

# Mine closure – misplaced planning priorities

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## Abstract

*Mines, unlike many other industrial activities, pass through distinct life-cycle phases from exploration and prefeasibility through operations to closure and rehabilitation. Closure assumptions have become an integral part of the planning for closure process. Good practice requires closure planning for each life cycle phase, with a growing focus on planning from the very earliest stages of project development. Each phase is characterised by specialist groups of people – starting with optimistic exploration geologists, focussed project managers for the construction phase and systems-orientated mining and process engineers for the operational phase. All of these have some deliberate or unintentional role to play in planning for closure.*

*However, the training and mind-sets of each of these groups, and the reliability of the assumptions they are using as they play their part in the closure planning process, have significant implications. Exploration imperatives for rapid orebody delineation and land access may result in inadvertent impacts with long-term implications for final closure. These include providing community access to previously inaccessible natural resources, the early introduction of invasive exotic species and ‘going off-message’ relative to what a trained social scientist or closure specialist might say. During construction, high magnitude social impacts associated with the influx of large numbers of construction workers may be overlooked due to their transient nature, and many mid-life mines fail to adequately manage key closure resources, like topsoil, because closure is seen as an event in the distant future. To further complicate matters, unplanned, sudden closure may occur at any time over the mine’s life: many sites only expect to close after years of operation, and closure at some other point in the life cycle may bring with it a number of unforeseen challenges.*

*Communities and other stakeholders in mining operations also change their expectations of closure planning as the mine matures. Initially, many stakeholders struggle to come to terms with the high failure rate of exploration projects and local entrepreneurs may overextend themselves in the expectation of economic expansion accompanying mine development. Later, communities may become unwittingly dependent on services that are only sustainable while the mine is in operation (like a cellular phone tower in a rural area) and may mistake closure planning and consultation for opportunities to increase their dependence on the mine (by requesting additional employment or infrastructure development, for example).*

*Examples drawn largely from the authors’ experiences in southern and central Africa are used to illustrate these misplaced planning priorities and the related consequences. The paper concludes with suggestions for improving closure planning efficacy across the mining life cycle and optimising inputs from the many disciplines involved directly and indirectly in the process.*

## 1 Introduction

### 1.1 Why closure planning?

One of the great differences between mining and other industries is that mining is a temporary land use. Mines and mining districts may persist for centuries, but each tonne of earth that is moved brings the enterprise closer to its demise. This transience is the root of most objections to an industry that radically transforms a landscape, often rendering it sterile and unproductive (especially from the perspective of the

pre-mining land users), creating dependency in the local communities and then closing down (sometimes collapsing overnight), leaving social and economic chaos in its wake.

Ironically, this transience also contains the seeds of sustainability. When properly planned, the end of mining can be the start of new value-adding activities or the return of land to conservation and the re-establishment of functioning ecosystems. The closure of mines in Kiruna, Sweden, is an example of the former, while the establishment of the Sperrgebiet National Park in the old Diamond Area No. 1 of Namibia is an example of the latter. The fortunes of the Kiruna mines first started to decline in the late 1970s, and in 10 years the population halved, with three of the four mines closing (Sternlund, 2008, 2009). The diversification of the economy to include tourism and the state-sponsored establishment of high-tech industries and a university went a long way towards mitigating the impact on the local community. By 2000, the population decline had stabilised. Recent improvements in the iron ore prices have resulted in the revitalisation of the mining industry in Kiruna (Newman, 2010). In the case of Diamond Area No. 1, the security zone stretching 100 km inland was so effective in protecting the virtually pristine, unmined portions of southwestern Namibia that the government was able to declare a nature reserve almost as soon as the mine started reducing production.

While both Kiruna and Diamond Area No. 1 are historical mining areas that did not benefit from up-front closure planning, they were endowed in ways that most mines are not (huge levels of government funding for Kiruna (see Hoadley and Limpitlaw, 2004) and almost 26,000 km<sup>2</sup> of land undisturbed by human activities for 100 years in the case of Diamond Area No. 1 (see Pallett, 1995)). To make a successful and sustainable transition from mining to the next land use, careful marshalling of the inherent strengths of mining development and the pre-existing environment is required. This is where mine closure planning becomes paramount. To this must be added the correct inputs from the most appropriate specialists throughout the mining life cycle, particularly for junior companies that may not be able to draw on in-house expertise and where the emphasis is firmly on exploration activities. Unfortunately, key closure decisions are often made by people with little understanding of the closure process, and advice from appropriate professionals may carry little weight at certain points in the life cycle:

- In the early stages of exploration and feasibility assessment, decision making is dominated by exploration geologists and venture capitalists; closure planning is often pursued for the benefit of funders and regulators.
- In mines in the middle portion of their operating lives, closure decisions are taken by operations managers who may actively resist interference from remote corporate managers.
- Late-life mines that do not have detailed closure plans are commonly operating in emergency mode, with operations managers trying to survive and not 'waste money' on closure programmes unless non-compliance with regulatory requirements is a greater threat or additional funding can be leveraged by having them in place.

## 1.2 Changing closure paradigms

Changes in closure practice are well illustrated by the Zwartkop Chrome Mine, which opened in 1935, and produced chromite ore from underground workings on the northwestern rim of the Bushveld Igneous Complex in South Africa for more than 40 years. In 1978, the Transvaal Mining and Finance Company – a wholly owned subsidiary of the General Mining and Finance Corporation, later to become part of BHP Billiton – closed the mine. The workings were secured in accordance with the legislation of the day. Surface infrastructure with salvage value was removed, and the workings were fenced off to prevent unauthorised access. Twenty-five years later, BHP Billiton, in accordance with its mine closure protocol, facilitated the return of the mined land to its traditional owners and rehabilitated the surface to ensure that it supported sustainable use by the community (see Absolom and Limpitlaw, 2005).

Whereas in the late 1970s it was acceptable to simply comply with legislation, by the second decade of this century, progressive companies had become interested in understanding how land cover and land use at a

closed mine change over time, how these changes might affect stakeholders in the land and how post-mining landscapes might be best designed to serve future needs of the community. Unfortunately, not every mining company has adopted this approach, and poor closure practice persists as a result of inadvertent oversight, a desire to do no more than the minimum and sometimes a lack of understanding of the negative consequences of not planning for closure, the effects of which play out for the company, local communities and other stakeholders.

Closure assumptions, integral to closure planning, must be made by appropriately trained/skilled professionals. Typically, these assumptions are made by the wrong people, with different groups dominating decision making at different stages of the mine life cycle. Decision making and actions that can significantly alter the closure planning process can be heavily influenced by geographic proximity: the opinion and actions of people working at or close to the site will often outweigh those of more-remote staff.

## 2 The mining life cycle and closure assumptions

Mines, unlike many other industrial activities, pass through distinct life-cycle phases from exploration and feasibility assessment through operations to closure and post-closure. Closure assumptions have become an integral part of the planning for closure process; these assumptions are typically a blend of collective industry experience and the personal experience of those involved with closure planning for a specific project.

Good international industry practice requires closure planning for each life-cycle phase (IFC, 2002; Peck et al., 2005; ICMM, 2008; EPA, 2011), with a growing focus on planning from the earliest stages of project development. However, the assumptions that are brought to each phase are significantly influenced by the mind-set of the dominant specialists at that time. The mining process begins with optimistic exploration geologists, is handed on to focussed project managers and engineers for the design and construction phases and to systems-orientated mining and process engineers for the operational phase. The training and mind-sets of each of these groups, and the reliability of the assumptions they use, have significant implications for the closure planning process.

Closure planning should be conducted as a seamless process from one phase of the life cycle to the next, as decisions made in one phase invariably affect closure options later. However, in the experience of the authors, current practice is largely to optimise design and operation for production, resulting in closure being viewed as a combination of earthmoving/rehabilitation exercises and charitable donations to communities.

### 2.1 Exploration

Exploration imperatives for rapid orebody delineation and land access may result in inadvertent impacts with long-term implications for final closure. These include providing community access to previously inaccessible natural resources and the introduction of invasive exotic species. There may be an assumption amongst some geologists during this phase that closure is an operations phase problem and that embedding closure planning so early is not necessary. From their perspective, the mine is more likely than not to go ahead and therefore exploration-related impacts will be subsumed by the development of the project as detailed design and construction take place – optimism is a required character trait in explorers.

Exploration geologists are often the first entrants into an area, well in advance of any social or community team. Their perception of the project and how it will be developed and the benefits it will bring may be absorbed at face value by communities, with little or no discussion of closure aspects at this early stage. Communities may struggle to accept that the investment decision for the mine is yet to be made. Even in areas with experience of industrial development, the substantial sums invested in exploration may, in the minds of locals, signal an irrevocable commitment by an explorer to mining. Unchecked, this perception can lead to speculation in property and the establishment of services, placing livelihoods at risk. During exploration work on a uranium tenement in South Africa, business people from a nearby town invested

heavily in a housing complex and two shopping malls (D. Limpitlaw, pers. comm., 2013). When the project failed to progress to the construction phase, and the expected influx of high-earning mine employees did not materialise, occupation rates in the malls were lower than planned, placing strain on the local economy. Managers responsible for exploration activities in this instance did not discourage local investors as they did not see the risks to the local economy. They believed that local economic interest in the success of the project would assist in overcoming any resistance from other quarters. This lack of awareness of the specific risks associated with mining development can have serious consequences for local communities.

Relative to the construction and operation phases of a mining project, the impacts associated with exploration are generally low and are sometimes assumed to be insignificant. However, embedding of assumptions and attitudes in local communities starts during this phase and may need to be undone and reversed or corrected before closure can commence.

It can also only take the faintest whiff of a mining project to trigger significant and uncontrolled influx of people looking for direct employment and other livelihood opportunities. The spread of rumours, half-truths and misinformation from local villagers to distant relatives and friends can quickly expand interest in the project from the local area to the entire region. Throwaway comments from project staff on the ground during exploration can be blown out of proportion and soon interpreted as a cast-iron opportunity for long-term employment. An uncontrolled influx can irreversibly change the physical and social environment at local and regional scales. Influx management therefore requires careful collaboration with government from the earliest stages; waiting until construction begins may be too late. Influx management is a specialist subject that is outside the skill set of many social scientists. In this context, it is clearly inappropriate to leave early work on influx to geologists, and it is no surprise that influx management is often playing catch-up with the reality on the ground.

Inappropriate closure assumptions – exploration:

- Influx only starts when a project is confirmed.
- Influx can be managed retrospectively.
- Influx management is the government's job.
- If project does not proceed, influx will reverse automatically.
- Environmental impacts will be subsumed by the construction phase.
- The project is highly likely to proceed.

It is easy to assume that the rehabilitation of exploration cutlines (pathways cleared of vegetation to facilitate geological reconnaissance) is not critical if the mine plan for the area is an open pit. Discounting the temporal impacts of improved access during the exploration programme, explorers can be forgiven for thinking that the land parcel is doomed anyway and that the impacts are not significant. The real problem arises if the project is stopped and the area is not open cast but has been stripped of valuable tree species and wildlife has been hunted out (cutlines increase access to intact forest and may promote local hunting activities). Experiencing this type of access in previously unexplored areas can also encourage communities to proactively seek similar timber or wildlife resources elsewhere.

Very little, if any, good international industry practice is available to guide the social aspects of planning for exploration closure – junior explorers have to make it up as they go along.

## 2.2 Pre-construction

Pre-feasibility, feasibility and detailed design involve a vast array of disciplines, each jostling for position and seeking to ensure that its perspective is not lost in the mix. This whirlpool of information – some of which is factual, some of which is predicted and some of which may verge on fictional – is where the assumptions that underpin the planning of closure begin to come into focus. At this stage of project

development, thousands of pages of reports are typically generated, and the closure plan, if it is even there, is just another report to be appended to the final feasibility report.

Inappropriate closure assumptions – pre-construction:

- The pre-construction phase is too early in the mine life cycle to start planning.
- Compliance with funder requirements is adequate.
- It does not matter if the closure plan is out of step with the actual mine design.

In this phase, closure plans are often only considered to be a means of compliance with funder requirements rather than as operational plans: a paper exercise that is considered of little real relevance to actual closure planning. This may represent a missed opportunity to build a strong and effective foundation for the closure process, with the plans remaining static as the mine design becomes increasingly detailed and refined.

### 2.3 Construction

During construction, high-magnitude social impacts associated with the further influx of large numbers of construction workers may be overlooked due to their transient nature. Additional laydown areas are cleared without due consideration for their rehabilitation, as the full life of the mine is expected to lie ahead of it. In the authors' experience, there is acceptance of high impacts on ecosystems because the impacts are temporary. Possible long-term social impacts may arise due to large numbers of construction workers on-site for short periods of time. In environmental assessments undertaken by the authors for large mining projects, potential impacts associated with the construction phase have included HIV/AIDS, pregnancies and social destabilisation.

Inappropriate closure assumptions – construction:

- Construction is a short-term activity (relative to life-of-mine); so are closure implications.
- There is plenty of time to consider closure during the operation phase.
- The cost of deferring closure planning is not likely to be significant.
- Regional planning considerations are the preserve of government and are not relevant to closure plans at this stage.
- Construction impacts are subsumed by operational impacts.

During the design and construction phases, some decisions have irrevocable impacts on final closure. As part of the planning for a potash operation in the Republic of Congo (both authors played a senior role in the associated environmental and social impact assessment), a decision was made to locate the processing plant and the bulk of surface facilities at the coast some 40 km away from the mine site. This decision was in part due to the desire to avoid attracting people to the mine site itself, as it is located on the margins of a national park that is on the accession list to World Heritage Status. By having no staff living at the mine site and bussing them in from near an existing town, development associated with the project would be nucleated around the town rather than in the park, limiting the associated problems of poaching and forest clearing. If these problems occur, they are very difficult to control and could have implications for the park long after the mine has closed.

Housing employees and contractors in a purpose-built, permanent accommodation camp (essentially a small town) instead of investing in housing stock in a local town is easier to manage from a construction perspective and may be cheaper in the short term. From a long-term sustainability perspective, bolstering existing infrastructure that can be used by mine personnel and the public is not only preferable, but, in developing countries, is almost always better aligned with government development objectives as well.

In South Africa, for example, municipalities are charged with maximisation of social and economic growth through integration and co-ordination of development activities (Ministry for Provincial and Constitutional

Development, 1998). Municipalities are responsible for ensuring that local economic and social conditions are conducive to the creation of employment opportunities – it is generally accepted that the provision of basic household infrastructure forms the central basis for ensuring social and economic development (Ministry for Provincial and Constitutional Development, 1998). It is important for all municipalities to ensure resources and investment initiatives from both public and private sectors are co-ordinated to meet development targets. Integrated development planning is an important method of ensuring this. Koma (2012) reports that the White Paper on Local Government (Ministry for Provincial and Constitutional Development, 1998) identified several key outcomes that are relevant to development-related local government imperatives and goals. One of these is the provision of sustainable household infrastructure and services. Another is the creation of integrated local areas – this is expected to enhance economic growth and will facilitate improved sustainability in the provision of services and a reduction in commuting costs. This approach improves the chances of sustainability of services post-closure.

## 2.4 Operation – the early years

This phase is often characterised by deferment of closure planning to the last few years of operation while short-term optimisation of the project is undertaken without due consideration for closure. An example of this was the proposed establishment of an off-site coal loading terminal (truck to rail) at a new South African colliery, apparently to save some initial capex in extending a rail spur to the mine site (Digby Wells, 2010). The short-term saving achieved would result in an additional contaminated satellite site, impacting local ecotourism businesses. After hearing concerns raised by adjacent landowners, the colliery redesigned the coal handling infrastructure and abandoned the off-site loading terminal, thereby reducing its closure liabilities.

Inappropriate closure assumptions – early operation:

- Closure planning can be deferred until later in the mine life.
- Legal compliance is adequate.
- There is limited overlap between operational activities and closure planning.
- Closure planning should focus on human resources issues.

In some countries, the focus is on strict compliance with regulations. These are frequently inadequate for closure planning. Mining regulations in the Democratic Republic of Congo (DRC) have very detailed requirements for the erection of fences, stabilisation of dumps and pollution monitoring, but very little in place for social impact mitigation (see Schedule IX: Directive in Respect of the Environmental Impact Study, Title V: Mitigation and Rehabilitation Measures: Chapter VII: Mitigation and Rehabilitation Measures after Closure of the Site, Schedules to the Mining Regulations, Decree No. 038/2003 of 26 March, 2003). This completely misses the fact that many environmental impacts are mediated through local communities; if social issues are left unaddressed, then closure activities focused on the physical environment can soon be undone.

For example, most ‘social’ measures are coordinated by the Labour Ministry and are focussed on retention, transfer or retrenchment of staff. Companies that focus on risk management as a process may end up complying with the letter of the law but not managing social risks on closure – often the greatest risk. Management of these social risks requires understanding of the local community (social baseline) and the existence of a long-running social impact management programme. Measures for post-closure job creation in the community are regarded as charitable investments on the part of the company not required by legislation; however, the drive for alternative livelihoods and increased natural resource use by local communities may have major negative implications for the physical environment. The lack of focus on post-closure job creation can therefore play a major role in triggering environmental degradation.

Consulting with stakeholders on closure issues can be difficult. Government representatives and community members may express alarm when consulted on closure, even if it is a decade or more in the

future. Without careful communication, stakeholders may expect imminent closure of operations. During a recent stakeholder consultation programme as part of the closure planning process for a central African copper mine, a government minister told the consultation team that his ministry was focussed on economic growth and did not want to discuss closure ‘as people can react badly’ (D. Limpitlaw, pers. comm., 2013). In his view, a mine only closes when reserves are exhausted. At this point the company should have other sites to which staff can be transferred. This process was regarded as giving people more hope than a discussion on post-mining land uses and non-mining jobs, ignoring the fact that communities cannot simply be transferred to a new site (if such a site exists) in the same way as company staff.

In the authors’ experience, even in the biophysical sphere, closure preparation is not seen as part of operational management. Because closure is seen as an event in the distant future, key closure resources, like topsoil, are not conserved and may be lost over time through rehandling, erosion or contamination with waste rock. A topsoil deficit then becomes a costing exercise for the closure planning team and something separate from the day-to-day management. Many regions do not have large amounts of surplus soil that can be used for reclamation; the simple failure to properly manage stripped soils can effectively extend the project’s impact footprint to include remote soil ‘borrow’ areas.

## 2.5 Mature operations

Maturity in everyday life often implies an enhanced level of responsibility and planning for the future. In mining, this is not always the case: maturity measured in the years of operation may not be matched with a reasoned approach to closure.

Many modern mines are located in remote areas in developing countries. In central Africa, mining, processing and technical services departments are often predominantly staffed by expatriates who have little understanding of the local environmental and social setting. Often, specialist biophysical input is provided by external consultants who are held accountable by the corporate office rather than the mine site. Social and community management is commonly undertaken by nationals who have insight into the culture, language and political realities but who may not be at the centre of decision making on-site (as this is dominated by expatriates). This can result in poor communication between the three key teams (production personnel, technical advisors and community liaison personnel). At some sites, this translates into little or no regard for long-term management of key closure assets like topsoil and a sense of irrelevance on the part of the community managers.

Inappropriate closure assumptions – mature operations:

- Economically or socially beneficial closure options are difficult, risky and expensive.
- Communities are always sufficiently informed to make appropriate choices when considering closure options.
- Parastatals (state-owned enterprises) are always able to efficiently operate and maintain mining infrastructure post-closure.
- Partnering with other companies in the area to enhance the closure process and deliver better outcomes is only required during closure.

Mature operations are often unwilling to embrace more economically or socially beneficial post-closure land use options (like tourism, industrial development) due to possible liability issues and general inability to control all aspects of the closure process. Project managers generally have a preference for economically sterile options such as wilderness land due to the relatively low levels of complexity in planning and implementing the measures required to get the site to this state.

Communities associated with mature operations may be too used to receiving, and relying on, benefits from mining companies. They may not have really thought about the implications for them when the operation has closed (particularly if engagement with the community on closure issues by the company is fragmented, incomplete and left until too late in the process). During a recent closure consultation in the

DRC, repeated calls were made for a new house for the community chief, and extensions to houses were considered higher priorities than investment in ongoing livelihoods.

Companies may expect, or be required, to hand over infrastructure to parastatals on closure. Such parastatals may have little or no capacity to manage, operate and maintain the infrastructure; erosion of infrastructure quality and functionality can have serious implications for communities. For example, at a project in central Africa, a power line is to be handed over to the state electricity company on closure of the mine. The power line also powers a local cellular phone mast – the loss of which would be a serious blow to the community (D. Limpitlaw, pers. comm., 2013).

Sudden downturns in metal prices can trigger the first real interest in closure at very mature mines and can result in hasty closure cost determination and closure planning. At this stage, where closure may be less than a year off, little can be done other than make infrastructure safe and provide retrenchment packages to employees. Setting up of industrial tourism ventures, modifying landscapes to provide alternative post-mining land use opportunities, reskilling and finding value adding uses for infrastructure are virtually impossible.

As closure approaches, it becomes increasingly critical that mining companies cooperate with other companies operating in their district and with local authorities. This cooperation should ideally commence as soon as the investment decision has been made at the end of the feasibility study and should not be left to the final months of production. Post-mining use of infrastructure, land capability and land use and community skills training are best planned and implemented as part of a broader partnership rather than one company working alone without cognisance of the plans of others. It is also important for mining companies to get a sense of whether other potential partners are also taking closure seriously and to adjust their own plans accordingly; reliance on a third party for some significant element of a co-operative approach is only sensible where there is a high level of confidence that the party can and will deliver as expected.

### **3 Unexpected or premature closure**

To further complicate matters, unplanned and sudden closure may occur at any time in a mine's life cycle: many sites only expect to close after years of operation, and closure halfway through construction or in the early years of operation may bring with it a number of unforeseen challenges.

Although the actual closure itself may be a surprise, the concept of sudden and unexpected closure is a 'known unknown', and it is possible to prepare for it. This does not mean planning for every possible eventuality, but there is a strong argument for the development of framework 'sudden' closure plan to supplement the more detailed end-of-life plan. The framework plan can be drawn from the detailed plan and address the closure activities required if the mine were to be closed within the next 12 months.

### **4 Suggestions for improvement**

A number of fixes can be applied to improve closure planning and realign assumptions so that they benefit rather than hinder the process. Many of these fixes do not require anything other than a change in the mind-set of those who are willing or unwilling players in the closure process; these may appear simple, but they are perhaps the hardest to achieve in reality due to inertia, intransigence and lack of awareness of the need for change.

Optimise approach to planning:

- Closure planning should be integrated into pit optimisation and infrastructure design to the extent that pit ramps and hauls are sited with the post-mining land use in mind.
- Expect the unexpected – have a 'Plan B' ready for sudden closure.
- Approach each phase in the mining life cycle as though it is the last one and will require closure.



- Define opportunities to add value beyond what is legally required – focussing on legal compliance may simply defer liabilities until later and cause erosion of reputation.
- Do not put off until tomorrow what can be done today – deferring planning for closure can introduce costs and risks that would otherwise have been avoided.
- Appropriate assumptions are important for reducing closure costs (e.g., reuse of infrastructure is possible if planned and constructed with post-mining use in mind).

Develop and apply appropriate closure and communication skills:

- Do not confuse geographic proximity to a site with expertise in closure – those on-site may not be well positioned to make closure-related decisions.
- Ensure first entrants to an area are trained in closure and the planning process; the same advice should be applied to other key site staff throughout the project life cycle.
- Closure training and guidance is relevant to exploration geologists and to companies engaged in unsuccessful exploration projects.
- Use closure-related seminars, joint reporting exercises (including perspectives from across the organisation) and brainstorming sessions to build trust and mutual understanding between production staff, technical advisors and the community liaison unit.
- Ensure appropriate expertise is available when necessary to complement (rather than replace) and support people on the ground.
- Clear social and environmental key performance areas should be in place for technical managers.
- Promote the development of diverse teams with a mix of expatriates and nationals in all departments, and avoid creating cultural silos with western expats in mining and processing and nationals in social management.

Communicate and work with stakeholders:

- Manage expectations of communities and other stakeholders from the outset – unrealistic early expectations can set the tone and requirements for the entire closure planning process and closure objectives.
- Long-term, consistent communication with regulators and communities is required as part of the closure plan.
- Make sure everyone on-site stays ‘on message’ when dealing with communities and other stakeholders – all staff are involved in stakeholder engagement and dissemination of information, whether they are aware of it or not.
- Discussing closure early in the project life cycle is a positive – stakeholders may need input from the company to understand this perspective and the benefits it brings.
- Work with parastatals and other recipients of infrastructure to enhance their management, operational and maintenance capacity to manage, operate and maintain; this can improve the chance of a ‘clean’ handover and sustainable outcomes and can reduce future liabilities for the company.

Bring the social aspects of closure to the fore:

- Get started early on influx management – identify partners, define the risks and do everything possible to manage the movement of people into the mining area. Contractors must ensure that their staff abide by the same rules as those of the company and do not inadvertently support influx by creating a local demand for goods and services.

- Land rehabilitation programmes should be linked to mitigating social impacts: proposed post mining land use must match land capabilities and community skills.
- Closure planning must take the surrounding land use and development trajectory of the region into account.
- Post-mining livelihood opportunities can be maximised if long-term training and the setting up of alternative economic opportunities are planned/implemented from the start of mining.
- Acceptance of mining by communities and regulators cannot be taken for granted – there is increased resistance to extractive industries in many parts of the world, as recent difficulties experienced by BHP Billiton with its Palawan permit in the Philippines have shown (Mining Weekly, 2013).

## 5 Conclusions

Assumptions shape the prioritisation of issues for closure. The wrong assumptions may leave the company facing in the wrong direction when it comes to environmental and, particularly, social issues around closure. This can result in limited financial resources being expended on activities that add little or no value to the closure process. In effect, assumptions can undermine rather than support closure planning, blocking off avenues of investigation that would deliver more-accurate and useful information.

The cost of closure can balloon and the sustainability of the post-closure phase can be seriously dented before exploration has even been completed. For example, uncontrolled influx during exploration can be impossible to reverse and completely change the physical environment and social setting for closure activities, increasing the complexity and number of indirect impacts that will eventually need to be addressed.

The people on the ground may not be well positioned to address the nuances of closure planning, through lack of training, awareness or interest. Closure planning is often just regarded as a desktop exercise and ignored by site management. At best, their focus may be on legal compliance and no more. However, it may be just as inappropriate to leave closure planning to closure consultants who do not know the site or setting as well as the site management does. A compromise is necessary: decisions on post-mining land uses for various precincts and the suitability of infrastructure for post-mining use should be guided by consultants, but input from site personnel is vital.

There are many fixes that can be used to modify the assumptions that frequently underpin the planning process. However, it is the mind-set of those involved in the process that must change before practices themselves can be improved. Recognising that the closure process as currently conducted is often inefficient and imperfect is an important first step; instilling in the wide range of staff involved in the closure process that it is an activity worth devoting time and effort to in search of improvements is a much larger step, but one that will deliver huge benefits for the project and the wider industry.

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