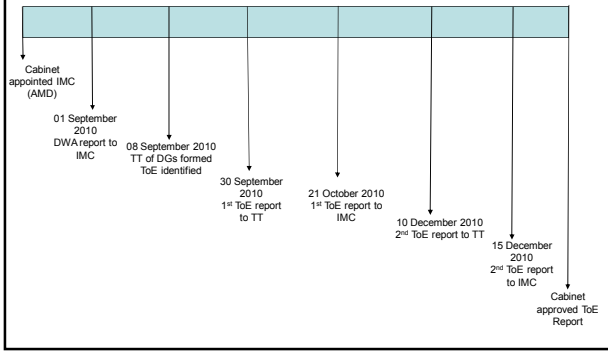


MINE WATER MANAGEMENT IN THE WITWATERSRAND GOLDFIELDS WITH SPECIAL EMPHASIS ON ACID MINE DRAINAGE
13 April 2011

Timeline of Key Events



Terms of Reference

- Assess what has been done
- Reappraise the risk
- Assess available solutions and technology
- Interrogate and assess the viability and costs of critical short-term interventions
- Propose integrated lasting and sustainable medium- and long-term solutions/measures
- Explore possible partnerships with the private sector

Decant Points – Western Basin



Western Basin

Decant from an abandoned shaft



AMD generation on surface

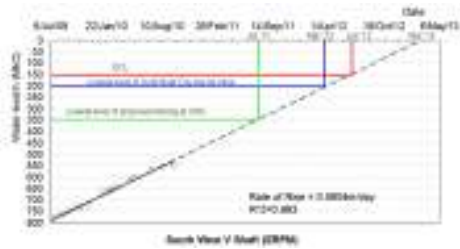


Critical Issues	Uncontrolled decant of AMD Downstream surface- and groundwater contamination affecting the Krugersdorp Game Reserve and Cradle of Humankind
AMD Volume	12-60Ml/d – recommend pumping capacity of 40Ml/d
Timeframe	Urgent intervention is required to prevent discharge of untreated water to the environment

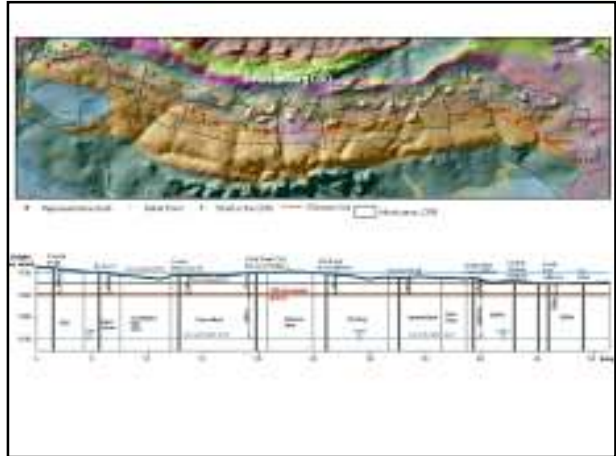
Likely Decant Area – Central Basin



Rising water level – Central Basin



- ~1.5 years to ECL and 2 years to decant level
- Real-time monitoring system installed



Central Basin



Critical Issues	Rising water level in the mine void Proximity to urban areas including the Johannesburg CBD Risk of decant in the Boksburg area Seismicity induced by rising water
AMD Volume	Historical average pumping rate of 60MI/d
Timeframe	Pumping and treatment infrastructure to be installed before water reaches critical levels

Likely Decant Area – Eastern Basin



Eastern Basin

Water pumped from Grootvlei Mine



Ingress of water underground at Grootvlei Mine



Critical Issues	Uncertain future of Grootvlei Mine, leading to erratic pumping and treatment
AMD Volume	Historical pumping rates of 75-108 MI/d, pumping capacity needs to be sufficient to address large rainfall-related inflows
Timeframe	Immediate intervention to ensure that Grootvlei continues to pump and treat water Immediate measures to address water ingress

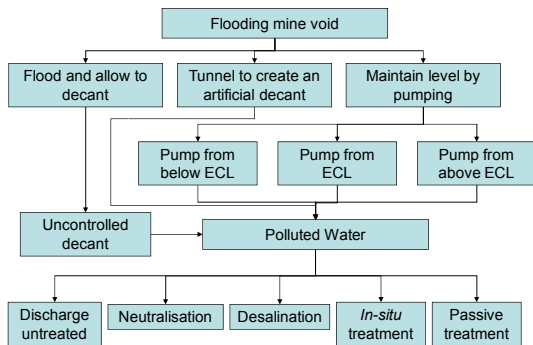
Representative mine water quality

Parameter	Western Basin	Central Basin	Eastern Basin	DWA Guideline for Category Industrial Use 4
pH	3.5	2.8	6.65	5-10
Electrical conductivity (mS/m)	510	467 ^(a)	246	250
Total dissolved solids (mg/l)	6580	4936 ^(b)	2041	1600
Sulphate (mg/l)	4010	3700	1037	500
Iron (mg/l)	697	112	38	10
Information source	Median value of >200 samples collected by Harmony Gold/Rand Uranium	Modelled inflow water chemistry (after Scott, 1995)	Median of data collected since 2008, provided to CGS by Grootvlei Mine	(Department of Water Affairs and Forestry, 1996a)

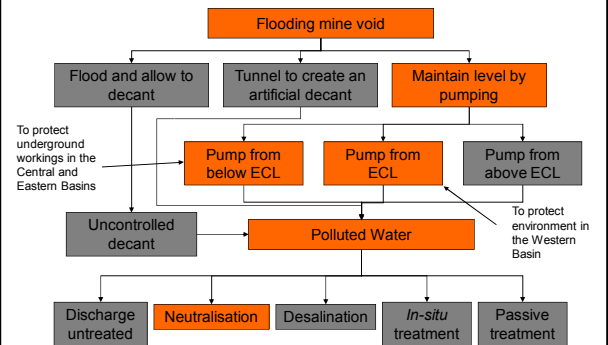
^(a) Derived from TDS/EC ratio of 10.6

^(b) Derived by summation of reported salts

Assessment of options



Assessment of short-term options



Recommendation 1: Pumping

Water must be pumped from the three priority basins to maintain water levels at least below the relevant environmental critical levels or, by agreement with stakeholders, the lowest level of underground activity within the basin.

Western Basin	Central Basin	Eastern Basin
Required urgently to prevent ongoing decant	Urgent intervention required before the water rises to unacceptable levels	Pumping and maintenance of existing infrastructure must continue

Recommendation 2: Ingress Management

Steps must be implemented to reduce the ingress of water into the underground workings, as far as is possible. This will reduce the volumes of water which need to be pumped and treated and consequently reduce the operational costs of AMD management.

Recommendation 3: Water Treatment

The water which will be pumped will not be of a suitable quality for productive use or discharge to river systems and will therefore need to be treated. In the short-term it is proposed that water be neutralised, including metal removal. In the medium- to long-term consideration should be given to steps which will reduce the mine water contribution to the salinity of major river systems.

Western Basin	Central Basin	Eastern Basin
Neutralisation plant required urgently to supplement mines' treatment capacity	Neutralisation plant(s) will be required when pumping commences	Neutralisation to be reinstated urgently

Further studies required now to address medium- to long-term concerns for salinity of river systems

Recommendation 4: Monitoring

Improved monitoring of mine water, groundwater, surface water, seismicity, subsidence and other impacts of mine flooding and related targeted research is required. It is recommended that a multi-institution monitoring committee be established to facilitate the implementation of the required monitoring programmes. Monitoring will show if there are significant changes in the quality of mine water which may have an impact on future management strategies.

Monitoring committee to be convened to commence with upgrading of monitoring infrastructure and programmes urgently

Recommendation 5: Other AMD Sources

The flooded mine voids are not the only sources of AMD in the Witwatersrand. Other sources, particularly mine residues need to be monitored and appropriate remedial measures implemented.

Monitoring committee to be convened to commence with upgrading of monitoring infrastructure and programmes urgently

Recommendation 6: Environmental Levy

The feasibility of implementing of an environmental levy to be paid by operating mines to cover the costs of the legacies of past mining needs to be investigated.

Implementation plan: Western Basin

Action	Time frame	Delivery period
Construct a 20Mld emergency neutralisation plant to treat uncontrolled decant to supplement current treatment capacity.	Commence immediately	6 months
Install pumping infrastructure to lower water level in the mine void to the ECL and maintain in the long-term.	Commence immediately	2 years
Continuous monitoring of water levels, flow, quality and profiles	Commence immediately	Infrastructure installed within 1 year. Continuous monitoring.
Continuous prevention of ingress	Commence immediately	Interventions identified within 1 year
Continuous monitoring of seismic events	Commence immediately	Infrastructure installed within 1 year. Continuous monitoring until stability is confirmed.
Continuous monitoring of subsidences	Commence immediately	Infrastructure installed within 1 year. Ongoing monitoring.
Stakeholder engagement	After Ministers' meeting	Ongoing

Implementation plan: Central Basin

Action	Time frame	Delivery period
Pump and treat the water: Assess the viability of refurbishing the existing treatment plant at EIRPM	Commence immediately, to have all requirements in place before the water rises above the ECL, or deeper level which will allow new mining to commence.	Before water reaches critical levels Central Rand Gold Workings - Sep 2011 Gold Reef City - Mar 2012 ECL - Jun 2012
Determine the optimal placement of pumps Negotiate cost sharing with other stakeholders within the Basin, in particular Central Rand Gold	Commence immediately	Infrastructure installed within 1 year. Continuous monitoring. Water level monitoring installed in two shafts
Prevention of ingress (construction of canals and other measures)	Commence immediately	3 years Florida Canal Phase 1 Completed
Continuous monitoring of seismic events and production of microzonation risk maps	Commence immediately	Some infrastructure already installed. Additional infrastructure to be installed within 1 year. Continuous monitoring until stability is confirmed.
Commence research/studies to optimise medium- to long-term solutions for all basins, looking at: Funding mechanisms Institutional models Legal issues Communications strategies Engineering and cost-benefit studies	Commence immediately	Up to 2 years, research/studies to be completed in phases. 1st phase to be completed within 6 months.
Stakeholder engagement — media statement after ministers' meeting and public awareness	After Ministers' Meeting	Ongoing

Implementation plan: Eastern Basin

Action	Time frame	Delivery period
Monitoring of pumping	Commence immediately	Weekly
Due diligence on the integrity of the pumping infrastructure	Commence immediately	3 months
Consider issuing a directive to ensure compliance with water license conditions	Immediate	3 months
Regular inspection of the integrity of pumps and treatment plant	Commence immediately	Weekly
Prevention of ingress (e.g. construction of canals)	Commence immediately	3 years
Continuous monitoring of seismic events	Commence immediately and continue until stability is achieved	Infrastructure installed within 1 year. Continuous monitoring until stability is confirmed.
Continuous monitoring of subsidences	Commence immediately	Infrastructure installed within 1 year. Ongoing monitoring.
Real-time monitoring (levels, quality and flows) — systems to be installed for the entire Witwatersrand Basin	Commence immediately	Infrastructure installed within 1 year. Continuous monitoring.
Stakeholder engagement — media statement after ministers' meeting and public awareness	After Ministers' Meeting	Ongoing

Recent Events

- Cabinet approved TOE Report 9 February
- TCTA directed on 6 April to do emergency work on the Witwatersrand.
- Appointment mainly to assist with
 - Installation of pumps
 - Construction of an on-site treatment plant in each Basin with option to refurbish existing plants.
 - Installation of infrastructure to convey treated water to nearby water courses.
 - Operation of the pump stations and treatment works.
- Discussions with mines to use mines' infrastructure.
- Institutional arrangement between role players changing
- Feasibility study by DWA for long term solutions.

Questions