

Acid Mine Drainage Brochure



A new word for water





INTRODUCTION

TCTA manages on behalf of the Department of Human Settlement, Water and Sanitation (DHSWS) the operation and maintenance of the treatment plants as part of the Acid Mine Drainage – Short-term Intervention (AMD-STI). AMD occurs when acidic water flows out of mine shafts and results in affected water supplies developing pH levels like those of battery acid. The water then becomes harmful to human beings, animals and plants. The challenge of AMD has existed for many years, but it is only recent, due to the scale of mining in the last century, that it been realised that mines cannot be abandoned, and the effects of AMD left to impact on the environment for generations to come.

Nowhere is this more apparent than Witwatersrand Goldfields in South Africa. Here, there are Western, Central and Eastern basins, which are situated in an arc stretching for more than 70 km, from Krugersdorp in the west to Nigel in the east and reaching over 2 000 m into the depths of the earth. Within each basin, the mines have been interconnected, so that as each mine floods it impacts on the adjacent mines. At the end of mining it was left to the last operating mine in each basin to carry the full cost of pumping and neutralising the AMD, which often was too great a burden leading to the closure and liquidation of the mines. TCTA runs treatment plants in the basins and has achieved good results in each.

AMD-STI aims to stop decant in the Western Basin and the Environmental Critical Levels being breached in the Central and Eastern basins. The achievements to date include discharged water consistently complying with (DHSWS) water quality specifications, and there being no decant of untreated AMD in the Western Basin. The water level in the Eastern Basin is already below the environmental critical level, while progress continues in the Central Basin towards the environmental critical level.

At this point, Government intervention was necessary. In 2010, Cabinet appointed an Inter-Ministerial Committee to investigate the serious challenges posed by Acid Mine Drainage (AMD) in the Witwatersrand Goldfields (The area between Randfontein in the West and Nigel in the East). A Team of Experts was appointed and a report "Mine Water Management in the Witwatersrand Gold Fields with Special Emphasis on Acid Mine Drainage" was presented to Cabinet on 9 February 2011.

It was in this context that TCTA was directed by the Minister of Water and Environmental Affairs to implement an emergency short-term intervention to neutralise the AMD and discharge it into the river system whilst the feasibility study for a long-term solution was being undertaken.



PROJECT BACKGROUND

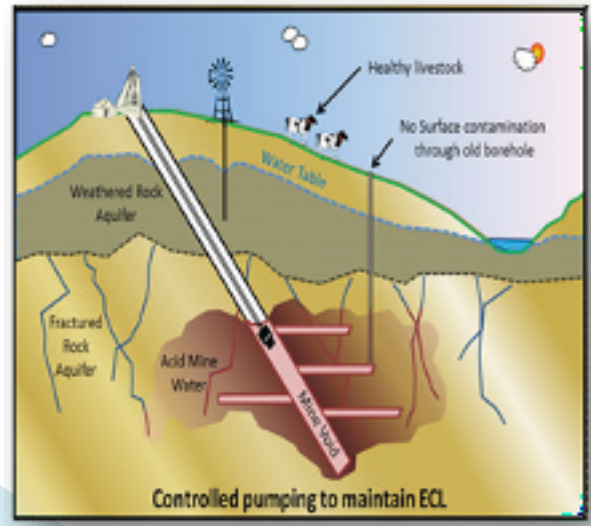
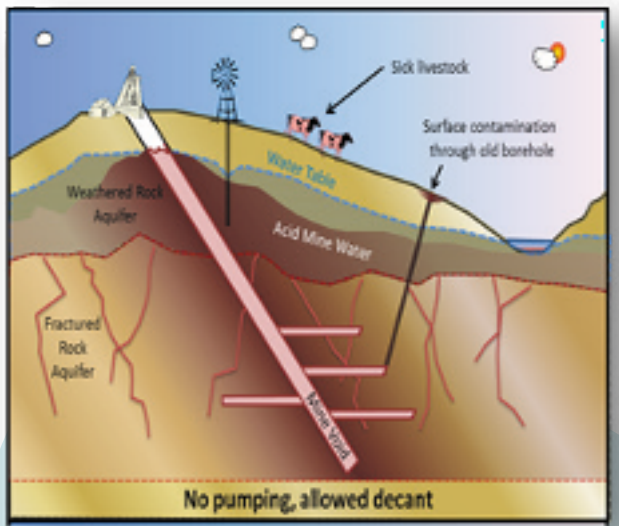
On the 8 April 2011 TCTA received the directive from the Minister of Water and Sanitation to implement “Emergency Works Water Management on the Witwatersrand Gold Fields with special Emphasis on Acid Mine Drainage (AMD)”. The AMD-STI project entailed construction and upgrading of the necessary infrastructure to extract and treat acid mine water, and then to convey the treated water to nearby water sources. Infrastructure rollout has been completed and the project is now in the operation and maintenance stage. It comprised the following features:

- Installation of the pumps to extract the water from the mine void to on-site treatment plants;
- Construction of an on-site Acid Mine Drainage treatment plant in each basin with the option of refurbishing and upgrading the existing ones owned by the mines;
- Installation of the infrastructure to convey the treated water to nearby water sources; and
- Helping Department of Human Settlement, Water and Sanitation (DWS) with a model on the operation of the pump stations and treatment works.

There are three main basins in the Witwatersrand Goldfields: the Western, Central and Eastern Basins and the risks listed above differ from basin to basin. The three basins are shown below.



The main objective of the emergency works is to maintain the AMD below the Environmental Critical Levels (ECL's) as defined for each of the basins and thereby prevent an environmental catastrophe from occurring. The key environmental risks identified are: Flooding risks: Contamination of shallow groundwater, flooding of underground infrastructure, increased seismic activity; Decanting of AMD to the environment risks: Ecological impacts, regional impacts on major river systems and localised flooding in low-lying areas. Below is a graphic illustration of the problem situation where pumping of AMD is not being done versus controlled pumping where ECL is maintained.



ECL Levels

Western Basin	Central Basin	Eastern Basin
161 amsl	126 amsl	100 amsl

DESIGN CRITERIA

The AMD neutralisation process entails a modified High-Density Sludge process which incorporates the following unit treatment processes as indicated below:

- Pre neutralisation of the feed AMD using limestone as alkali to remove free acidity, aluminium associated acidity and a fraction of the feed iron associated acidity.
- Aeration to oxidize the ferrous iron and manganese. The pre neutralization as well as the main neutralization reactors are equipped with surface mechanical aerators.
- Conditioning of the recycle sludge using lime.
- Final neutralisation of the AMD using lime.
- Gypsum crystallisation of the excess supersaturated calcium sulphate
- Solids separation in dedicated clarifier/thickener and production of a clear product water.
- Handling and disposal of the waste sludge, mainly containing metals hydroxides and gypsum.
- The treatment process also required the storage, make-up and dosing of limestone, lime and polymer.



STATUS QUO

Western Basin

An existing one train plant was upgraded, and the two new trains were built to increase the capacity of treating 12 ML/day to 33ML/day of AMD. The target is for an average volume of water treated in the Western Basin of between 30–33 MI/d. The treated AMD water from the plant meets DHSWS specifications.

Central Basin

The plant targets water level of 8m above the ECL. The treated AMD water from the plant meets the DWS specifications.

This contract was for construction of the Central Basin treatment plant comprising the following:

- Demolition of existing structures and bulk earthworks
- AMD pump station at ERPM # shaft
- 3 x 300 T limestone silos with associated limestone mixing and dosing plant
- 5 x 300 T quicklime silos with associated lime mixing and dosing plant
- Polyelectrolyte dosing plant
- 2 x Concrete reactors 33 m x 60 m each comprising a pre-neutralisation chamber, sludge conditioning chamber, two neutralisation chambers and two gypsum crystallisation chambers all with mixers or aerators
- 2 x Thickeners 47 m diameter
- Treated water sump 27 m diameter
- Sludge pump station and sludge disposal pipeline
- Treated water pump station and treated water pipeline
- Potable water supply pipeline
- Electrical equipment
- 1300 kVA standby generator
- Administration and control building
- Workshop
- Ablutions
- Weighbridge
- Plant terracing, civil services, internal roads and access to Power Street.
- Security fencing and guardhouse



STATUS QUO

Eastern Basin

The target water level in the Eastern Basin is between 10–15 m below ECL. The treated AMD water from the plant meets the DHSWS specifications.

The project entailed the construction of the following components:

- Construction of Shaft Capping for Grootvlei Shaft No. 3;
- Construction of a structural steel pump station superstructure, including foundations;
- Procurement and Installation of three deep mine abstraction pumps;
- Construction of a 106ML/day High Density Sludge (HDS) Treatment Plant;
- Construction of MCC Building and Generator Room;
- Construction of several short pipelines
- Road works and fencing;
- Supply and installation of Medium and Low Voltage Switch Gear and other electrical components.

Project Milestones

Project Milestones	Actual/Forecast
Upgrade of Western Basin Phase 2A	May 2013
Construction Central basin	August 2013
Start of construction Eastern basin	Apr 2014
RFO Central basin	April 2014
RFO Eastern basin	Oct 2015
Project Close-out	Sep 2015

ENVIRONMENTAL MATTERS

Environmental Authorisation

The project was issued an exemption from the Environmental Impact Authorisation due to the emergency nature of the project and other compelling stakeholder concerns. However, construction compliance was monitored closely by the ECO and through independent environmental audits.

Water quality

The treatment of the water entails the neutralisation of the acidity and removal of the heavy metals. The process followed is based on the proven and reliable High-Density Sludge (HDS) process optimised through the use of limestone. The water, once treated, will still contain high salt loads.

The table shows AMD water quality before and after neutralisation.

Water Quality Variable	Average water quality across all three Basins	HDS plant effluent standard
Sulphates	4344 mg/l	2400 mg/l
pH	4	6-9
Iron	768 mg/l	<1 mg/l
Aluminium	35 mg/l	<1 mg/l
Manganese	127 mg/l	<3 mg/l
Uranium	0.2 mg/l	0.05 mg/l

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