Mine saves millions through ZERO DISCHARGE PLAN

Lani van Vuuren

At the on-site water treatment plant water is treated to both process and potable quality.

In a water-scarce South Africa, mines are not only compelled to prevent potential pollution of the aquatic environment, they also have to use their freshwater allocations sparingly. Xstrata's Eland Platinum Mine is proving that, with long-term vision and dedicated effort, mines can do both. Compiled by Lani van Vuuren.

The availability of water is fast becoming one of the major elements restraining the expansion of mining in South Africa. While not the biggest users of water in the country, the mining sector does require large volumes. In many instances existing bulk water infrastructure was developed with agriculture and industry in mind, and mining operations have to compete with these users for available water resources.

When additional bulk water infrastructure schemes are constructed for new mining developments, as is largely the case with the De Hoop Dam, mining companies are compelled to sign off-take agreements to help finance these schemes. The off-take agreements 'force' mines to buy a certain volume of water; irrespective of whether they use it or not.

Typical new raw water costs are more than R10/m^3. In this case there are no incentives for mines to use less water. As a result, simply constructing more expensive bulk water schemes are not an attractive option – both for the environment and for mining companies. In addition to water security issues, continued pressure from government and public forums are prompting mining houses to improve their environmental management practices.

DRAWING UP A PLAN

Situated outside Brits, in North West Province, Eland Platinum is situated in the western portion of the platinum-rich Bushveld Igneous Complex. The mine became operational in 2006, and in late 2007, it was bought by Xstrata Alloys. An opencast operation, the mine produces about 200 000 t a month.

The mine requires about 3 million m^3 per year of water, which is traditionally fed to the mine from the Hartbeespoort Irrigation Board canal system. However, this water supply can, at times, be erratic, due to, for example, unexpected maintenance and blockages in the system. Water quality is also affected by high nutrient levels and algae blooms.

Along with the erratic water supply, the mine experiences ingress of water into its opencast pits. Once in the pit, this water becomes polluted with suspended solids, hydrocarbons and other

contaminants. When this water seeps out into the environment and underlying aquifer it can affect downstream users, including farmers.

Historically, seepage water from the open pit was captured and retained in a dam on site, named Lapa Dam. However, it was found that the spillway of the dam had developed leaks, which further increased seepage of dirty water into the environment.

In 2008, a decision was made to optimise Eland Platinum's local water resources and improve water management. The mine came up with an integrated groundwater resource management plan. The primary aim of the plan is to introduce a culture where groundwater is viewed as a sustainable partner rather than as a risk to be managed.

The plan is designed to ensure that both the environment and the mine benefit from proper groundwater management. The strategy is framed by four phases: real-time monitoring, resource and system modelling, resource protection and training and development.

Groundwater inflows into open-pit area.

Courtesy Eland Platinum

Prior to the implementation of the mine's zero discharge plan, water pollution was a constant headache.

EARLY PHASES

During the initial phase, specialists worked together to prove the value of the integrated approach, explains independent consultant Fanie Botha. "Hydrogeological understanding was gained through adapting mineral resource exploitation data, thereby building a better conceptual hydrogeological model."

Core data was used to position water exploration boreholes and strikes with yields up to 30 ℓ/s were recorded. The mine now became aware of deep-seated water which could be removed before the aquifers are intersected by mining works.

ZERO DISCHARGE PLAN

One of the most important tasks under the integrated groundwater resource management plan is the zero discharge plan. The mine-water management team developed a site-specific integrated dynamic simulation model providing options to exercise zero water discharge from the operation and reducing the need for the abstraction of surface water for the mining operation.

Water is pumped from the open pit at a rate of between 450 and 900 m^3/h. The pumping can continue for anything between ten minutes and 24 hours, depending on the volume rainfall and fissure water. To improve handling of the dirty water, it needs to be pumped at a more constant rate, explains Botha. "This means water from the open pit needed to be captured and released at a constant rate."

Following a detailed site visit three retention dams were identified. Upstream it was decided to construct a stilling basin to serve as a first retention dam. An existing farm dam was identified as the second retention dam. The wall of this dam had been opened by the previous mine owners and the dam no longer functioned. The Lapa Dam, situated

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***Above**: At Eland Platinum Mine, outside Brits, in the North West water flowing into the opencast pit is captured and stored for re-use.*
***Below**: Captured water is used for, among others, dust suppression.*

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downstream from the old farm dam, would serve as the third retention dam. A stilling basin would also be constructed to allow solids to settle before the water is captured in the old farm dam.

The stilling basin was constructed using gabions from fresh waste rock coming from the open pit. The old farm dam wall was repaired using the same material as well as limited fine material, also from the open pit. "This permeable dam wall creates an almost constant flow rate. It also acts as a stilling basin, allowing solids to settle further," explains Botha.

The Lapa Dam was re-designed to capture and pump excess water to the process water dam or raw water storage dam. All raw materials except the reinforced concrete came from the open pit. The dam wall was covered and compacted with moderately weathered norite. This lowers the risk of failure and ensures safer access to the spillway, notes Botha.

The pump system comprises a small artificial recharge basin with two boreholes equipped with submersible pumps. Each pump can transfer 25 ℓ/s. Both pumps are electronically controlled and are able to handle low and high flow volumes.

This water is treated on site at a specifically designed water treatment plant, operated on behalf of the mine by Fraser Alexander. The plant, which has a capacity of 300 m^3/h, has two streams – water is treated both to process water quality and to potable water quality.

Regular on-site testing and monthly laboratory analysis of the process streams conducted at an off-site accredited facility ensure that the respective plant performance remain within the required standard. In addition, Fraser Alexander is responsible for identifying and implementing suitable technologies to improve the efficiency and performance of the water treatment works over the contract period and to provide support and input into broader water management activities.

IMPROVED WATER MANAGEMENT

Apart from the obvious benefits to the environment, the zero discharge plan has brought Eland Platinum significant gains. The mine's conjunctive use of groundwater, surface water and return water (from the tailings dam) has greatly reduced the mine's dependence on surface water to the extent that it now only uses about 780 000 m^3/year. As a result of its reduced dependency, the mine is also paying much less for its water. The mine's reduced dependence on surface water has freed up that water for other uses, such as irrigation.

Eland Platinum's water requirements may double in the near future. Development of the first two underground decline shaft systems, which will replace the limited-life open-pit operations, has already started. However, the mine's water management system will allow it to be completely self-sufficient in the future.