



**IGF**

INTERGOVERNMENTAL FORUM  
on Mining, Minerals, Metals and  
Sustainable Development

## IGF CASE STUDY

Inclusive Closure  
and Post-Mining  
Transition at the  
Golden Pride Mine,  
Tanzania

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## 1.0 Introduction

Successful mine closure is a vital part of the full life cycle of a mining operation. Preparing for closure starts early and continues throughout the mine life until all closure activities have been completed according to the agreed-upon closure criteria. Mine closure is a multifaceted activity that includes engaging with communities and stakeholders, reclaiming and stabilizing a mine site such that it is environmentally sound and productive into the future, and supporting the post-mining resilience of communities. Every mining operation is unique, and the approaches to closure must be tailored to the environmental, social, economic, and regulatory context of each mine.

This case study of the Golden Pride open-pit gold mine in Tanzania provides good examples of how closure and post-mining transition can be done effectively and

inclusively. It outlines the steps that were taken by the mine, the Government of Tanzania, and local communities to define and implement the closure plan for the operation. It provides a summary of the steps taken to define post-mining land use, implement closure activities, and support opportunities for the post-mining resilience of communities. It concludes with an outline of lessons learned and policy implications for government, including the importance of early engagement with communities, the need for adaptable post-mining land-use plans, the benefits of progressive reclamation, the importance of addressing post-closure site safety and security, and the value of applying international best practices to mine closure.

**FIGURE 1.** Location of Golden Pride Mine,, Tanzania



Source: Author's design using the Tanzania Base Map.png (2021).



## 2.0 Overview of Golden Pride Mine

Golden Pride Mine (GPM) is located in the Nzega district of the Tabora region in west-central Tanzania in the southern part of the Lake Victoria Goldfields (Figure 1). The Nzega district has a population of about 500,000 people and comprises almost 7,000 km<sup>2</sup> of Miombo woodlands, grasslands, and agricultural areas that receive between 650 mm and 1,200 mm of rain annually, with a dry season from May through October (Tabora Region Administrative Secretary, 2017). Several communities are located around the mine site, where subsistence agriculture is the dominant economic activity and where limited formal employment, deforestation to support agriculture, and access to potable

and agricultural water supply are socio-economic challenges.

GPM was an open-pit gold mine that operated for 15 years from 1998 to early 2013 by the Australia-based Resolute Mining Limited. Over 2.2 million ounces of gold was produced from a total mined volume of 78 million m<sup>3</sup>, which included 66 million m<sup>3</sup> of waste rock. At the end of its mining life, the open pit was approximately 2,850 m in length, 720 m at its widest section, and 252 m at its deepest point (Resolute Mining Limited, 2015; Sinclair, 2015a). Waste rock was stored in several locations around the pit and two circular ring-dike, upstream raised embankment facilities were used to store tailings (Figure 2).

The Statutory Mine Closure Plan for GPM was approved by the Tanzanian government

**FIGURE 2.** Surface layout of GPM in 2014, approximately 2 years after mining ended, showing the pit, waste rock dumps, and ring-dike tailings storage facilities



Source: Resolute Mining.



in 2011 as the first modern mine closure to take place in Tanzania. Given that mine closure practices were just emerging in Tanzania and there was limited guidance or regulatory framework, Resolute Mining chose to implement Australian mine closure standards at GPM. This process included approaches to community engagement, employee support with the post-mining transition, and defining the post-mining land use. It also included technical approaches to covering and reclaiming waste rock piles and tailings storage areas. The aim was to ensure the physical and chemical stability of the closed mine site and productive post-mining land use that would support community resilience. Final closure and relinquishment of the mine were approved by the Government of Tanzania in 2015 after a short period of post-closure monitoring.

## 3.0 Approaches to Closure at Golden Pride

### 3.1 Community and Regulator Engagement

During its operating mine life, GPM provided approximately USD 300,000 annually in direct contributions to community initiatives and projects (Sinclair, 2015b).

Local communities were involved in the identification of funded projects through a Participatory Rural Appraisal (PRA) approach that started in 2000 and was initiated and supported by GPM throughout the mine life (Chambers, 1994; Macdonald, 2017). PRA allowed for the development of community action plans and helped identify where the mine could assist community interests. Funded projects included those related to health, education, agriculture, roads, water supply, and environmental awareness. Starting in 2008, about 4 years before closure, GPM began engaging with communities, government, and other stakeholders about the planned end of mine life with the aim of preparing the community for a post-mining economy and understanding how GPM could support that post-mining economy (Figure 3). The PRA work allowed GPM to have a good understanding of community needs and interests prior to specific engagement on closure. Engagement with regulators was through the National Mine Closure Committee, which was formed in accordance with mining regulations. The committee included representatives from ministries responsible for mining, environment, water, and natural resources (wildlife and forestry), as well as the National Environment Management Council, Land Use Planning

#### BOX 1. PARTICIPATORY RURAL APPRAISAL

A PRA is a community-based approach that supports and empowers local rural communities to identify development issues, create solutions, and participate in the implementation and evaluation of those solutions. A number of different approaches and tools can be used in PRA, depending on the issues and communities involved. In the case of the GPM, Macdonald (2017) stated that the use of PRA “over a period of 15 years, demonstrates that this approach can be undertaken in a lowkey, cost-effective, and sustainable manner. The PRA approach allows people to build their capacity by making their own choices and learning through their own successes and failures. PRA methods specifically include women and a wide spectrum of society, to ensure that projects are broadly based and widely supported” (p. 12).

More information on PRA can be found in Chambers (1994), Macdonald (2017), and at the Participedia website (<https://participedia.net/method/4907>).





**FIGURE 3.** Community members consider post-mining land-use options for the GPM site



Photo: Niza Mwenesi.

Commission, and regional and district authorities. In addition, GPM undertook a regional socio-economic study to better understand local needs and the impact and feasibility of various closure options.

### 3.1.1 Water Needs

As closure approached, the focus of the community was on supporting a transition toward lasting benefits that could be managed by the community after closure without the need for ongoing investment, upgrades, or technical expertise. Water was identified as one of the most important needs, particularly for agriculture during the dry season. This focus led to the construction of a series of small dams in rural areas around the mine that would create water reservoirs for stock watering and other agricultural needs (Figure 4). The mine also retained a dam and water treatment plant adjacent to the mine site and near Nzega town that was previously used for mine production so it could continue to provide

potable water to Nzega. The original plan was to demolish and reclaim the dam, but this changed with community input. In addition, the decision to establish a pit lake became a key aspect of the closure plan, as it could provide a year-round stable water source for the local region (see details on the pit lake in section 4).

## 3.2 Employee Engagement and Transition

GPM began engagement with employees and contractors in 2009, about 3 years before closure, to increase awareness and understanding of mine closure and the progressive workforce reductions that would occur. To support employees in the post-mining transition, GPM agreed to severance packages that went beyond the requirements of the Tanzanian Employment and Labor Relations Act and initiated an employee assistance program on financial management, job search skills,



**FIGURE 4.** Isanga dam was built by GPM to provide water for agriculture



*Photo: Resolute Mining.*

and strategies to prepare for the loss of employment and support future pathways. The mentoring and training of employees over the life of the mine also supported the closure transition, and a number of highly skilled staff were offered positions at other mines operated by Resolute Mining or with other mining companies operating in Tanzania and across Africa.

### 3.3 Post-Mining Land Use

The community and regulator engagement undertaken by GPM both during operation and leading up to closure identified a range of post-mining land uses. One of the early plans was to dismantle the entire infrastructure, reclaim the site to a Miombo woodland setting, and encourage low-impact activities such as beekeeping, a traditional activity in the region. As closure approached, the national government supported a plan to turn over the site to the Tanzania prison

service, which needed a location for new facilities and which could provide security at the site to limit incursion by small-scale miners and the cutting of reclaimed forest. However, concern by local communities and government officials about this land use resulted in a change to retain site facilities and turn them over to the Mineral Resources Institute<sup>1</sup> as a training facility for geology and mining—a use that is ongoing.

Another important aspect of the post-mining land-use plan involved the open pit. Some community members and government officials originally wanted the pit fully backfilled and then reclaimed. GPM considered this option challenging (see Table 1), and some government regulators were concerned that complete backfill of the pit would seal off potential remaining gold resources that could be extracted in the future. After considerable discussion with communities and regulators, the final

1 <https://www.mri.ac.tz/>





plan was to backfill part of the pit and turn the remainder into a pit lake that would serve as a water reservoir for irrigation and discourage the use of the site by small-scale miners to protect their own safety (the pit lake is described in more detail below).

### 3.4 Progressive Reclamation

One of the primary post-mining land uses for the site was to return much of it to a natural Miombo woodland setting (Figure 5). This required planning from the earliest stages of mining to ensure that soil material was harvested and stored during operation, so it was available for reclamation. Revegetation of the mined landforms began in the second year of mining operations. This early work resulted in a growing native forest that was recognized as important by regulators since much of the forest in the region had been cut down. It also helped inform closure designs, such as water-shedding landforms for the tailings storage facilities

that would support forest growth and discourage the establishment of rice paddies that would disturb the forest. In addition, the development of erosional gullies that disrupted some of the early reclamation work on the waste rock storage facilities led to the redesign of the water-shedding landforms to include rock chutes that focused drainage to maintain the physical stability of the reclaimed facilities.

The mine also undertook studies on the chemical character and acid-rock drainage potential of all the rock material extracted at the mine to determine the best material for use as a cover for waste rock and tailings storage facilities. Oxide waste rock material was determined to be non-potentially acid generating and was used as cover material below the topsoil layer. By scheduling progressive closure activities during operation, oxide waste rock could be tipped directly onto tailings storage facilities that were undergoing reclamation and save the

**FIGURE 5.** Growth on reclaimed tailings storage facilities approximately 2 years after closure shows mixed species consistent with a Miombo woodland and local grass cover



*Photo: J. Hartnett.*



cost of storing the material and then moving it again once reclamation started.

Progressive reclamation over the entire life of the operation contributed to an understanding of what methods worked and what did not work and allowed GPM to adapt approaches before final closure. It also built trust with communities and the regulatory authorities in the closure plan, as they could see the results of the work before final closure activities were initiated.

### 3.5 Security and Small-Scale Miners

One of the challenges that can impact a closed mine is if it becomes occupied by illegal artisanal or small-scale miners. The occupation of the site can quickly degrade or reverse reclamation and closure activities and leave a closed mine site unsafe—potentially physically or chemically unstable—and make communities vulnerable to the impacts of the illegal activity. There are often no easy solutions to this challenge, but where small-scale mining is common, it should be recognized that small-scale miners will likely want access to the site to extract gold from the pit, waste rock, and even tailings disposal areas. This reality should be factored into closure objectives and plans with consideration for how the site could be legally used by small-scale miners while supporting safety and protecting reclaimed areas.

At GPM, the national government initially recommended the use of the site as a prison for agricultural production. This had the added benefit of providing site security and thus reducing occupation by illegal miners. While the prison plan did not proceed, the use of the site by the Mineral Resources Institute means that it continues to be occupied for official purposes, making it harder for illegal miners to take over the site. The Mineral Resources Institute is also providing training to legally registered

artisanal miners on safe mining practices, and the government has issued small-scale mining licences (called Primary Mining Licences) over part of the closed mine site and a prospecting licence to the Mineral Resources Institute for training purposes. Nevertheless, as of the middle of 2022, illegal miners are also operating on the site, and this is having an impact on the closed and reclaimed facilities (see Section 5 on the state of the site in 2022).

### 4.0 Closure of the Open Pit

The closure plan for the open pit serves as a good example of how the various approaches to closure were integrated at GPM, including community and regulatory engagement, social and environmental studies, and the desire to leave a productive and stable site that would support communities after closure. In the early planning stages, some in the government and communities expressed an interest in completely backfilling the pit. This option was challenging for several reasons, including a lack of sufficient material to fill the pit and the sterilization of potential future resources beneath the pit. At the same time, communities identified the need for a secure year-round water source, particularly for stock watering. This led to extensive engagement with communities and regulators and a range of studies by GPM to assess options for turning the pit into a lake that would satisfy the closure objectives of the mine and support the community through access to a water reservoir. The final approved closure plan involved backfilling a portion of the pit and allowing the remaining part to become a pit lake (Figures 6, 7, and 8). Table 1 outlines how various issues with the closure of the pit were addressed by GPM.





**TABLE 1.** Approaches to addressing the closure of the GPM open pit

Closure Issue	Issue	GPM actions	Solution/benefit
Complete backfill of the pit	<ul style="list-style-type: none"> <li>• Insufficient material to completely backfill the pit—new excavations would be required.</li> <li>• Cover material needed for reclamation would have to be used as backfill.</li> <li>• Reclaimed waste rock piles would be relocated to the pit, which would remove the growing forest.</li> <li>• Potential future mineral resources beneath the pit would be sterilized.</li> <li>• Very high cost.</li> </ul>	<ul style="list-style-type: none"> <li>• Engagement with government and communities over several years around the challenges of a complete backfill and assessment of alternative solutions.</li> <li>• Assessment of partial backfill options that would minimize resource sterilization.</li> </ul>	<ul style="list-style-type: none"> <li>• Partial backfill of the pit and creation of a pit lake.</li> <li>• Reduced footprint of waste rock piles as some material is used as backfill.</li> <li>• Reduced cost, as waste rock from the final years of mining is tipped directly into the pit.</li> <li>• Partial sealing of potential future resources deemed an acceptable compromise.</li> </ul>
Water source for a pit lake	<ul style="list-style-type: none"> <li>• Insufficient volume of rainwater and runoff to refill the pit lake annually.</li> <li>• Long projected time frame for the pit to fill with water (42 years).</li> </ul>	<ul style="list-style-type: none"> <li>• Full environmental and social impact assessment to assess diverting water from a local creek (Bundomo Creek) into the pit to increase inflow.</li> <li>• Redesign of reclaimed waste rock and tailings storage facilities to shed water into the pit lake at closure.</li> </ul>	<ul style="list-style-type: none"> <li>• A pit lake that has sufficient annual water inflow to support community water needs.</li> <li>• Increased freshwater inflow from Bundomo Creek improves water quality and mixing.</li> <li>• Reduced time to fill the lake (estimated at 32 years).</li> </ul>
Water quality in potential pit lake	<ul style="list-style-type: none"> <li>• Concerns that water quality would not be acceptable for agricultural or human use.</li> </ul>	<ul style="list-style-type: none"> <li>• Extensive hydrological and water quality modelling studies (Goldsim models) to determine the length of time for the pit to fill and expected water quality.</li> </ul>	<ul style="list-style-type: none"> <li>• Water quality is expected to meet stock watering and irrigation standards in a short time frame (three wet seasons).</li> </ul>



Closure Issue	Issue	GPM actions	Solution/benefit
Pit safety and security	<ul style="list-style-type: none"> <li>• Use of the pit by illegal artisanal or small-scale miners.</li> <li>• Collapse of pit walls if left open.</li> <li>• Potential for drownings in a pit lake.</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate security solutions for the various pit closure options.</li> </ul>	<ul style="list-style-type: none"> <li>• A pit lake will submerge rocks that may be of interest to illegal miners and submerge/stabilize the pit walls.</li> <li>• Backfill will stabilize the remaining part of the pit.</li> <li>• Safety bunds around the pit will limit access.</li> </ul>

**FIGURE 6.** View of mine site looking west in 2005. This photo shows the pit and some of the early reclamation work on the north waste rock pile (right of the pit) and the ring tailings storage facilities in the background.



Photo: Resolute Mining.





**FIGURE 7.** View of the partially backfilled open pit and reclaimed waste rock piles looking southwest about 1 year after the end of gold production in December 2014



*Photo: J. Hartnett.*

**FIGURE 8.** View of the pit lake looking east as of February 2022. The backfilled parts of the pit are at the far end in this photo. The pit lake reservoir is filling quickly and may reach capacity in a few years. This is considerably faster than initial projections, which estimated 32 years for the lake to reach capacity.



*Photo: Niza Mwenesi.*



Initial monitoring of the water in the pit 2 years after closure (2013 and 2014) indicates that the modelling data on water quality and quantity is being met, although the short time frame does not provide sufficient data to fully assess the water quality. Observations of the site in the middle of 2022 show that the pit lake is filling faster than expected (Figure 8), and if water inflows continue at recent rates, the pit lake will be full in a few years (see Section 5 for more on the pit lake).

## 5.0 Site Status in Mid-2022

As of the middle of 2022, the reclamation and closure works completed at GPM have, for the most part, been successful. Vegetation is well established and maturing, and the pit lake is filling faster than expected. Observations at the site indicate that water in the pit lake is clear, and catfish and tilapia are commonly seen. The Mineral Resources Institute continues to offer training on the site and has recently become part of the University of Dar es Salaam, where it can support training in the School of Mines and Geosciences in addition to supporting its certificate and diploma programs.

Challenges at the site include wood harvesting for building material and charcoal, given that wood is relatively scarce in the region, and local burning of reclaimed vegetation to encourage grass growth for livestock grazing. However, the primary challenge to the reclamation and closure work is the use and occupation of parts of the site by small-scale miners. Some of the miners are legally registered and hold Primary Mining Licenses from the government and were planned for at the time of closure by allocating the resources of a small satellite pit for use by community miners. However, illegal miners are also using the site. These miners are disrupting parts of the reclaimed waste rock piles and tailings storage areas, as well as mining rock recently

exposed due to slumping along the margins of the pit as the lake fills (see the back right of the pit in Figure 8). This creates safety issues, particularly in underground workings, as the newly exposed rock is unstable. There is some indication that illegal miners are disrupting reclaimed waste rock that they believe may contain stockpiled ore. Some miners believe that the mine will re-open, and thus they are positioning themselves for compensation if that happens. There are also reports of miners washing their workings in the pit lake along with the use of mercury to extract gold. This will impact the water quality of the lake, which could affect the use of the lake water for irrigation in the future.

Implementation of an irrigation system to use water from the pit lake has not yet been planned by government agencies, although it was not anticipated that the lake would fill so quickly (it was originally estimated to fill in 32 years). This is one area where preparations should get underway to take advantage of the water resource. However, this will have to come with better management of small-scale mining on the site to ensure the water is not contaminated and rendered unsuitable for agricultural use.

## 6.0 Lessons Learned and Policy Implications for Governments

The closure of GPM provides an excellent example of how mine operators, communities, and government can work together on the social and environmental transition from an operating mine to a post-mining future. The approaches taken provide a number of lessons and policy implications for governments that should be considered when establishing closure policies, regulations, and processes. Some of the lessons relate to practices that government should require of mine operators, such as early engagement with communities or





implementing progressive reclamation, and others are recommendations on the role of government, such as participation on closure committees; defining post-mining land uses that are consistent with local, regional, or national development plans; and the management of small-scale miners who will have an interest in the site after it closes.

## 6.1 Ensure Early and Regular Engagement

Governments should ensure that mine operators start the process of engaging about closure with communities and regulators prior to the mine's operation. Most modern mine closure policies, and good practice, require that a conceptual or preliminary closure plan is submitted as part of the environmental and social impact assessment and mine permitting. This plan should be developed with the engagement of communities and regulators. However, as shown in the GPM example, aspects such as end land use and community interests can change over the life of the mine. As such, engagement should continue and evolve as the mine operates and closure approaches, factoring results of engagement into updates to the closure plan as needed. At GPM, it took 6 years of consultations, studies, assessments of alternatives, and approvals to finalize the closure option for the pit. This highlights the importance of starting detailed closure planning and designs well before final closure. Another aspect that was effective was the PRA approach used at GPM. Although this was initially used to support community development plans during the mine's operation, it provided the groundwork to determine the post-mining land use of the site and how GPM could support community resilience post-mining.

## 6.2 Allow for Adaptable Post-Mining Land Use

Establishing post-mining land use is one of the important steps in planning for mine closure. Initial land-use plans are normally determined early in the process with the conceptual or preliminary closure plan. However, the interests and needs of communities, as well as local, regional, or national government development plans and goals, are likely to change over the life of a mining operation. In addition, as mine closure approaches, risks that need to be factored into end land-use plans for the site will be better understood. Regulators should ensure that post-mining land use is revisited with each update to the closure plan to assess whether changes are needed. In the case of GPM, changes in the post-mining land-use plan occurred almost up to the date of closure—from dismantling infrastructure and turning the site over to the prison service to retaining much of the infrastructure and turning the site and facilities over to the Mineral Resources Institute and, to some degree, to legally registered small-scale miners. Even the success of early reclamation efforts increased interest in returning the site to a natural woodland rather than for other uses, such as agriculture.

It is also important to consider future resource development potential in post-mining land-use plans. As commodity prices change, the resources that remain beneath or adjacent to the pit may, at some point, become economical to mine again. The economics of mining are also scale dependent. What might not be economical for large-scale mining could be economical for small or medium-sized mines. At GPM, one advantage of the pit lake option is that removing water from the pit is a much lower-cost option than removing backfilled waste rock; therefore, this option improves the chances of future generations benefiting from the gold that remains below the pit.



## 6.3 Require Progressive Reclamation

Progressive reclamation is recognized as an important process in mine closure. Starting reclamation early reduces the impacts of the mine as soon as possible and allows a mine to demonstrate the effectiveness of proposed reclamation methods and adapt and improve those methods well before final closure. These aspects are effectively demonstrated at GPM. By the time the mine had closed, early reclamation activities had produced a healthy growing forest on several parts of the site (see Figures 5 and 7), and initial problems with the formation of erosional gullies on waste rock piles were addressed to ensure the physical stability of all reclaimed waste rock at the time of final closure. Most of the site had been reclaimed before gold production ceased.

## 6.4 Plan for Post-Mining Site Safety and Security and Small-Scale Mining

Efforts to reclaim and close a mine site can be compromised by illegal activities or occupation of the site after closure. This can be particularly challenging if the site is occupied by illegal miners, but wood harvesting and clearing for agriculture can also be an issue. Solutions to these challenges can be difficult to achieve, but consideration of site security should be part of closure planning. Government should also play an active role in considering how to address these issues in a manner that is consistent with development plans, policies, and programs, such as those on small-scale mining and the safety and security of communities. The knowledge that small-scale miners will likely want to use a large-scale mine site after closure should be given consideration as a viable land-use option. This could involve supporting the formation or development of local mining cooperatives as well as training on safe and

environmentally sound mining methods as part of the support provided to communities in the post-mining transition.

At GPM, the safety and security of the site after closure was considered early in the planning processes. Some of the closure solutions that have helped with safety and security include continued occupation of the site by the Mineral Resources Institute, sealing off the pit as a lake and through backfilling, and support for legal small-scale miners through safety training and providing licences to some of the resources on the site.

## 6.5 Establish Closure Committees

Mine closure is a multidisciplinary process that involves a range of perspectives through consultation with the community and groups from many different disciplines, including geoscience and engineering, environment, social sciences, economics, and local and regional planning. One aspect that supported closure planning and implementation at GPM was the formation of a community closure committee and a national closure committee. These committees ensured that there was input from and representation of community members, local government, and various ministries and interests at the national level. It is recommended that governments consider requiring the formation of closure committees that represent the diverse community and government interests and that these committees are formed early in the closure planning process and continue through to the final closure of the site. Active community participation on these committees is important to strengthen local knowledge and influence over post-mining land use decisions.





## 6.6 Harness Leading Global Practices

Mine closure is a complex undertaking that requires diverse expertise and experience. A number of mining jurisdictions have developed leading policies and practices, and various international organizations have developed technical and policy guidance on mine closure, including the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development. It is recommended that governments draw on these existing closure guidelines and practices and require their use where local or national guidance or policies have not yet been developed. GPM took this best practice approach by supplementing and building on Tanzanian requirements in place at that time with leading closure practices required in Australia. This is consistent with the expectation that international mining companies use leading global practices regardless of the jurisdiction in which they operate.



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