Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage associated with the East, Central and West Rand Underground Mining Basins, Gauteng Province

AMD FS LTS

newsletter

Edition 2 • 2013

This newsletter provides stakeholders with an update on the progress of the Feasibility Study for a long-term solution (LTS) to address the Acid Mine Drainage (AMD) associated with the Witwatersrand underground mining basins. The goal of the Feasibility Study is to investigate and recommend a feasible LTS to the AMD problems emerging in the study area (shown in Edition 1), in order to ensure long-term water supply security and continuous fitness for use of water in affected major river systems.

The study consists of three phases, of which the first two, the Initiation and Prefeasibility Phases have now been completed. The completion of the Feasibility Phase will be the focus for the upcoming months. The focus of this newsletter is to present the results of the Prefeasibility Phase. For more background on the Initiation Phase, Edition 1, which was issued in 2012, can be consulted. It is available on the DWA website as indicated below.

More newsletters will follow.

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For more information on the feasibility study, please visit the AMD webpage on the Department of Water Affairs website:

http://www.dwa.gov.za/Projects/AMDFSLTS

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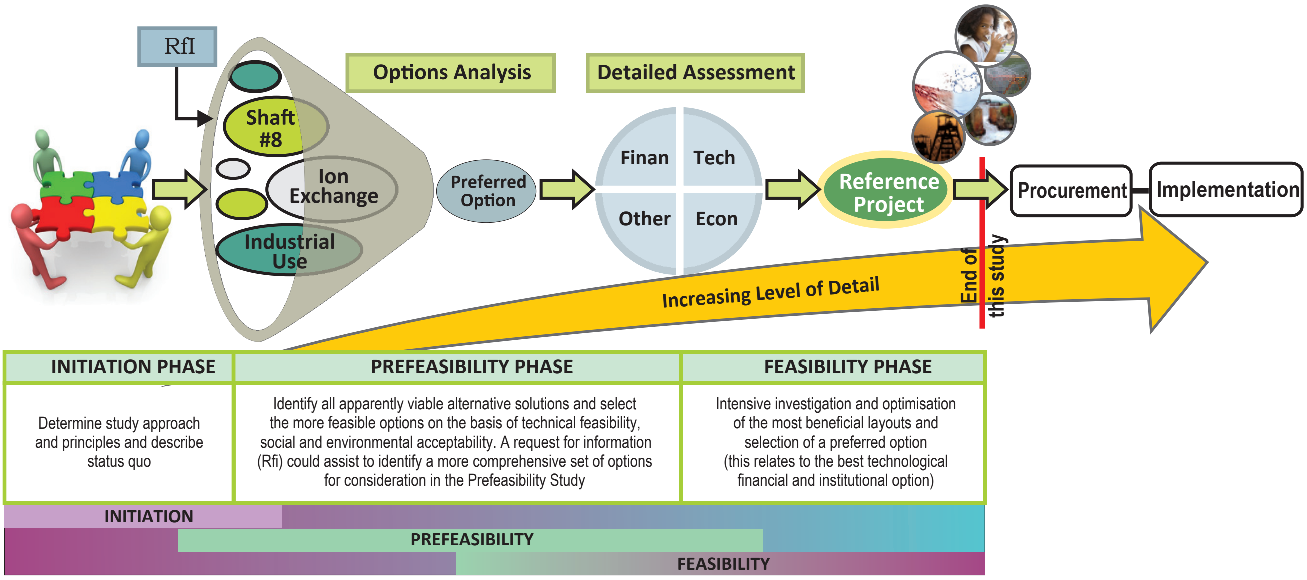
The Study Approach

In order to explain the study approach, a short summary of the problem is provided here (refer to Edition 1 for more detail). In the Witwatersrand region, mining has taken place in the three underground mining basins of the East, Central and West Rand since the discovery of gold in 1886. As the mines were worked out and abandoned, dewatering of the mine voids became the responsibility of fewer and fewer mines, until underground mining essentially ceased in 2010. The voids (tunnels, drives, stopes and shafts) are currently filling with water that ingress into the mined out workings. Acid Mine Drainage (AMD) is formed due to exposure of sulphide bearing minerals to oxygen and water. AMD is typically characterised by elevated sulphates, low pH, dissolved metals and sometimes when uranium is present, radiological properties. Once pumping from the Central and Eastern Basins commences again, large quantities of water will have to be released from the Vaal Dam to dilute the salinity, resulting from AMD, in the Vaal River System. The continuation of these dilution releases will reduce the system yield, potentially affecting the assurance of supply and increasing the risk of introducing water restrictions, and ultimately adversely affecting economic growth. It is therefore necessary to undertake a Feasibility Study for a Long-term Solution to address the salinity of AMD in the most cost effective way, in order to avoid negative impacts to the environment and humans, as well as to conserve water. The Feasibility Study is a planning study, comprising three phases: Initiation, Prefeasibility and Feasibility Phases, as shown in the figure below. Note that there is some overlapping between the phases.



Study Progress

"Where are we now?"

The Prefeasibility Phase of the Study has been completed, with the findings contained in a group of reports culminating in the Technical Prefeasibility Report (which is in the process of being reviewed). The preferred option that was identified in this phase is analysed in more detail in the Feasibility Phase and Concept Design. The first drafts of these reports are now in the process of being completed.

Results from the Prefeasibility Phase allowed the financial team to start compiling the economic models and conduct the necessary analyses for the financial and institutional arrangements. The results of these analyses will be contained in a report encompassing the institutional procurement and financial assessment. A subsequent report on the Implementation Strategy and Action Plan will describe several of the recommended actions that will be required for implementation for e.g. monitoring and communication.

Study Deliverables

The aim is to finalise all the deliverables by July 2013. All study reports (except the confidential ones) will be available on the DWA website as soon as they have been approved.

Why are some reports confidential?

The Feasibility Study, being a planning study, does not allow for extensive public participation. Instead, key stakeholders are consulted as the Feasibility Study progresses, while information is made available to the public through newsletters and the AMD website. Wider public participation is foreseen during the implementation stages, including the EIA. With this being said, it must be stressed that there are certain reports that cannot be made public until the appropriate implementation process stages have been reached, as such reports may potentially compromise future procurement and legal processes. Of the 18 reports to be produced, six are considered confidential.

Management of AMD in the Witwatersrand

Multiple initiatives are needed to manage AMD in Gauteng. While the Feasibility Study is focussed on underground AMD, there are other initiatives which complement the Feasibility Study, such as the studies and programs run by the DMR, CGS, CSIR and the monitoring programme by the Hydrological Monitoring Committee chaired by DWA.

Vaal River Strategy

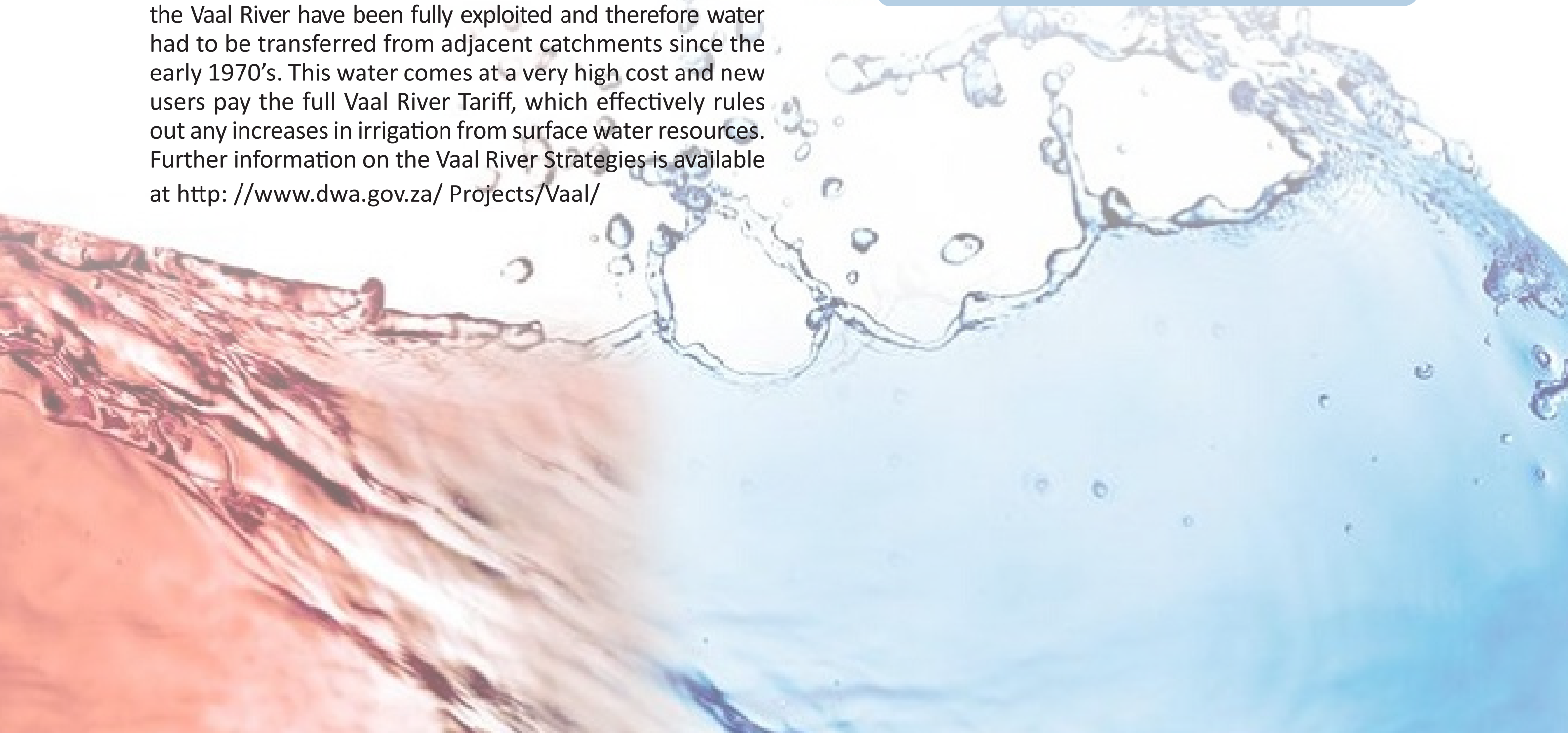
The AMD challenge needs to be managed within the context of the Vaal River strategies. These strategies deal with a dynamic area, with huge growth in water requirements, and needs to sustain water supply for social and economic activities. Efficient use of this scarce resource is therefore important, and special efforts must be taken to ensure that there will be enough water that is fit for use in this important area. The strategies to be implemented to achieve this amongst others include:

- The eradication of unlawful water use, which will increase the available water supply;
- The implementation of Water Conservation and Water Demand Management to reduce water use of relevant Water Services Authorities by 15%; and
- Addressing the AMD related salinity to sustain the current system yield into the future.

Successful implementation of all these strategies will mean that the second phase of the Lesotho Highlands Water Project (LHWP), which is the construction of Polihali Dam, can be expected to supply the water demands from 2020 onwards. Should these strategies fail to be implemented, the risk of water restrictions occurring can be expected to be higher in future. The local surface water resources of the Vaal River have been fully exploited and therefore water had to be transferred from adjacent catchments since the early 1970's. This water comes at a very high cost and new users pay the full Vaal River Tariff, which effectively rules out any increases in irrigation from surface water resources. Further information on the Vaal River Strategies is available at http: //www.dwa.gov.za/ Projects/Vaal/

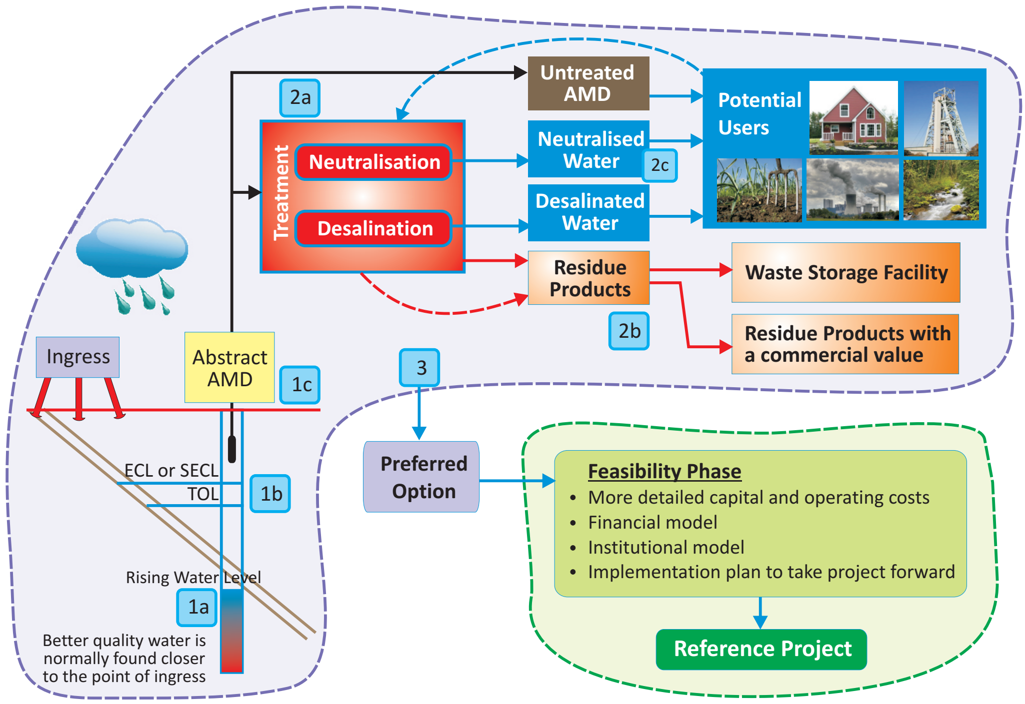
Long-term monitoring, at an adequate number of locations in the three basins are essential for:

- Establishing the Target Operating Level (TOL) – This is the level in the mine voids at which the water should be maintained in order to protect the ECL or SECL. (explained on page 5). The recommended TOL may be adjusted based on monitoring after pumping commences;
- Determining the volume of AMD to be pumped and treated, and obtain a better understanding of seasonal fluctuations, will be more certain with continuous monitoring being implemented;
- Obtaining more data on the water quality of AMD and how it may vary; and
- Obtaining a better understanding of the connectivity of the mine voids.



Prefeasibility Phase

The AMD challenge in this study deals with the largest potential quantities of AMD in the world. The figure below shows the “AMD life-cycle” and the key aspects of the complex and multiple interdependent activities forming part of the study, for underground AMD.



Prefeasibility Approach

1. Status Quo Assessment and Problem Definition*

1a. Assess the water quantitiy and quality of the mine voids and determine the current status of the technical management of underground AMD.

1b. Define the water control levels

1c. Identify the most suitable location for abstracting AMD.

2. Determine and Evaluate Options for the management of AMD*

2a. Identify and assess treatment technology options.

2b. Identify and assess the options for the sustainable management of residue from the treatment of AMD.

2c. Identify and assess the options for use or discharge of water

3. Determine the Preferred Options. These options are being investigated further in the Feasibility Phase.

**Draft reports with the outcomes of these tasks are made available on the DWA website.*

KEY

The potential users will determine the water quality required, the level of treatment and the technology to be used.

The quality of water in the void and treatment technology to be used will determine the type of waste and volume produced.

Prefeasibility Phase

Feasibilty Phase

It can be seen how the information (e.g. ECLs, raw water quality, ingress, etc.) and the decisions to be made, or the options to be investigated (e.g. abstraction points, qualities and quantities required by potential users, locations of users, treatment technologies), feed into the options assessment and identification of the Reference Project.

What is meant by the Reference Project?

This is the option that uses proven technologies, has the least associated risk, and is used for financial modelling and budgeting purposes. It will probably not be exactly the same as the option that is implemented, but constitutes the benchmark against which implementation proposals will be judged.

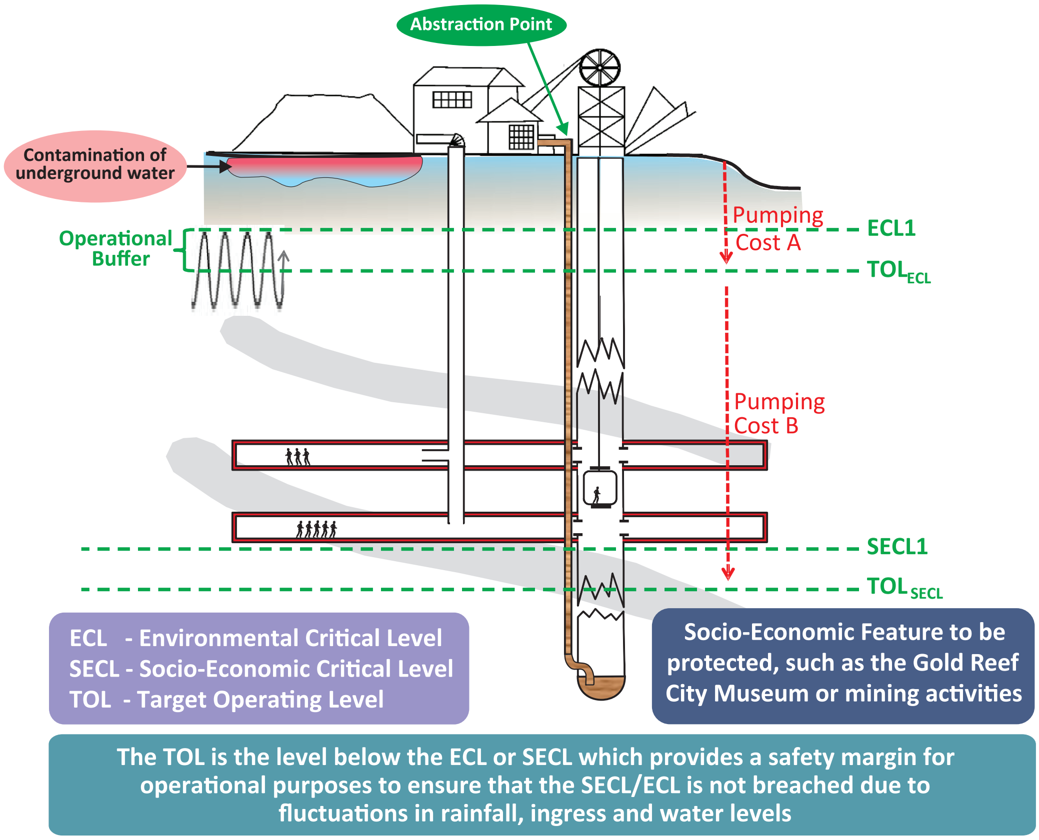
The Concept Design, which forms part of the Feasibility Phase, is based on the Reference Project and includes the costing and land requirements. This in turn provides input for the evaluation of the institutional framework, procurement and financing options and the implementation strategy and action plan. The figure below is a generic illustration of the Reference Projects that are recommended for each of the underground mining basins. All the main aspects of the Reference Projects are shown here, e.g. abstraction, neutralisation, desalination, brine and sludge disposal and supply to an end user.

The details of each basin’s specific Reference Project will obviously differ. The following aspects are results from the prefeasibility phase and are dealt with under the appropriate headings.

Key findings of the assessment of quantity and quality of water in mine voids

The current body of knowledge relating to the quality and quantity of water in the mine voids and the connectivity between the shafts and different sub-components in the mine void will be strengthened through proper monitoring once the pumping of AMD has commenced and has continued for a number of years.

What are the ECL, SECL and TOL?



The ECL, SECL and TOL proposed for the three basins are:

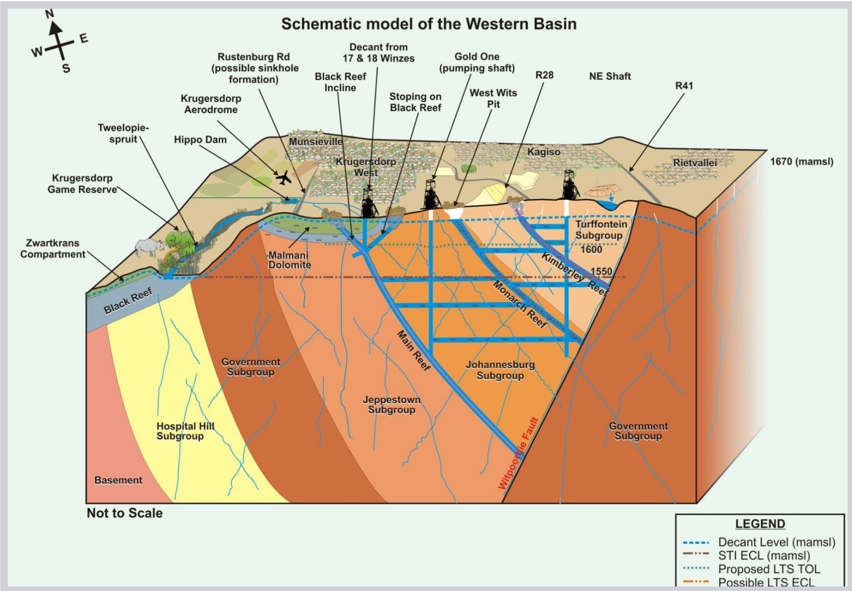
Proposed Water Control Levels				
Basin	***ECL or SECL (mamsl*)***	***TOL (m)***	***Depth to TOL at abstraction point (m)***	***Rationale***
Western Basin				
Initial Level	*1 600*	*1 585*	*141*	Water surface be held at initial level for an extended period. If monitoring shows on-going polution, it should be lowered to the conservative level.
Conservative Level	*1 565*	*1 550*	*176*	
Central Basin				
SECL	*1 474*	*1 454*	*192*	Protection of the Gold Reef City Museum
ECL	*1 520*	*1 500*	*146*	Protection of the groundwater sources
Eastern Basin				
Conservative Level	*1 280***	*1 280*	*290*	Protection of dolomites
Higher Level	*1 470*	*1 450*	*120*	Protection of groundwater sources

** metres above mean sea level*

*** This level is considered to be conservative and the TOL is also set at 1 280 mamsl*

The recommendations made regarding control levels are based on the existing information that was available. The recommendations will be refined once more comprehensive monitoring data becomes available, but for now a conservative approach has been used. It is essential that in the future the TOL be adjusted to the highest possible elevation, due to the high cost of pumping. Significant cost savings can be made if pumping from shallower levels can be done while still protecting the environment and users.

Western Basin



It is recommended that the water table is lowered to, and maintained at 1 600 m amsl by pumping void water from Gold One Shaft (previously called Rand Uranium #8) and monitored to verify that the groundwater flow is reversed towards the void, with no further decant to the shallow aquifer and the Tweelopies Spruit. In addition, by effectively minimising infiltration through removal of old tailings dams, dumps, and covering old surface excavations, the surface water ingress into the void can be reduced. It is estimated that there can be a reduction of at least 5-6 Mℓ/day.

Central Basin

If the Central Basin void is allowed to fill completely, decant is likely to occur at a level of approximately 1620 m amsl in the vicinity of the Cinderella Shaft, in the east, into the Elsburgspruit. It is possible that decant can also take place through several other points across the basin in low lying areas. Shallow surface workings were widespread in the Central Basin and several rivers cross these, resulting in ingress into the void.

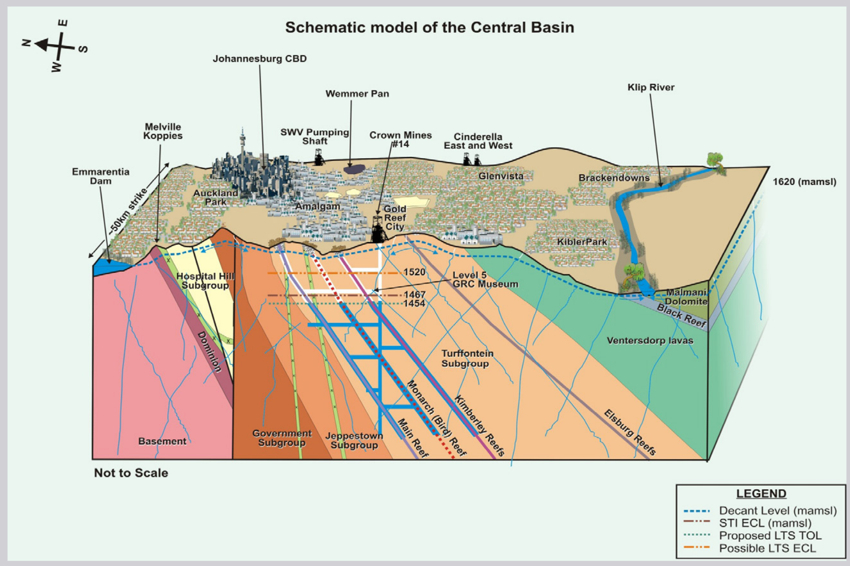
Ingress can be reduced by an estimated 10 Mℓ/day by implementing proposed plans to canalise rivers and surface water bodies overlying or near mine workings, and upgrading leaking municipal infrastructure in this highly urbanised area.

The proposed abstraction point for the Short-term intervention (STI) is South West Vertical shaft located in the eastern corner of the basin. There is a slight risk that in future connectivity to the western side of the basin could be restricted through rock falls. Then additional pumping will be needed at either a sustainable shaft or through deep boreholes.

"Why do we need to pump? Why not leave the untreated AMD to decant naturally?"

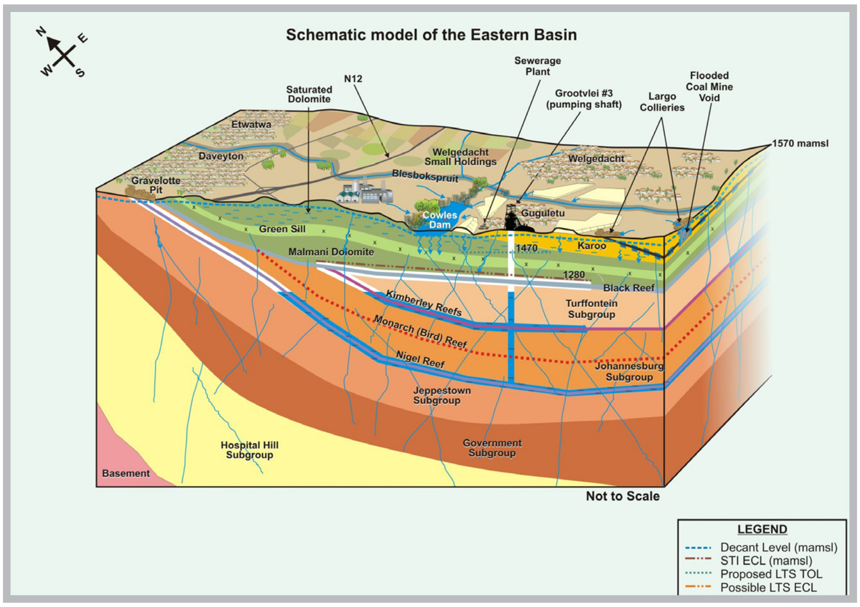
If the mine voids are allowed to fill completely and decant into the streams and springs, it will affect the fitness-for-use of water in the receiving water resources. The water quality in the tributaries to the Vaal and Crocodile Rivers will deteriorate, adding to the salt load, resulting in severe localised environmental impacts, as well as affecting major river systems. In addition, if the void water mixes with overlying shallow aquifers occurring in the weathered and fractured rocks, the deterioration in water quality will compromise groundwater use from shallow boreholes and result in further deterioration in surface water quality as such aquifers provide baseflow to the rivers.

Another big drawback of the Do-Nothing Option (i.e. no pumping, thus allowing decant) is that what is essentially a point source of pollution may become a non-point (diffuse) source of pollution, thereby making it extremely difficult, if not impossible to manage.



Eastern Basin

In the Eastern Basin there is a horizontal layer of dolerite occurring within the dolomites (“Green Sill” on diagram), which effectively acts as an aquaclude preventing complete dewatering of the saturated dolomite aquifer whilst mining was occurring. The water quality in this void has a higher pH of around 7 and lower TDS of 3 300 mg/ℓ indicating the effectiveness of the buffering capacity of water from the dolomite compartments.



It is recommended that pumping should commence to initially maintain the water at 1 280 m amsl and then gradually increase the level in steps to a maximum of 1 450 m amsl while it is adequately monitored to see that no pollution of the aquifer occurs. The groundwater from the saturated dolomites would still flow towards the mine void, leaving the water quality in the dolomites uncompromised.

The abstraction point proposed for the STI is Shaft #3 at Grootvlei, which was used to maintain the water level whilst mining took place. This shaft is also recommended for the LTS. Ingress volumes from surface water bodies through fractures in the dolomites into the mine void could be reduced by an estimated 21 Mℓ/d.

The anticipated average volume that will have to be abstracted from each underground mining basin to maintain the water levels was estimated and is given in the table below. These estimates are shown against the volumes to be abstracted if measures to reduce ingress are implemented.

Basin	Average Abstraction Rates (Mℓd)		Reduction from ingress control (Mℓd)	Predicted Abstraction with improved ingress control (Mℓd)	
	Average	Range		Average	Range
Western	23	19-27	5	18	14-22
Central	46	30-90	10	36	24-74
Eastern	80	70-100	21	59	49-79

Treatment Technology/ Processes Options Investigated

A Request for Information (RfI) on different treatment technologies that could be used to treat AMD was issued in December 2012 and about 50 technology providers responded through registering and providing information. This information was assessed and assembled to evaluate the various options. In order to evaluate the various treatment technologies, it was necessary to classify the technologies according to the state of development, which impacts directly on the risks associated with the implementation of the technology. The following categories were used:

- Laboratory-scale Technologies - Includes all technologies that have only been tested at a theoretical laboratory scale. (High risk)
- Pilot-scale Technologies - Technologies that have been simulated in pilot plants to prove the chemical, physical or biological principles on a larger scale. (Medium risk)
- Proven Technologies - Technologies that have been in operation at a scale comparable with the scale required for the application under consideration. (Low risk)

Options for **passive, biological, chemical** and **physical** treatment were assessed. The low risk technologies that are proven and that can currently be recommended if government provides funding are:

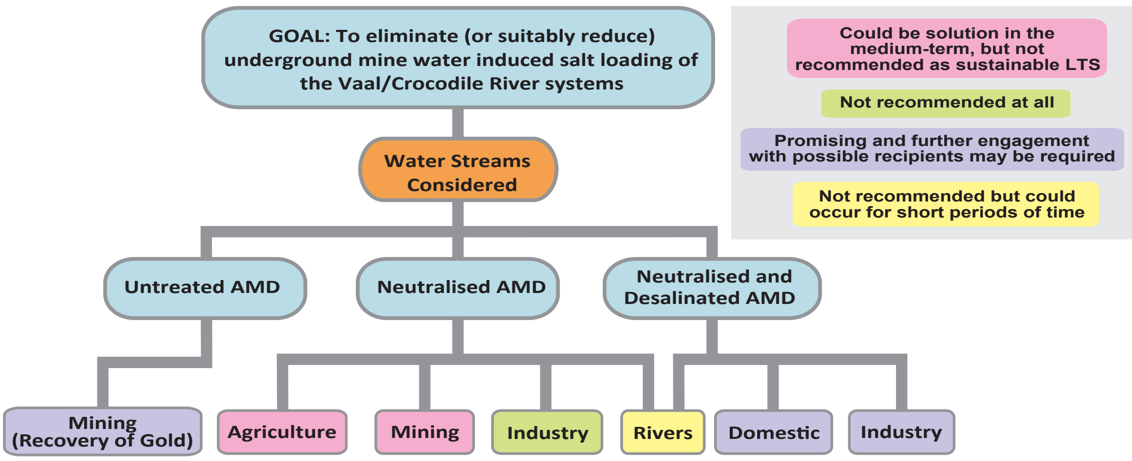
- **High density sludge** (HDS) for neutralisation and removal of most metals;
- **Reverse Osmosis** (RO) for desalination (physical process); and
- **Ion exchange** for the removal of uranium (physicochemical process)

A possible alternative is that **Government partners** with the mining companies for a period, for a **combined gold extraction and neutralisation process (in the Western Basin) and the disposal of waste, and thus shares risks and costs.**

The private sector may be prepared to fund a project with a technology other than those proposed above and carry the risk for the success of it. A Design Build Operate Maintain (DBOM) or Design Build Operate Maintain and Fund (DBOMF) (PPP) contract could allow alternative processes to be offered.

Potential application of raw and treated AMD

The various water uses that were considered are summarised in the figure below



Using neutralised water for agriculture or mines (pink boxes in figure) poses too great a risk since there is no assurance that the salts in the system will be reduced to acceptable levels. In the long-term it might end up back in the river, which will mean that the objective of the strategy has not been achieved. These usage options have been considered for the medium-term, while alternative solutions for the long-term are further investigated. An option that was also proposed is to implement agriculture in conjunction with a desalination plant treating the return flow from the agriculture, with the intention that the agriculture would remove a great deal of the salts at low costs. The problem posed by this approach is that the salts that will still remain in the system will no longer be a point source of pollution, but a diffuse source which is much harder, if not impossible, to manage.

Supplying neutralised water to industry (green boxes) is not recommended. For industries, the salts will not be consumed in the industrial processes and will most likely end up back in the river system.

The discharge of any water to rivers is not recommended, because discharging neutralised water to the river will defy the objective of the Study and doing this with fully treated water will not be financially sustainable.

The one option that has been identified for the reference project is the supply of fully treated water to industries or domestic users. During implementation further engagement with Rand Water and other possible recipients is necessary to optimally utilise this option.

Alternative Residue Management Options Considered

The proven technology for neutralisation is the HDS process that produces gelatinous sludge, requiring special facilities for disposal. Co-disposal of the sludge from the HDS and the RO plant with the processed tailings provides an attractive option currently being considered. In the long-term, provision needs to be made for the safe disposal of all non-commercial residue products to ensure that the salts and other pollutants do not find their way back into the river systems.

The resultant brine from the RO process will also need to be disposed of in specifically designed facilities i.e. evaporation ponds. The sizing and location of land required for such facilities are identified for the three mining basins.

In the Reference Project, allowance is made for Ion Exchange to remove uranium. The uranium must be disposed of in a sustainable and safe manner (i.e. as hazardous waste) or it can be sold as a product to offset the cost of treatment.

The viability of the safe disposal of the residue underground into the mine voids can currently not be proven and further research will be required before such methods can be considered.

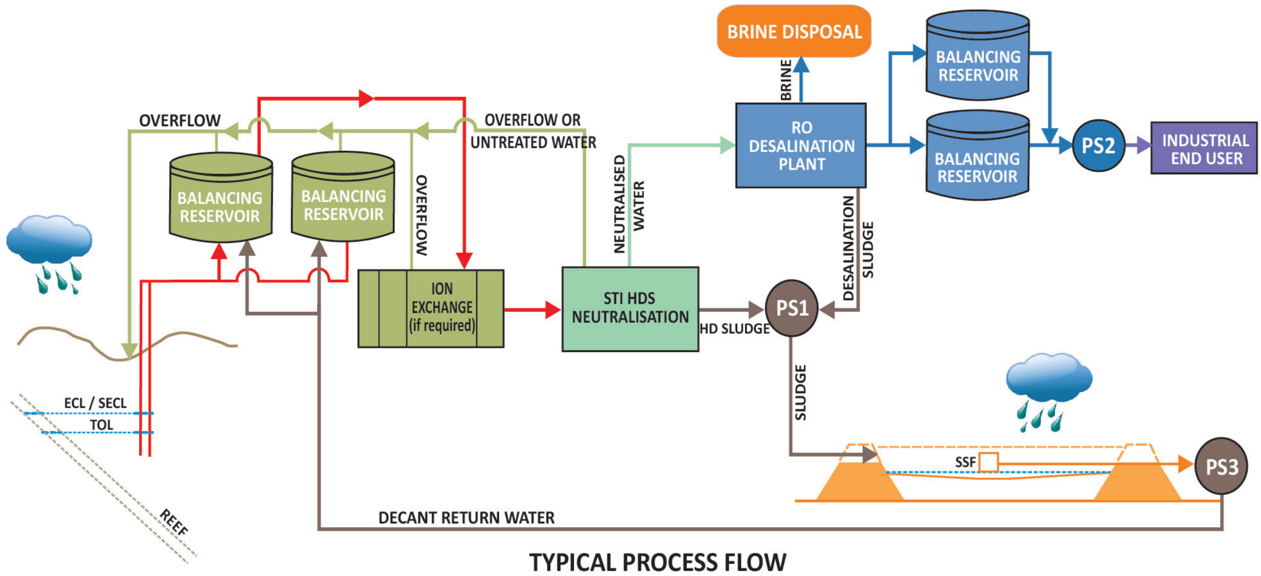
Alternative Technical Options Considered

The process of analysis of technical options involved evaluating the information on options for alternative use, discharge or disposal, and developing alternative treatment and infrastructure layout options to supply the treated AMD to the potential recipients. The options were analysed and considered on the basis of:

- Technical and practical viability;
- Recipient water quality requirements;
- Land development constraints;
- Geological constraints;
- Legal and institutional considerations / constraints;
- Environmental constraints;
- Socio-economic considerations; and
- Meeting the objectives of the applicable water resource strategies (e.g. Vaal and Crocodile Reconciliation Strategies).

Fourteen options were identified in the Western Basin, of which 4 options were selected for costing. Nineteen options were identified in the Central Basin, with 5 being selected for costing, while 14 options were identified in the Eastern Basin and 3 were selected for costing. Altogether, a total of 47 options were identified of which a total of 12 were selected for costing. From the options that were costed, one Reference Project per basin was recommended for more detailed assessment during the Feasibility Phase of the Study.

A schematic diagram illustrating the generic Reference Project is included below. Note that the specifics for each basin may differ from what is shown in the diagram.



TYPICAL PROCESS FLOW

Note: Ion exchange may not be required in all the basins.

It must be emphasised that what is shown here is not necessarily what will be implemented, but it will be used to compare proposals submitted in response to the Request for Proposals during the project procurement that will follow the Feasibility Study.

Estimated high cost of operation - Preliminary cost estimations have shown that for the planning horizon under consideration (50 years), the schemes will have substantial operational costs. There is thus a need to explore alternative technologies through the implementation of pilot plants with the objective to achieve lower operating cost.

Pilot Plants – An alternative to the Reference Project in the Western Basin would be to invite tenders to design, build, own and operate pilot plants (capacity 8 to 10 Mℓ/day) that utilise alternative treatment technologies which generate less waste and have lower operating costs. The objective is to provide an opportunity for such technologies to be proven suitable for the long-term, with acceptable risks. Such proven technologies can be considered to replace HDS and RO after 10 to 15 years.

Conclusions and Recommendations

HDS and Conventional RO are technologies that are “Proven and Ready for Implementation”, but these are also some of the most expensive technologies. Other AMD treatment technologies have distinct advantages, but also disadvantages and risks that need to be resolved. Further research and pilot plant operations are required to improve the promising innovative technologies, such as Alternative RO, Biological treatment and Electro-coagulation.

In the medium-term (10 - 15 year horizon) HDS and conventional RO are proposed as reference processes. The objective of research on pilot-scale technologies during this medium-term period would be to give such technologies the chance to prove themselves and thereby reduce the associated risks. If the associated risks can be reduced, then some of these technologies may be considered for the next phase of the Long-Term Solution if they offer significantly lower operating costs.

The above aspects will need to be considered by Government in the decision making process on the implementation of the works.



Feedback/Progress on the Short-Term Intervention

On the installation of pumps to keep AMD below the ECL and the construction of HDS treatment plants to neutralise AMD before discharge to the environment, a number of agreements have been concluded and decisions made on how to proceed given the extremely limited funds available. In the Central Basin the construction contract has been awarded to Group Five for the installation of pumps, treatment plant and monitoring shafts to the value of R319 million. Construction commenced in January 2013, after Environmental Authorisation was given by the Department of Environmental Affairs. The works are considered of a temporary nature and after 5 years from the date of completion, must be either demolished or incorporated into the final solution. In this regard, the EIA process for the Short-Term Intervention was halted and a new process will commence which looks at the total solution for AMD, rather than the partial intervention, which the Short-Term Intervention represents.

The pumps and plant will be situated at the South West Vertical Shaft in Germiston and an agreement has been reached with ERPM which allows access to land, use of their infrastructure and co-disposal on their tailings facility. They will also use up to 30 mega litres per day of untreated or partially treated AMD.

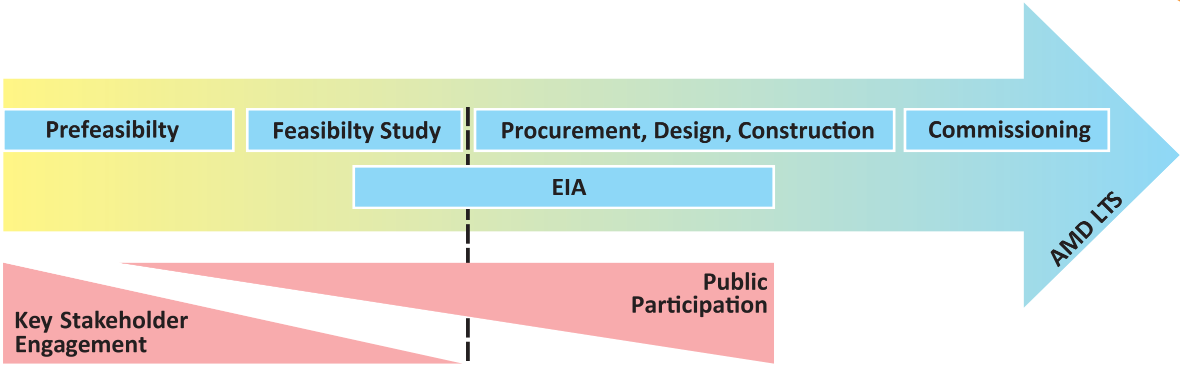
Another agreement has been signed with Central Rand Gold for the donation of the submersible pumps required to keep the water below the ECL. This arrangement is mutually beneficial whereby the project does not have to purchase the pumps required and CRG's underground mining operations, above the ECL, will not be flooded. Any costs associated with drawing down the water level below ECL will be for CRG's account. Both these arrangements have helped significantly to reduce the cost of the project.

In the Western Basin further upgrades will be undertaken to the existing Rand Uranium/Gold One Plant to further improve the quality of the effluent and to draw the water in the mining void down to create a buffer against high rainfall events. This will contain the situation until the "Long-Term Solution" is implemented.

In the Eastern Basin there is currently insufficient funding to commence with construction and no agreement has been reached with the liquidators of Pamodzi (and the associated mines) on access to land and infrastructure.

No more uncontrolled decant in Western Basin!

Key stakeholder engagement and communication



Given that the prefeasibility and feasibility phases of the Study are planning phases, and not a regulatory environmental authorisation process, a regulatory public participation process with the general public is not required. The planning process includes activities such as information collection and verification, the pooling of collective knowledge and wisdom, deliberating the details and complexities around potential solutions and considering alternatives towards the recommended LTS for AMD. This requires high level input from a technical planning perspective, rather than wide public participation, which will be undertaken as part of a separate EIA process.

The tight timeframe and technical complexity of the Study does not permit efficient consultation with the general public. Hence the approach to stakeholder involvement for this Study, as summarised in the table below is directed at focussed engagement and collaboration with identified key stakeholders representing various sectors of society, to inform the Study at a technical level. In addition, the approach provides for communication information, study progress and key outcomes of the Study to the wider stakeholder group, not directly engaged in the technical components of the Study.

	KEY STAKEHOLDER ENGAGEMENT	COMMUNICATION
PURPOSE	Information gathering to inform the study (existing information, monitoring data, technical input and expertise)	Communicate progress and key outcomes at certain milestones in the study
TARGET AUDIENCE	**Key Stakeholder Sectors and Groups** *(Directly affected parties, who have a high level of influence on the direction and success of AMD long-term initiatives, and whose input is critical to the study)*	**Wider Stakeholder Group** *(More than 900 interested and affected parties representing a wide range of sectors of society)*
METHOD OF ENGAGEMENT	Individual consultation meetings; Focus group meetings; Technical workshops; Study Stakeholder Committee (SSC) Meetings; as well as DWA presentations to Catchment Forums	Newsletters at certain milestones in the study; Press releases; and the AMD webpage on the DWA website

Several engagement meetings were held with key stakeholders to date. The various types of meetings and stakeholder groups engaged are summarised below. The study team acknowledges the many valuable contributions and information sources received from stakeholders (see acknowledgements on the DWA AMD website).

TYPES OF MEETINGS	STAKEHOLDER GROUPS ENGAGED
Study Stakeholder Committee meeting: May and October 2012 and May 2013	National Government; Provincial Government; Local Government; Mining Sector; Organised Business; Industry and Labour; Organised Agriculture; Utilities (Water and Electricity); Environmetal NGOs and conservation groups; Catchment Forums or other existing structures; as well as Parastatals
Individual and small group consultation meetings	Independent specialists; Technical commentators; NGO representatives (FSE); National Treasury; World Bank; Gold Reef City; Joburg Water; City of Joburg; and GDARD
Technical workshops / specialist meetings	Geohydrology specialists; Agricultural sector; Rand Water; WRC and DST
Focus Group Meetings (September 2012)	Environmental NGOs; Conservation Groups; Tourism/Recreation and Interest Groups; as well as Local Government
Information gathering meetings	DMR; Council for Geosciences; North West University; University of Pretoria; Various Technology Providers; and TCTA

The key questions, concerns and suggestions, raised by stakeholders during the key stakeholder and communication activities, and responses from the Study Team are available as Frequently Asked Questions and Answers on the AMD webpage on the Department of Water Affairs website:

http://www.dwa.gov.za/Projects/AMDFSLTS

Way forward and Next Newsletter

The way forward in addressing this immense AMD challenge is becoming clearer. The deliverables from the Feasibility Phase of the study, which are due in July 2013, (to be published on the DWA AMD webpage later in the year) will provide definitive recommendations on the implementation actions to be taken by DWA. These deliverables will not only address the technical side of the recommended solution, but also report on the institutional and procurement model, and funding mechanisms.

Focus of next Newsletter:

- Feasibility Phase
- Concept Design for each basin
- Institutional & Financial Arrangements
- Procurement
- Implementation Plan

THE HOPE FOR THIS STUDY, ALL THE PARALLEL INITIATIVES AND THE ACTIONS TO FOLLOW ARE THAT AN ENVIRONMENTAL CHALLENGE WILL BECOME A WATER RESOURCE OPPORTUNITY.