

CLOSURE PROGRAM AT SAN MANUEL COPPER MINE ADDRESSES ENVIRONMENTAL ISSUES



Following closure of our San Manuel copper operation in Arizona, USA, reclamation of the mine sites has commenced. All mining ceased in August 1999, following which the operations were managed on a care and maintenance basis until the mine site was closed in January 2002 and the plant site in October 2003. Decommissioning and reclamation of the sites will be completed over the next five to seven years. A significant environmental challenge will be management of the future pit lake that will form at the mine site, due to acidity from spent process solutions that remain in the former open pit mine. Reclamation strategies include a number of options to reduce the residual risk. Our commitment to protection of the environment will be central to the reclamation process.



► Aerial view of the San Manuel mine site

The San Manuel mine and plant operation is located in the arid south-west of Arizona, approximately 48 kilometres north-west of Tucson. The ore body is one of several large copper deposits that were discovered in the area in the early 1900s. Mining commenced in 1948, and in 1952 Magma Copper Company constructed an underground mine, plant and railroads and started developing the community of San Manuel. Development of open pit mining operations on top of the subsidence area of the underground mine began in 1985. BHP Billiton acquired the property through the purchase of Magma Copper Company in 1996.

The mine site included the underground block cave mine that supplied sulphide ore via a dedicated railway to the mill located at the plant site, as well as the open pit mine operation that extracted and processed the copper contained in the oxide cap over the block cave mine. There was also an in situ leach operation within the open pit area. The mine site covers approximately 2000 hectares, of which approximately 1200 hectares have been disturbed by mining.

The plant site is located about 11 kilometres south of the mine. Operations there included a concentrator, smelter and refining facilities as well as a tailings dam that covers approximately 1450 hectares. The plant site is bordered by the town of San Manuel to the west and the San Pedro River to the east.

Planning for the future pit lake

A significant environmental challenge associated with the reclamation of San Manuel is the management of the future pit lake at the mine site.

When the mine was placed under care and maintenance in 1999, groundwater continued to be pumped from the underground mine to sustain operations until closure was announced. Upon closure, the pumping ceased, allowing groundwater to begin flowing into the underground mine. In approximately ten years the groundwater will reach up into the open pit and a lake will begin to form. A network of groundwater monitoring wells is in place and groundwater level readings and samples have been collected over time, from which baseline measurements have been developed.

Our reclamation project team has applied the Company's HSEC management standards as well as Enterprise-Wide Risk Management standards to identify and manage environmental issues. By applying this decision-making methodology, it was determined that well-timed implementation of closure activities can provide significant cost savings over time. Therefore, the project schedule is driven by a desire to realistically compress the reclamation program while adequately addressing the environmental challenges associated with formation of the pit lake.

The water quality of the future lake is expected to be affected by spent process solutions that remain in the former open pit mine as a result of in situ mining on the benches. Acidity in the spent process solutions and pit slopes will be partially offset by acid neutralisation due to rock composition in the former underground mine; however, the pit lake pH is expected to approach 5.0, and dissolved metals will still be present in the water. Planning contingencies include treatment of the pit lake water to adjust the pH to approximately 7.0, which will ensure that migratory birds and groundwater will be further protected from impacted pit lake water quality.

Computer models of groundwater movement and pit lake formation suggest that that groundwater will move very slowly through the rock and soil, and any remaining solutions will naturally degrade over time; however, evaporation from the pit lake surface will be insufficient for the lake area to passively contain all the groundwater that will rise into the lake over time.

Exploring options for managing residual risk of the pit lake

A number of proactive management options to reduce the residual risk of the pit lake have been identified. These include:

- segregating affected and non-affected groundwater inflow for potential treatment or beneficial use off site, such as for drinking water, agricultural use or industrial purposes
- water treatment methods that involve in-situ or pre-emptive measures to improve water quality in the pit lake

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- promoting neutralisation of acidity in the spent process solutions in the former underground mine by treating them with acid-neutralising materials such as from the San Manuel Formation, which contains a considerable amount of carbonate that neutralises acid and precipitates metals out of the water.

Various technical studies and regulatory assessments will be carried out during the next three to five years of groundwater recovery. At the same time, it is anticipated that public awareness of the value of the water resources at the mine site will increase. The processes we have put in place to identify issues and manage residual risk recognise the importance of the closure and reclamation process to the community and the local environment.