



Re-defining sustainability

Better planning promises better pit lake outcomes

by Clint McCullough

Companies that build a sound reputation for environmental stewardship will find it easier to attract investment capital and debt financing, as well as be in better position to close their projects and sell on their properties once mining is completed. They may also find it easier to get regulatory approval on their project by considering this key element of closure upfront.

Questions about post-closure are becoming more prominent as mining seeks deeper deposits and lower grades of ore. Rather than the small, shallow pits that were more common in previous decades and centuries, the sheer size of today's open pit mines – both in width and depth – creates post-closure challenges of a whole new order.

Pit lakes are an increasingly large part of the mining industry's legacy around the world. Much of the focus on post-closure remediation is on limiting acid mine drainage (AMD) from tailings and mine waste rock. However, even after these waste facilities have been stabilized and revegetated, the pit lake often remains as one of the lasting legacies of the mine. As a result, developing better closure outcomes for pit lakes is becoming an important issue for mining companies.

Additionally, mining now extends into locations that were previously considered too challenging, particularly the drier areas of the world, where water issues come to the forefront. In some of these regions, evaporation of the water in pit lakes can represent a substantial abstraction of the total water resources in the area.

In many parts of the world, pit lakes have no natural counterparts. For example, in Western Australia most natural lakes are shallow and seasonal. Pit lakes may be deep and often persist year-round; therefore, they may play a significant role in contributing to a novel post-mining environment. Good mining practice includes deliberately designing and developing a

positive outcome for these new landscapes from an environmental, social and economic point of view.

Pit lake pros and cons

Pit lakes can produce many effects that are negative, including:

- In arid regions, evaporation may cause a rising concentration of salts and metals to the point that the water becomes dangerous to wildlife or livestock that drink it.
- Where acid rock drainage is present, acidic water may cause environmental risk to wildlife.
- Metals, salts and acid in the water may contaminate groundwater, or overflow may contaminate surface water.
- The steep sides of the pit pose a risk of potential collapse and falls by animals and people.
- Pit lakes may support waterborne disease vectors, such as mosquitoes.

Yet, it is often possible for pit lakes to provide positive outcomes through beneficial end uses such as:

- A water source for wildlife, including waterfowl, at a time when many wetlands are in decline.
- A habitat for game and traditional hunting species, such as fish, so the lake becomes useful for sport, subsistence or even tourist fishing.
- A recreational waterbody, for activities such as swimming and boating, for example.
- A water source for irrigation of surrounding forestry, crops, livestock or aquaculture.

Water in a pit lake may also be useful for other mining operations, either as the pit is filling or following production. A backfilled open pit mine can be a repository for waste rock and,



A pit lake at the now-closed Black Diamond coal mine in Western Australia.

if locked away from air and water, less prone to generate acid mine drainage. It can also be a final repository for other types of acid-generating and mine waste materials, such as heap leach pads, provided this is a sound environmental practice.

Planning for closure must include the pit lake

With the concept of planning for closure now frequently considered by mining companies at initial conceptual stages, it is important to consider making the eventual pit lake a positive part of the closed mine. This includes predicting the eventual quality of the water that will be in the lake by considering factors such as the mineralogy of the surrounding soil and rocks, the quality and flow rate of local groundwater, and rates of precipitation and evaporation. Plans can then incorporate mitigation steps to achieve good water quality by designing the pit lake around these constraints.

In some cases, engineered aquatic habitats, such as lakes, can be included in the closure plans. These environmental factors may help improve water quality and will also help to provide some environmental benefit as habitat for fauna and flora.

There can never be a one-size-fits-all solution for pit lakes. A location close to inhabited areas will be more viable as a commercial or recreational site than will one in a remote area. Some can be converted into highly beneficial use, while others may require more investment in remediation and post-closure monitoring to ensure risks are minimized instead.

Further study needed

One of the difficulties mining companies face regarding pit lakes and closure is that there are few relevant standards guiding the required quality of the water in the lake. Most of the standards available are for natural lakes, and pit lakes will expectedly have different ranges for many water quality parameters. Pit lakes also tend to have only limited, if any, ecological processes active in them. Therefore, one area for further study is the degree that regionally

representative ecosystems can be restored in these new water bodies.

Predictive geochemical modelling is an important tool when developing post-closure plans for the mine pit, including its lake. More work is needed to adapt current models – designed for use in natural lakes – for use in a pit lake environment, and to use them as a means to learn what key obstacles to water quality may need to be remedied.

The goal of good mining management is to operate sustainably by minimizing risk and maximizing both short- and long-term benefits for all stakeholders. This goal also holds for sustainably closing components of the final mining landform, including pit lakes.

Not all negative effects from pit lakes can always be removed or mitigated.

However, mining companies that mostly seek just to reduce their liability post-closure may be missing opportunities to build positive relations with the community, regulators, government authorities and other stakeholders through investing in the best possible outcomes for their pit lakes at closure. **CIM**

This article is based on a presentation the author will make at the Mine Closure 2011 conference to be held September 18 to 21, 2011 in Lake Louise, Alberta.

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