

WATER AND MINING

New atlas gives mine closures more direction

Mining can bring a host of ills, not least to our water sources. And when the pit gear grinds to a final halt, things frequently get worse. The good news is that new risk assessment tools and an online atlas should improve closure planning. Matthew Hattingh reports.



Early one Sunday nearly 60 years ago, a certain Mr Brits of Blyvooruitzicht, a mining town on the West Rand, was up and about, restless. It was 2 am and he was looking for a pill to help him sleep when what sounded like wagon wheels on a rough road caught his attention. Mr Brits peered from his window, but saw nothing out of the ordinary. Seconds later, the noise returned, only much louder. Then Mr Brits watched in horror as the home of his neighbours, the Oosthuizen, “collapsed like a paper cup”.

A giant sinkhole swallowed the Oosthuizen, man, wife and three children (aged six to 12) along with the family’s domestic servant. Their bodies were never found. In the ensuing panic, 170 families were evacuated.

In time, a monument was erected on a hill overlooking where the Oosthuizen once lived. A simple plaque commemorates the disaster and its victims, ending with the inscription, “*God het hulle te aarde bestel*” – “God laid them to rest”. No doubt providence played its part, but man likely had a hand in it too.

Much of the West Rand rests on dolomite, a soluble sedimentary carbonate rock particularly susceptible to sinkholes when water is pumped or otherwise extracted from nearby mines.

To this day residents of towns and townships near Blyvooruitzicht, like Westonaria, and Khutsong, which owe their establishment to deep-level gold mining, are at risk of sinkholes, road collapses, flooding and polluted waters.

Further afield, a similar sinking feeling (or worse) afflicts many residents of the Witbank coalfields, who must reckon with declining water quality and soil fertility. And in the Platinum Belt, shack-dwellers bemoan the around-the-clock noise from nearby shafts. Sadly, mining's environmental ills don't disappear when the pit gear grinds to a final halt. Jobs inevitably disappear along with the basic services and infrastructure that mining companies provide to many communities.

This triple-whammy of environmental, social, and economic ills – and efforts to find a more systematic way to soften the blow – are the focus of a new Water Research Commission report.

Developing mine closure risk ratings and a post-closure opportunity framework for South Africa (WRC Report No. TT 930/23) works to put the problem in context. It reviews the literature, draws on cases studies, and interviews experts and community support groups to see what lessons might be learnt.

It also provides several tools to help assess the likelihood of closures and the associated risks. A risk-rating system was developed and translated into an interactive atlas. The atlas – officially launched on 12 March – aims to help the mining industry, professionals, policymakers and communities near

mines, better plan for closures. A framework was developed with step-by-step procedures for understanding local conditions, weighing up influencing factors and exploring post-mining land use options. The process emphasised the need for a shared vision and for fostering community participation to support 'just economic transitions away from mining.'

Mining, once the bedrock of the South African economy, has declined from its peak, at 21% of GDP in 1980, to 7.5% in 2022. Mine closures are widespread, even as attention has shifted away from the demise of gold mining in the Witwatersrand basin to the troubled thermal-coal mines of Mpumalanga. Reserves and resources become depleted, or uneconomical to extract. Meanwhile, the world switches to renewable energy sources. Nevertheless, mining remains vital to South Africa, with over 230 mines operating at present, extracting 22 commodities. The mines are located in a quarter of the country's local municipalities – home to 6.2-million people.

The report, by Megan Cole and University of Cape Town colleagues, Tapiwa Chimbanga, Murad Esau, Amber Abrams and Jennifer Broadhurst, reminds us that badly managed closures are a worldwide problem. Mining disruptions of the natural flow of surface and groundwaters are often difficult to



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remedy. Active discharge, seepage, run-off and dust emissions from abandoned or ineffectively rehabilitated mine workings harmed “surrounding water sources and land for decades and even centuries”.

Especially worrying was acid mine drainage, in many hard rock ores and coal deposits. “Unless contained, [it] can continue to be dispersed into the surrounding environment. . . with the acidity, salts and metals impacting the quality of water sources and soils, the growth of local vegetation, and the health of living organisms, such as fish.”

Historically, mines close with little regard for the future. Cole reckons South Africa counts anywhere between 4 000 and 6 000 derelict or ownerless mine features – including quarries, waste dumps, heaps and adits. Rehabilitating these represents a R30-billion-plus headache for the state. There’s change for the better though, with the first legislative requirements for rehabilitation introduced in 1956, and numerous new laws and regulations governing closures coming on stream from the 1990s.

A broader understanding of the risks of mining closure has emerged too. Drawing on lessons from the fading Free State goldfields, the authors noted that while the environmental consequences of living near old or abandoned mines were well known, the socio-economic consequences have lately come to be recognised as the “most critical risk facing the sector”. Closures could have “very negative effects on communities and local municipalities, particularly those with poor governance”, the report said, observing that some towns and villages near mines were among the most deprived in the country, with 55% of their populations living below the poverty line.

Closures hurt, but why are some communities hurt more than others? The authors cite several scholars and retired mining boss and national planning commissioner Bobby Godsell, who note that small, isolated mining towns, “whose social, political and economic life are completely dominated by the mine” feel the pain of closure most acutely.

South Africa’s National Water Act, National Environmental Management Act and Mineral and Petroleum Resources Development Act and amendments were intended to prevent or remedy a host of ills, or at least prod the different players in the right direction. However, “The land use objectives are not adequately integrated across the different legislations and plans,” the report said, noting a “disconnect” which meant “successful mine closure remains elusive”.

It needn’t be so. Post-mining land-use planning in a developing country like South Africa “presents an opportunity to use mine closure as a catalyst for sustainable development” and with economic diversification around the world, former mining land has been put to good use. The report cites examples from the literature mentioning everything from agricultural and forestry projects in Australia and Honduras, to wind turbines and museums in Germany’s Ruhr coalfields, and tourism at places like Kimberley’s Big Hole.

Picking among alternatives isn’t straightforward. Alongside legislation, various guidelines have been drafted (and revised) by regional authorities in the mature mining countries of Canada

and Australia, as well as by the World Bank and mining houses like Anglo American. But the report found little consensus among these guidelines on which criteria and indicators should be used, making it hard to assess “successful closure”.

To better understand this, the authors considered four post-mining land use case studies: the Impact Catalyst, focusing on the Mogalakwena platinum mines in Limpopo; the Green Engine initiative, in the Witbank coalfields; the Resilient Futures Community of Practice in the West Witwatersrand goldfields; and Bokamoso Ba Rona, also on the West Rand. The studies covered a wide spread of areas, commodities, mining methods, stages in the life of a mine, urban and rural contexts, water and land resources and demands from residents.

We are limited by space to a brief look at the Resilient Futures Community of Practice study. This happens to include the Blyvooruitzicht mine, near where the Oosthuizen met their fate all those years ago. That mine closed in 2013 amid industrial action, a falling gold price and increasing costs. Nearby, mining continues but ownership and operations have been



Proper closure and rehabilitation of mines are essential to prevent the pollution of environmental resources.

consolidated, with some shafts and operations shut or put under care and maintenance.

The Community of Practice study lists mines still operating and their expected remaining lifespan (varying from two to 84 years); describes the local geography (much of it urban); and surveys the population, its living conditions and workforce (58% of miners are unskilled so would struggle to find other jobs). The study shows the region's 22 mine villages remain male-dominated (73%) and that almost 12% of the Far West Rand population live in informal settlements. Widely varying conditions among these communities are a legacy of "apartheid and the inability of the current government to create enough jobs and housing".

Much of the land is arable and "presents an excellent opportunity for post-closure land use if the soil is not contaminated by mining activities", the report noted.

"Post-mining land-use planning presents an opportunity to use mine closure as a catalyst for sustainable development"

What about water? Dolomitic land in Khutsong and Carletonville is prone to fissures and sinkholes which "impacts on water infrastructure, causing shutdowns and decommissioning of reservoirs". Mine flooding is another problem. At Kusasaletu, a deep-level gold mine near Carletonville, 1.5-million litres of fissure water must be pumped out of the mine a day. But when mines close and pumping stops, flood waters flow to the surface, raising the risks of acid mine drainage.

What land-use opportunities did the study identify? There was a strong focus on using crops to clean up contaminated soil, air and water and to feed downstream industries. Various fibre crops have been trialled as part of an Anglo Gold Ashanti initiative now in the hands of new owners, Harmony. Non-invasive *Bambusa Balcooa* bamboo found favour with the researchers, due to high yield and end-uses including poles, wood products and fibre for paper and more.

The potential of such fibre crops "make them an attractive opportunity for regenerative agricultural systems" and warrants larger-scale pilot projects. Several other development and land-use initiatives reviewed included the Blyvoor Gold company's local economic development initiatives. These focused on services, including refurbishing the Ekuphakameni Wastewater Treatment Works and maintaining the waste management service in Blyvoor Village.

The other case studies' land use suggestions included large-scale regenerative agriculture, agro-processing, water treatment and game farming. In a presentation at the atlas launch, Cole noted an overall lack of integration in social development initiatives, rehabilitation, and post-mining development and red-flagged "uncertainty on the continuity of projects" accompanying the sale of mines and other assets.

The case studies, along with expert reviews, helped the authors test their mine closure risk rating system, which seeks to gauge the likelihood of a closure, and the accompanying social and environmental risks. Identifying influencing factors and risk categories, they developed indicators and weighting systems for data sets. Likelihood of closure considered ore reserves, commodity markets and operating costs.

Social risk factors and indicators included population size, number of mining jobs, distance from cities and local government capacity.

Evidently the most deprived areas, typically villages in the former Homelands, with large mine workforces were at highest risk, "most notably chrome and platinum mines in Limpopo and North West".

Environmental risk rating considered factors and indicators like duration of mining, mine water threat and distance from protected areas, and threat to biodiversity. "Gold and coal mining have the greatest risk due to acid mine drainage and their location on good arable land," said Cole.

Drawing on more than 65 spatial data sets, the atlas includes a host of functions, letting users zoom in on an area and assess opportunities and risk and to make comparisons. With the option to turn different filters or layers on and off, it helps users understand conditions at a particular mine in a visual way. Maps may be generated that, for example, provide a picture of water resources, transport links, socio-economic profiles and even bird life surrounding a mine.

At the launch guests welcomed the atlas and the other tools developed alongside it.

Dr Ravi Vadapalli, of the Council for Geoscience, called it an "excellent piece of work" which complemented efforts to develop a national mine closure strategy, and wondered if the atlas might in future include closed and abandoned mines.

Others present called for the inclusion of sand mining and quarrying, and details on post-closure projects to help users "see what the neighbours were doing". This would foster partnerships and ultimately help protect water resources.

The atlas is available at <https://www.wrc.org.za/programmes/mine-closure-risk-and-opportunity-atlas/>

To view the final report, *Developing mine closure risk ratings and a post-closure opportunity framework for South Africa (WRC Report No. TT 930/23)*, visit: <https://wrcwebsite.azurewebsites.net/wp-content/uploads/mdocs/TT%20930%20final%20web.pdf>