation ensures that the views and concerns of all stakeholders are taken into account throughout mine closure process, thus promoting more successful mine closure. The study found that Kenya has some requirements for stakeholder involvement during the licensing of mining operations but lacks these provisions during mine closure. This is a setback to achieving successful mine closure outcome since the views and concerns of stakeholders will not be considered in decision making.

All three regulatory approaches lack provisions that address socio-economic impacts of mine closure even though all have provisions that require mine operators to commit to employ locals and providing some community services during the licensing. Mine closure results in the loss of employment and the future of services that the mining companies provided is not guaranteed.

Lack of regulatory provisions that address transitional issues such as concerns about provision of alternative livelihoods, sustainability for social services, infrastructural development and maintenance impedes sustainable mine closure.

Western Australia and Kenya both lack provisions that address preservation of historical and cultural sites. This may not have any implication in Western Australia since the *National Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* covers situations where the state laws do not offer effective protection of such sites (Australian Government, 2006b). Lack of regulatory requirements for preservation of heritage sites puts Kenya at risk of losing its cultural and historic sites.

Technical achievability is an essential criterion evaluates the technical capability of achieving successful closure outcomes. It also evaluates whether the regulations have provisions that specify that rehabilitation and closure practices should be based on best practice and latest technical and scientific information. The study found that none of the regulatory framework that had provisions that rehabilitation and closure practices should be based on best practice and latest technical and scientific information. Although Western Australia's regulatory framework has provisions that require mining companies to show their knowledge of the physical and biological environments, and social and economic aspects, it does not specify whether this information should be latest and closure practices should be based on best practice. This information is important when making decisions on post-mining land uses and establishment of post mining ecosystems. Lack of this provision in mine closure regulation compromises the assessment of whether the company has sufficient latest ecological knowledge or engineering capacity to achieve rehabilitation option. Lack of sufficient technical and scientific knowledge may result into undesirable rehabilitation outcomes and in some cases loss of life and property as a result of accidents.

The study has shown that the regulatory approaches to mine closure for the three case study areas do not integrate all aspects of mine closure to the same extent. Western Australia and Queensland have adopted an integrated approach to a greater extent than Kenya, although each fail to meet at least two the evaluation criteria developed in this study. As was the expected, Kenya did not meet many evaluation criteria and therefore has potential to learn from the other two regions. Given that Kenya is a country where mining is an upcoming industry, there is a

need to improve its current regulations approach to incorporate the remaining aspects of mine closure to ensure successful closure outcomes. However, the existing regulatory approaches for Western Australia and Queensland also require improvement to incorporate the missing aspects.

Previous studies that developed evaluation criteria for mine closure success (Copin, 2013; Logan et al., 2007; Worall et al., 2008), did not apply the criteria to evaluate any real-world case studies. This study addresses the knowledge gap identified from previous studies to some extent. Although this study evaluated real-world regulatory approaches to mine closure, the scope did not extend to evaluate actual rehabilitation projects. This is an important area of future research; the evaluation of how well on-the-ground rehabilitation projects incorporate various aspects of mine closure.

## **5. Conclusion**

This research identified the fundamental components necessary for successful mine site closure, namely; environmental, health and safety, economic, social and community, statutory, cultural and technical achievability. It provides a detailed understanding of regulatory approaches to mine closure in three, case study areas: Kenya, Western Australia and Queensland. The results demonstrate which aspects of mine closure have not been integrated in the existing regulatory approaches. Incorporating these aspects in mine closure regulation will contribute to improvement of mine closure processes. The evaluation framework developed in this study can contribute to development of best practice guidelines for mine closure planning. This study will also be useful to future studies as it provides an analytical framework that can be used to evaluate actual rehabilitation projects or mine closure regulatory approaches for other jurisdictions.

## References

- ABS, 2012. Mining industry remains WA's biggest economic contributor, Mining industry remains WA's biggest economic contributor, Australian Bureau of Statistics, Canberra. <http://www.abs.gov.au> > ABS Home > Statistics > By Release Date. Accessed on 25<sup>th</sup> August, 2015
- Allen, C., Maurer, A., Fainstein, M., 2001. Mine site rehabilitation. An economic review of current policy issues. Australian Bureau of Agricultural and Resource Economics, Canberra. <http://www.agriculture.gov.au/abares/publications/> Accessed on 5<sup>th</sup> April, 2015
- Anderson, K., 1999. Using financial assurances to manage the environmental risks of mining projects, Environmental policy in mining : Corporate strategy and planning for closure. Lewis Publishers, Washington, D.C.
- ANZMEC, MCA, 2000. Strategic Framework for Mine Closure. Australian and New Zealand Minerals and Energy Council Minerals Council of Australia. <http://www.sernageomin.cl/pdf/mineria/cierrefaena/DocumentosRelacionados/Strategic-Framework-Mine-Closure.pdf>. Accessed on 25<sup>th</sup> March, 2015
- Australian Government, 2006a. Mine Closure and Completion, Department of Industry Tourism and Resources. <http://www.industry.gov.au/resource/Documents/LPSDP/LPSDP-MineClosureCompletionHandbook.pdf>. Accessed on 8<sup>th</sup> April, 2015
- Australian Government, 2006b. Mine rehabilitation, Department of Industry Tourism and Resources, Commonwealth of Australia, Canberra. [http://www.dmp.wa.gov.au/documents/mine\\_rehab.pdf](http://www.dmp.wa.gov.au/documents/mine_rehab.pdf). Accessed on 13<sup>th</sup> July, 2015
- Australian Government, 2014. Queensland's metalliferous and industrial minerals, Department of Industry Tourism and Resources, Queensland State government, Brisbane. [https://www.dnrm.qld.gov.au/data/assets/pdf\\_file/0011/271919/metalliferous-industrial-minerals-2014-part-1.pdf](https://www.dnrm.qld.gov.au/data/assets/pdf_file/0011/271919/metalliferous-industrial-minerals-2014-part-1.pdf). Accessed on 21<sup>st</sup> June, 2015
- Centre for Social Responsibility in Mining, 2007. Estimating Social - Economic Impacts of Mine Closure, Minerals Council of Australia Global Sustainable Development Conference, Cairns.
- Chang, J., Lv, H., Li, J., Wang, W., 2010. Reclamation and rehabilitation of the post-mining landscape in China. AusIMM Bulletin, 38-42.
- Copin, N.J., 2013. *A framework for success criteria for mine closure, reclamation and post -mining regeneration*, in: Fourie, A., Tibbett, M., Digby, C. (Eds.), Eighth International Seminar on Mine Closure. Australian Centre For Geomechanics, The University of Western Australia, Cornwall, England.
- Danielson, L., Nixon, M., 2000. *Current regulatory approaches to mine closure in the United States, Environmental Policy in Mining*. Corporate Strategy and Planning for Closure, Lewis Publishers, Washington D.C.
- Department of Mines and Natural Resources, 2014. Abandoned mines Queensland. <http://mines.industry.qld.gov.au/safety-and-health/abandoned-mine-lands-program.html>. Accessed on 15<sup>th</sup> March, 2015
- Finucane, S.J., 2008. Thinking about the end before you start- Integrating mine closure planning into feasibility studies and environmental and social impact assessment, in: Fourie, A., Tibbett, M., Weirersby, I.M. (Eds.), Third International Seminar on Mine Closure. Australian Centre For Geomechanics, The University of Western Australia, Johannesburg, South Africa.
- Flores, J.C.C., Lima, H.M., Herrmann, H., 2007. Mine closure- Legal, Social and Environmental aspects in Brazil, in: Fourie, A., Tibbett, M., Wiertz, J. (Eds.), Second International Seminar on Mine Closure. Australian Centre For Geomechanics, The University of Western Australia, Chile.
- Government of Kenya, 2013. Minerals and Mining Policy, in: Ministry of Mining. [ices.or.ke/wp.../05/Minerals-Mining-policy-draft-December-2013.pdf](http://ices.or.ke/wp.../05/Minerals-Mining-policy-draft-December-2013.pdf). Accessed on 13<sup>th</sup> May, 2015

- Government of Queensland, 2014. Rehabilitation requirements for mining resource activities, in: Department of Heritage and Environment Protection, Government of Queensland, Brisbane. <https://www.ehp.qld.gov.au/era/mining/mining-rehabilitation-em1122.pdf>. Accessed on 23<sup>rd</sup> June, 2015
- Government of Queensland, 2015. Queensland's mining and petroleum industry overview, in: Department of Natural Resources and Mines, Queensland State government, Brisbane. [https://www.dnrm.qld.gov.au/data/assets/pdf\\_file/0004/238072/queensland-mining-petroleum-overview.pdf](https://www.dnrm.qld.gov.au/data/assets/pdf_file/0004/238072/queensland-mining-petroleum-overview.pdf). Accessed on 2<sup>nd</sup> July, 2015
- Government of Western Australia, 2006. Contaminated Sites Regulations of 2006, in: Department of Environment Regulation, State Law Publisher, Western Australia. [www.slp.wa.gov.au/legislation/.../dec\\_main\\_mrtitle\\_1261\\_homepage.html](http://www.slp.wa.gov.au/legislation/.../dec_main_mrtitle_1261_homepage.html). Accessed on 30<sup>th</sup> July 2015
- Government of Western Australia, 2013a. Mining Rehabilitation Fund Regulations 2013, in: Department of Minerals and Petroleum, State Law Publisher, Western Australia. [www.slp.wa.gov.au/legislation/.../main\\_mrtitle\\_13067\\_homepage.html](http://www.slp.wa.gov.au/legislation/.../main_mrtitle_13067_homepage.html). Accessed on 30<sup>th</sup> July, 2015
- Government of Western Australia, 2013b. Western Australian Mineral and Petroleum Statistics Digest 2012–13, in: Department of Minerals and Petroleum, Government of Western Australia, Western Australia. [http://www.dmp.wa.gov.au/documents/statistics\\_release/2012-13\\_web\\_acces\\_Digest.pdf](http://www.dmp.wa.gov.au/documents/statistics_release/2012-13_web_acces_Digest.pdf). Accessed on 27<sup>th</sup> July, 2015
- Government of Western Australia, 2015. Guidelines for Preparing Mine Closure Plans, in: Department of Minerals and Petroleum, Environment Protection Authority. <http://www.dmp.wa.gov.au/documents/ENV-MEB-121.pdf>. Accessed on 29<sup>th</sup> April, 2015
- Hendrychová, M., 2008. Reclamation success in post-mining landscapes in the Czech Republic: a review of pedological and biological studies. *Journal of Landscape Studies* 1, 63-78.
- International Institute for Environment and Development, 2002. *Breaking New Ground: Mining, Minerals and Sustainable Development*. International Institute for Environment and Development, London, pp. 1-476.
- International Council on Mining and Metals, I., 2003. 10 Principles for sustainable development performance. International Council on Mining and Metals. <https://www.icmm.com/our-work/sustainable-development-framework/10-principles> Accessed on 29<sup>th</sup> March, 2015
- Jenkins, H., Yakovleva, N., 2006. Corporate social responsibility in the mining industry: Exploring trends in social and environmental disclosure. *Journal of Cleaner Production* 14, 271-284.
- Kahn, J.R., Franceschi, D., Curi, A., Vale, E., 2001. *Economic and financial aspects of mine closure*. Natural Resources Forum 25, 265-274.
- Kenya, Mining Act, Cap. 306 of 1940. [www.kenyalaw.org/klr/fileadmin//Acts/MiningAct\\_Cap306.pdf](http://www.kenyalaw.org/klr/fileadmin//Acts/MiningAct_Cap306.pdf). Accessed on 25<sup>th</sup> July, 2015
- Kenya, Environment Management and Coordination Act. of 1999. <http://www.nema.go.ke/index.php/laws-and-guidelines/environmental-act-emca> Accessed on 5<sup>th</sup> April, 2015.
- Kenya, Mining Bill, Bill No. 8. of 2014. [www.cickenya.org/index.php/legislation/item/329-the-mining-bill-2013](http://www.cickenya.org/index.php/legislation/item/329-the-mining-bill-2013) Accessed on 25<sup>th</sup> July, 2015.
- KPMG, 2013. Economic reach of the Western Australian resources sector. Chamber of Minerals and Energy of Western Australia, Australia. <https://www.cmewa.com/policy-and-publications/annual-reportsspecialpublications/preview?path=Economic%2BReach%2Bof%2Bthe%2BWestern%2BAustralian%2BResources%2BSector.pdf>. Accessed on 25<sup>th</sup> July, 2015
- Laurence, D., 2006. Optimisation of the mine closure process. *Journal of Cleaner Production* 14, 285-298.
- Leybourne, M.L., 2014. Ensuring Rehabilitation into the future- The Western Australian Mining Rehabilitation Fund, Life-of- Mine, Brisbane, Queensland.

- Logan, R.B., Murphy, D.P., Beale, C.A., 2007. *Mine Closure Risk and Decision Analysis*, in: Fourie, A., Tibbett, M., Wiertz, J. (Eds.), *Second International Seminar on Mine Closure*. Australian Centre For Geomechanics, The University of Western Australia, Chile.
- Mulvey, P., Baker, A., Scott, a.P., 2012. *Mine Closure and Waste -Responsibilities and Liabilities, Environmental mine management*. Environmental Earth Sciences, Sydney.
- Queensland, Mineral Resources Act of 1989.  
<https://www.legislation.qld.gov.au/LEGISLTN/.../M/MineralReA89.pdf>. Accessed on 30<sup>th</sup> July, 2015
- Queensland, Environment Protection Act of 1994.  
<https://www.legislation.qld.gov.au/legisltm/current/e/envprota94.pdf>. Accessed on 15<sup>th</sup> July, 2015
- Queensland Mining Council, 2001. *Guideline for mine closure planning in Queensland*, in: Queensland Mining Council, Queensland Mining Council, Brisbane.
- Rao, P.M., Pathak, K., 2005. Socio-economic impacts of mine closure: a casestudy using satellite imagery. *International Journal of Environmental Studies* 62, 555-570.
- Robertson, S., Blackwell, B., 2014. Mine Lifecycle planning and enduring value for remote communities. *International Journal of Rural Law and Policy*, 1-11.
- Sansom, M., 2014. Deep dig for answers on disused mines.  
<http://www.governmentnews.com.au/2014/07/deep-dig-answers-disused-mines/> Accessed on 6<sup>th</sup> April, 2015.
- Stacey, J., Naude, A., Hermanus, M., Frankel, P., 2010. The socio-economic aspects of mine closure and sustainable development: literature overview and lessons for the socio-economic aspects of closure– Report 1. *Journal of the South African Institute of Mining and Metallurgy* 110, 379-394.
- Swart, E., 2003. The South African legislative framework for mine closure. *Journal-South African Institute of Mining and Metallurgy* 103, 489-492.
- Unger, C., Lechner, A., Glenn, V., Edraki, M., Mulligan, D., 2012. Mapping and Prioritising rehabilitation of abandoned mines in Australia, *Life of Mine 2012, Maximising mine rehabilitation outcomes*, AusIMM/CMLR.
- Villas-Bôas, R.C., Barreto, M.L., 2000. Mine Closure: Iberoamerican Experiences. CYTED-CETEM.  
<http://www.ebookdb.org/reading/101615G36A1E1D372A3E1E69/Mine-Closure-Iberoamerican-Experiences> Accessed on 6<sup>th</sup> June, 2015]
- Warhurst, A., Noronha, L., 1999. *Environmental policy in mining: Corporate strategy and planning for closure*. CRC Press, New York.
- Warhurst, A., Noronha, L., 2000. *Corporate strategy and viable future land use: planning for closure from the outset of mining*. *Natural Resources Forum* 24, 153-164.
- Wassenaar, T.D., Yates, M., 2008. *Is it Mineral? Is it Vegetable? Perceptions about ecological rehabilitation in the Namibian mining industry*, in: Fourie, A., Tibbett, M., Weirersby, I.M. (Eds.), *Third International Seminar on Mine Closure*. Australian Centre For Geomechanics, The University of Western Australia, Johannesburg, SouthAfrica.
- Welsh, D.R., 2007. *Mine Closure- A regulators guide to the things that matter*, in: Fourie, A., Tibbett, M., Wiertz, J. (Eds.), *Second International Seminar on Mine Closure*. Australian Centre For Geomechanics, The University of Western Australia, Chile.
- Western Australia, Mining Act, Act No. 107 of 1978.  
[https://www.slp.wa.gov.au/legislation//main\\_mrtitle\\_604\\_homepage.html](https://www.slp.wa.gov.au/legislation//main_mrtitle_604_homepage.html). Accessed on 29<sup>th</sup> July, 2015
- Western Australia, Environment Protection Act of 1986.  
[www.slp.wa.gov.au/legislation/statutes.../main\\_mrtitle\\_304\\_homepage.html](http://www.slp.wa.gov.au/legislation/statutes.../main_mrtitle_304_homepage.html). Accessed on 18<sup>th</sup> July, 2015
- Western Australia, Mining Rehabilitation Fund Act of 2012.  
[http://www.slp.wa.gov.au/legislation/statutes.nsf/main\\_mrtitle\\_12984\\_homepage.html](http://www.slp.wa.gov.au/legislation/statutes.nsf/main_mrtitle_12984_homepage.html). Accessed on 30<sup>th</sup> July, 2015

- Worall, R.C., Neil, D.T., Brereton, D., Mulligan, D.R., 2008. A sustainability Criteria and Indicators for Legacy Mine Land, in: Fourie, A., Tibbett, M., Weirersby, I.M. (Eds.), Third International Seminar on Mine Closure. Australian Centre For Geomechanics, The University of Western Australia, Johannesburg, SouthAfrica.
- Zhang, J., Fu, M., Hassani, F., Zeng, H., Geng, Y., Bai, Z., 2011. Land Use-Based Landscape Planning and Restoration in Mine Closure Areas. *Environmental Management* 47, 739-750.



## APPENDICES

### *Detailed assessment results of the regulatory approach in each case study area*

#### **APPENDIX A- Kenya regulatory approach evaluation criteria**

<b>Evaluation criteria</b>	<b>Provision under the regulatory approach</b>
1 Environmental	
1.1 Does the regulatory approach have a requirement or incentive for progressive rehabilitation?	Unable to find any documented provisions
1.2 Is the regulatory approach broad enough to account for various ecosystems types?	Unable to find any documented provisions
1.3 Does the approach address long term ecosystem sustainability	Unable to find any documented provisions
1.4 What are the regulatory requirements for post mining ecosystems?	No provisions found under <i>Mining Act 1940</i> , however, Part XI section 152(d) of the Mining bill 2014 awaiting to be enacted requires that upon completion of prospecting or mining, the land in question shall be restored to its original status or to an acceptable and reasonable condition as close as possible to its original state (Mining Bill, 2014)
1.5 Are there regulatory provisions for post -mining land use suitability assessment?	Unable to find any documented provisions
2 Healthy and safety	
2.1 Are there regulatory guidelines for post closure risk assessment?	Unable to find any documented provisions
2.2 What are the regulatory guidelines for assessment of contaminated site?	Unable to find any documented provisions
3 Economic	
3.1 Does the regulatory approach have a requirement for mining companies to provide financial assurance to cover closure and rehabilitation costs?	Under section 71 of <i>Mining Act 1940</i> the Commissioner may require an applicant for a lease to show to his satisfaction that he possesses or commands or will within twelve months from the date of his application command sufficient working capital to ensure the development of and working of mining operations on the area applied for, and to supply such other information as the Commissioner may require (Mining Act ,1940).

	Minerals an Mining policy 2013 section 3.5 mining companies will be required also to provide a suitable upfront guarantee or set aside a reserve fund to meet its rehabilitation and mine closure obligations (Government of Kenya, 2013)
3.2 What type(s) of financial instruments are to enhance compliance?	<p>Under section 28(2) of EMCA 1999 the “Minister responsible for finance may prescribe payment of deposits bonds by those persons engaged in activities or operating industrial plants and other undertakings, which have or are most likely to have significant adverse effects on the environment when operated in a manner that is not in conformity with good environmental practices” (Environment Management and Cordination Act, 1999)</p> <p>Part XI section154(1)of Mining bill 2014 waiting for enactment states “An applicant for a prospecting licence, a retention licence or a mining licence shall provide a bond or some other form of financial security in this section called an environmental- protection bond sufficient to cover the costs associated with the implementation of the environmental and rehabilitation obligations of the holder under this Act (Mining Bill, 2014)”</p>
3.3 Are there regulatory requirement for mining companies to pay funds to cover the cost of rehabilitation in the event the company does not honour its obligations	Under section 25 of <i>Environmental Management and Co-ordination Act 1999</i> , National Environment Restoration Fund which is levied from projects proponents which act as a supplementary insurance for the mitigation of environmental degradation where the perpetrator is not identifiable or where exceptional circumstances require the Authority to intervene towards the control or mitigation of environmental degradation (Environment Management and Cordination Act, 1999).
4 Social and community	
4.1 Is it a regulatory requirement to involve stakeholders in mine closure process?	No documented provisions found
4.2 Do the regulatory requirements clearly define roles of stakeholders?	Unable to find any documented provisions
4.3 Are there any regulatory provisions that address socio-economic impacts of mine closure such as employment loss and sustainability of social services?	Unable to find any documented provisions

5 Statutory	
5.1 Does the legislation require submission of mine closure plans?	No provisions under <i>Mining Act 1940</i> but the new Mining bill 2014 awaiting enactment has this provision under Part X1 section 153(1) (Mining Bill,2014).
5.2 Are mine closure commitments laid down in the legislation?	Yes. The legislation requires mining companies to submit mine closure plans as a condition for licensing. Under the legislation mining plans are required to provide financial assurance as well as contributing to National Environment Restoration Fund.
5.3 At what level of government is mine closure commitments laid down; policy or guidelines?	The laws that regulate mine closure that is the <i>Mining Act 1940, Mining bill, 2014 Act, and Environment Management and Coordination act 1999</i> stipulate the mine closure commitments mining companies have to make before licensing
5.4 Who has the legal responsibility for mine closure? Is it government? Individual companies?	Individual companies The closure plans submitted under Part X1 section 153(1) of the Mining bill 2014 make responsible for mine closure.
6 Cultural	
What are the regulatory requirements in regard to preservation of cultural/heritage values and indigenous concerns?	Unable to find any documented provisions
7 Technical achievability	
7.1 Are there regulatory requirements for mining companies to show their capability to achieve their planned rehabilitation option in terms of knowledge and technology?	Unable to find any documented provisions
7.2 Do the regulations specify that rehabilitation and closure practices should be based on best practice and latest technical and scientific information?	Unable to find any documented provisions

## APPENDIX B – Western Australia regulatory approach evaluation criteria

Evaluation criteria	Provision under the regulatory approach
1 Environmental	
1.1 Does the regulatory approach have a requirement or incentive for progressive rehabilitation?	Section 4.12.2 of the guidelines require mining companies to undertake progressive rehabilitation(Government of Western Australia, 2015)
1.2 Is the regulatory approach broad enough to account for various ecosystems types?	Unable to find any documented provisions
1.3 Does the approach address long term ecosystem sustainability	<p>The <i>Mining Act 1978</i> requires rehabilitated mines to be (physically) safe to humans and animals, (geo-technically) stable, (geo-chemically) non-polluting/non-contaminating, and capable of sustaining an agreed post-mining land use (<i>Mining Act ,1978</i>).</p> <p>The <i>Environment Protection Act 1986</i> requires rehabilitation and decommissioning is to ensure that premises are decommissioned and rehabilitated in an ecologically sustainable manner (<i>Environment Protection Act ,1986</i>)</p>
1.4 What are the regulatory requirements for post mining ecosystems?	Unable to find any documented provisions
1.5 Are there regulatory provisions for post -mining land use suitability assessment?	Section 4.8.1 of the guidelines stipulate that post mining land use(s) should be relevant to the environment in which the mine will operate or is operating; achievable in the context of post-mining land capability; acceptable to the key stakeholders; and ecologically sustainable in the context of local and regional environment (Government of Western Australia, 2015)
2 Healthy and safety	
2.1 Are there regulatory guidelines for post closure risk assessment?	Section 3.2 of mine closure guidelines provides requirements for post closure risk assessment. The guidelines require a structured risk management process to be undertaken to identify, assess and manage the potential risks associated with closure issues (Government of Western Australia, 2015)

<p>2.2 What are the regulatory guidelines for assessment of contaminated site?</p>	<p>Suspected or known contaminated sites are deemed a closure issue as well as an operational issue, as defined under the <i>Contaminated Sites Act (CS Act)</i>. To ensure compliance with the CS Act, appropriate investigations must be carried out to identify, assess and remediate any contamination issue. In accordance with regulation 31(1) (c) of the <i>Contaminated Sites Regulations 2006</i>, a mandatory auditor's report is required to accompany every report submitted to Department of Environmental Regulation relevant to the investigation, assessment, monitoring or remediation of a site prepared for the purpose of complying with a condition or requirement imposed under another written law (such as conditions of Ministerial Statements). The CS Act also has enduring powers relating to the operator or tenement holder causing contamination (Contaminated Sites Act, 2003; (Government of Western Australia, 2006)</p>
<p>3 Economic</p>	
<p>3.1 Does the regulatory approach have a requirement for mining companies to provide financial assurance to cover closure and rehabilitation costs?</p>	<p>Section 4.14 of closure guidelines requires cost of closure be estimated as early as possible to ensure that adequate funds are available at the time of closure and that the community is not left with an unacceptable liability (Government of Western Australia, 2015)</p>
<p>3.2 What type(s) of financial instruments are to enhance compliance?</p>	<p>Mining Rehabilitation Fund (Mining Rehabilitation Fund Act, 2012)</p>
<p>3.3 Are there regulatory requirement for mining companies to pay funds to cover the cost of rehabilitation in the event the company does not honour its obligations?</p>	<p>Mining Rehabilitation Fund required under Mining Rehabilitation Fund Act 2012 and Mining Rehabilitation Fund Regulations 2013</p> <p>Money in the fund will be used for rehabilitation where the tenement holder/ operator fails to meet rehabilitation obligations and every other effort has been used to recover the funds from the operator.(Leybourne 2014; (Government of Western Australia, 2013a)</p>
<p>4 Social and community</p>	
<p>4.1 Is it a regulatory requirement to involve stakeholders in mine closure process?</p>	<p>Section 4.7 of the guidelines stipulates that both DMP and EPA require a stakeholder's engagement register that identifies the rehabilitation and closure consultation that has been conducted (Government of Western Australia, 2015).</p>
<p>4.2 Do the regulatory requirements clearly define roles of stakeholders?</p>	<p>Section 4.8 and 4.9 of closure guidelines define the role of stakeholders as giving proposals that address their interests and concerns, particularly when determining post-mining land-use, closure objectives and outcomes (Government of Western Australia, 2015)</p>

4.3 Are there any regulatory provisions that address socio-economic impacts of mine closure such as employment loss and sustainability of social services?	Unable to find any documented provision
5 Statutory	
5.1 Does the legislation require submission of mine closure plans?	Under <i>Mining Act 1978</i> Division Part IV Section 74(ca) requires mining firms to submit mining proposals which are in the form required by the guidelines ( <i>Mining Act, 1978</i> ). The mine closure guidelines give details of the information which should be included in the closure plans.
5.2 Are mine closure commitments laid down in the legislation?	Yes. The legislation requires mining companies to submit mine closure plans as a condition for licensing. Under the legislation mining plans are required to provide financial assurance as well as contributing to MRF.
5.3 At what level of government is mine closure commitments laid down; policy or guidelines?	The laws that regulate mine closure that is the <i>Mining Act 1978 Act</i> and <i>Environment Protection Act 1986</i> stipulate the mine closure commitments mining companies have to make before licensing.
5.4 Who has the legal responsibility for mine closure? Is it government? Individual companies?	Individual companies the mining proposals submitted under <i>Mining Act 1978</i> , Division 3, Part IV, Section 74(ca) give mining companies a legal responsibility for mine closure ( <i>Mining Act, 1978</i> ).
6 Cultural	
What are the regulatory requirements in regard to preservation of cultural/heritage values and indigenous concerns?	Unable to find any documented provisions
7 Technical achievability	
7.1 Are there regulatory requirements for mining companies to show their capability to achieve their planned rehabilitation option in terms of knowledge and technology?	Section 4.10.1 of mine closure guidelines require mine closure plans to provide a summary of the best available data on aspects of the physical and biological environments, as well as the social and economic aspects (where relevant) that are critical for successfully meeting mine closure outcomes ( <i>Government of Western Australia, 2015</i> )

7.2 Do the regulations specify that rehabilitation and closure practices should be based on best practice and latest technical and scientific information?	Unable to find any documented provisions
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## APPENDIX C- Queensland regulatory approach evaluation criteria

Evaluation criteria	Provision under the regulatory approach
1 Environmental	
1.1 Does the regulatory approach have a requirement or incentive for progressive rehabilitation?	Section 6.2 of rehabilitation guidelines has provisions for administering authority to issue progressive rehabilitation certification to mining companies based on whether they have met satisfactory rehabilitation several years before final rehabilitation (Government of Queensland, 2014).  Part 10 section 268(c) of <i>Environmental Protection Act</i> the administering authority may use progressive rehabilitation certification as one of the criteria to make decision on a surrender application (Environment Protection Act, 1994)
1.2 Is the regulatory approach broad enough to account for various ecosystems types?	Section 3.2 of the guidelines stipulates that here may be requirements to establish vegetation communities that are demonstrably similar to a pre-existing ecosystem (especially where native vegetation is the proposed land use); establish or enhance the habitat of an endangered species (especially where the mining has affected habitat however, such site specific goals are identified indirectly by the government through requirements from other legislations dealing with matters such as endangered species, water, registered heritage places or regional or local planning (Government of Queensland, 2014).
1.3 Does the approach address long term ecosystem sustainability	Part 2, Section 3 of <i>Environmental Protection Act 1994 (EP Act)</i> stipulates its objective is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends thus ensuring the attainment of ecologically sustainable development (ESD) (Environment Protection Act, 1994)
1.4 What are the regulatory requirements for post mining ecosystems?	Section 3.1 of the guidelines requires rehabilitation of areas disturbed by mining to result in sites that are: safe to humans and wildlife; non-polluting; stable; able to sustain an agreed post-

	mining land use (Government of Queensland, 2014).
1.5 Are there regulatory provisions for post -mining land use suitability assessment?	Section 4.3 guidelines require that the proposed post mining land use be clearly specified using terms such as grazing (up to a particular intensity), cropping (including type of crop), forestry plantation (for a specified type of wood), habitat (for a nominated species), or return to native vegetation (see next dot point), and the prior land capability and use of the site, the existing uses of adjacent land and the views of landholders when selecting the future land use should be considered (Government of Queensland, 2014).
2 Healthy and safety	
2.1 Are there regulatory guidelines for post closure risk assessment?	Section 4.3 of rehabilitation guideline stipulates “If safety hazards remain at mine closure or inevitably will develop after closure, solely as a result of the mining activities (e.g. steep slopes, exposure of hazardous materials, subsidence or potentially unstable structures), the application documents must indicate what management controls will be implemented to reduce risks to humans or animals
2.2 What are the regulatory guidelines for assessment of contaminated site?	Unable to find any documented provisions
3 Economic	
3.1 Does the regulatory approach have a requirement for mining companies to provide financial assurance to cover closure and rehabilitation costs?	Under section 292(1) (a) (b) of <i>EP Act 1994</i> the holder of an environmental authority is required to provide a financial assurance before commencement of any activity, the financial assurance acts as security for compliance (Environment Protection Act, 1994)  Section 190 Mineral resources Act “The Minister may accept a bond or a guarantee or indemnity by, or other financial arrangement with, a financial institution, insurance company or another credit provider approved by the Minister or other form of security acceptable to the Minister as the whole or part of the security to be deposited under this section.”(Mineral Resources Act, 1989)
3.2 What type(s) of financial instruments are to enhance compliance?	Bonds under section 292 of <i>Environment Protection Act 1994</i>
3.3 Are there regulatory requirement for mining companies to pay funds to cover the cost of rehabilitation in the event the company does not honour its obligations	The financial assurance bonds provided under section 292 of <i>EP Act 1994</i> covers the cost or rehabilitation in the event the company fails to honour its obligations or becomes bankrupt (Environment Protection Act, 1994)



4 Social and community	
4.1 Is it a regulatory requirement to involve stakeholders in mine closure process?	Section 6.1 of the guidelines requires completion criteria be developed in consultation with stakeholders such as the landowner, local government, indigenous groups, community groups and various State departments(Government of Queensland, 2014)
4.2 Do the regulatory requirements clearly define roles of stakeholders?	Section 4.3 of the guidelines stipulates that consultation with the landowner, the local community and other stakeholders is essential when making the future land use decisions (Government of Queensland, 2014).
4.3 Are there any regulatory provisions that address socio-economic impacts of mine closure such as employment loss and sustainability of social services?	Unable to find any documented provisions
5 Statutory	
5.1 Does the legislation require submission of mine closure plans?	Section 288 subsection1(c) (iii) <i>EP Act 1994</i> stipulate a requirement of a plan which shows rehabilitation program for land disturbed or proposed to be disturbed under each relevant lease(Environment Protection Act, 1994)
5.2 Are mine closure commitments laid down in the legislation?	Yes. The legislation requires mining companies to submit mine closure plans as a condition for licensing. Under the legislation mining plans are required to provide financial assurance as well as contributing environmental bonds
5.3 At what level of government is mine closure commitments laid down; policy or guidelines?	The laws that regulate mine closure that is the <i>Minerals resources Act 1989</i> and <i>Environment Protection Act 1994</i> stipulate the mine closure commitments mining companies have to make before licensing. Rehabilitation guidelines for mining resource activities provide details on the format and information to be included in the closure plans.
5.4 Who has the legal responsibility for mine closure? Is it government? Individual companies?	Individual companies; the commitments through submission of closure plans under section 288 subsection1(c) (iii) <i>Environment Protection Act1994</i> and payment of bonds under section 292 of the same Act make them legally responsible for closure
6 Cultural	
6.1 What are the regulatory requirements in regard to preservation of cultural/heritage values and indigenous concerns?	Section 3.2 of the guidelines states that there may be requirement in some sites to preserve specific European and indigenous heritage that has been registered for the site but these values are managed under other legislation(Government of Queensland, 2014)

7 Technical achievability	
7.1 Are there regulatory requirements for mining companies to show their capability to achieve their planned rehabilitation option in terms of knowledge and technology?	Unable to find any documented provisions
7.2 Do the regulations specify that rehabilitation and closure practices should be based on best practice and latest technical and scientific information?	Unable to find any documented provisions