Start

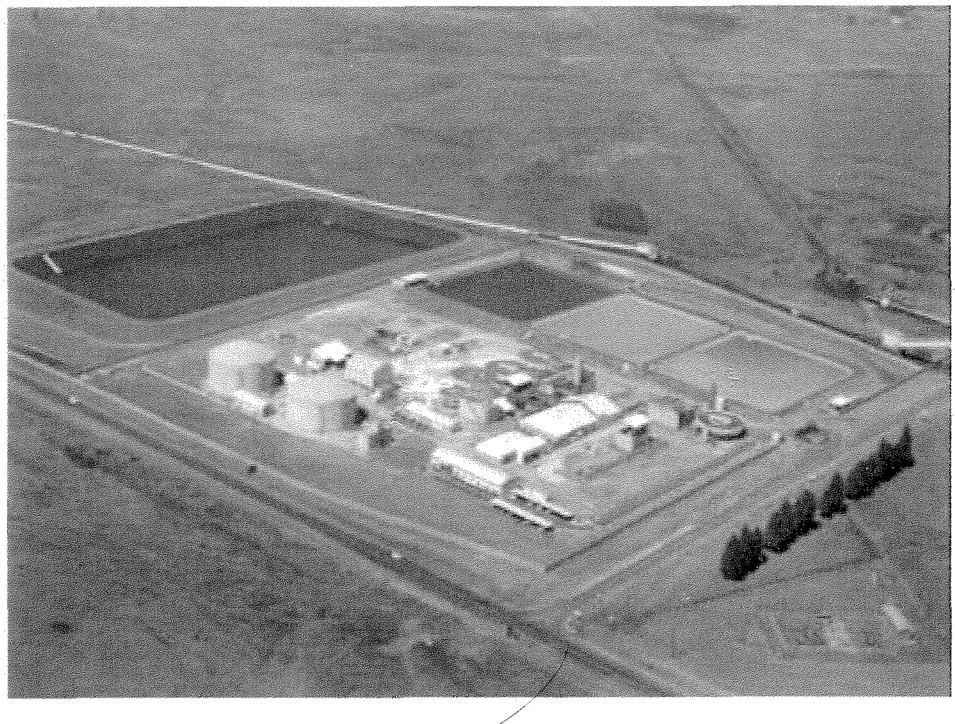
October 2010

FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE ANGLO AMERICAN THERMAL COAL PROPOSED EXPANSION OF THE EMALAHLENI MINE WATER RECLAMATION SCHEME

MDEDET REFERENCE NUMBER 17/2/2/1(E) NK-5

FOR SUBMISSION TO THE AUTHORITIES



Golder Report Number: 12485-9531-7

AngloAmerican

Golder Associates

A world of capabilities delivered locally

PURPOSE OF THE FINAL EIA REPORT

Anglo American Thermal Coal (Anglo) proposes to expand the capacity of the existing eMalahleni Mine Water Reclamation Scheme in eMalahleni, Mpumalanga Province. The proposed expansion will involve expanding the capacity of the existing Water Reclamation Plant (WRP) at Greenside Colliery to treat approximately 50 Mℓ of mine water per day. The components of the proposed expansion project will comprise the following:

- Collection of excess mine water from Landau Colliery (Kromdraai, Excelsior and Navigation Sections), and the defunct Middelburg Steam and Station Collieries, for which Greenside Colliery has environmental responsibility;
- Installation of conveyance systems to transfer excess mine water to the existing WRP;
- Upgrading of the existing WRP where mine water is treated to potable water standards;
- Distribution of treated water to an existing municipal water reservoir; and
- The disposal of waste generated during the mine water treatment process at existing mine waste disposal facilities and/or at newly constructed facilities at Blaauwkrans Mine Residue Disposal (MRD) site at Navigation. In terms of integrated waste management, downstream uses of the waste will also be assessed.

In order to obtain Environmental Authorisation for the proposed project, Anglo is required to conduct an Environmental Impact Assessment (EIA) in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA). Golder Associates Africa (Pty) Ltd, an independent company, is conducting the EIA and is compiling the Environmental Management Plan (EMP) to support the EIA application.

The first phase of the EIA, i.e. the Scoping Phase, involved the identification of issues and concerns which were then evaluated by technical specialists during the next phase of the EIA, the Impact Assessment Phase (see **Figure 1**). In accordance with the EIA Regulations published in terms of the NEMA, all Interested and Affected Parties (I&APs) must have the opportunity to comment on the findings of the EIA. The Draft EIA Report and its accompanying reports (including the Draft EMP) were made available for comment for a period of four weeks from 16 August to 13 September 2010. Subsequent to the public comment period, the reports have been updated with comments received and are ready for submission to the lead authority for the EIA, the Mpumalanga Department of Economic Development, Environment and Tourism (MMDEDET) for consideration of environmental authorisation, i.e. whether the proposed project may go ahead and, if authorised, under what conditions.

The full set of reports consists of:

- Final Environmental Impact Assessment Report, including the Final Environmental Management Plan (EMP);
- Specialist Reports;
- Comment and Response Report; and
- Map Set and Property Registers (accompanying CD)

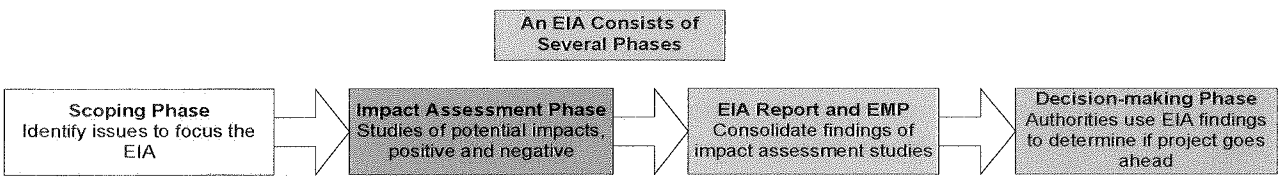


Figure 1: An Environmental Impact Assessment consists of various phases. The EIA for the eMalahleni mine water reclamation scheme expansion project is now in the Decision-making Phase.

ACRONYMS AND ABBREVIATIONS

ACRONYM	EXPLANATION
AMD	Acid Mine Drainage
BID	Background Information Document
CBO	Community Based Organisation
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DWA	Department of Water Affairs
DWEA	Department of Water and Environmental Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ELM	eMalahleni Local Municipality
EMP	Environmental Management Plan / Environmental Management Programme
EMPR	Environmental Management Programme Report
HDPE	High Density Polyethylene
I&APs	Interested and Affected Parties
MMDEDET	Mpumalanga Department of Economic Development, Environment and Tourism
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002)
MSSC	Middelburg Steam and Station Collieries
NEMA	National Environmental Management Act, 1998 (Act 108 of 1998)
NEMWA	National Environmental Management: Waste Act, 2008 (Act 59 of 2008)
NGO	Non-governmental Organisation
NHRA	National Heritage Resources Act, 1999 (Act 25 of 1999)
NWA	National Water Act, 1998 (Act 36 of 1998)
RWQO	Raw Water Quality Objective
SAHRA	South African Heritage Resources Agency
SANS	South African National Standard
T&DB	Transvaal and Delagoa Bay Colliery
WPCW	Water Pollution Control Works
WRP	Water Reclamation Plant

UNITS OF MEASUREMENT

UNIT OF MEASUREMENT	EXPLANATION
km	Kilometre (1 000 metres)
km^2	Square kilometres
ℓ	litres
ℓ/s	Litres per second
m	metres
m^3	Cubic metres
M^3	Mega cubic metres
mamsl	metres above mean sea level
Mℓ	Mega litres (million litres)
Mℓ/day	Mega litres per day
tpa	Tonnes per annum

EXECUTIVE SUMMARY

Introduction and project description

Anglo American Thermal Coal (Anglo) proposes to expand the capacity of the existing Mine Water Reclamation Scheme in eMalahleni, Mpumalanga Province. The proposed expansion will involve expanding the capacity of the existing Water Reclamation Plant (WRP) at Greenside Colliery to treat approximately 50 Mℓ of mine water per day.

The project components associated with the proposed project include the following:

- Collection of excess mine water from Landau Colliery (Kromdraai, Excelsior and Navigation Sections), and the defunct Middelburg Steam and Station Collieries, for which Greenside Colliery has environmental responsibility;
- Installation of conveyance systems to transfer excess mine water to the existing WRP;
- Upgrading of the existing WRP where mine water is treated to potable water standards;
- Distribution of treated water to an existing municipal water reservoir; and
- The disposal of waste generated during the mine water treatment process at existing mine waste disposal facilities and/or at newly constructed facilities at Blaauwkrans Dump site at Navigation. In terms of integrated waste management, downstream uses of the waste will also be assessed.

Approximately 400 additional employment opportunities will be created for skilled and unskilled workers during the Construction Phase. This will be over an 18-month period. Ten (10) to twenty (20) permanent jobs will be created for the routine operation and maintenance of the new pipeline and pump system. It is anticipated that the Construction Phase will commence in April 2011. It is proposed that commissioning of the upgraded WRP will commence in January 2013. This proposed project will be operated and maintained over the long term. For the purposes of the financial model, the expansion project has been allocated a life cycle of 20 years. It is, however, anticipated that the Operational Phase will continue indefinitely. In the unlikely event that the project is decommissioned, plans will be drawn up for dismantling the infrastructure and rehabilitating the sites.

Overview of the existing environment, impacts and mitigation measures

Geology

Baseline: The geology of the study area is dominated by near horizontally bedded successions of shales, sandstones and coal layers. This succession of sedimentary rocks overlies the well-consolidated conglomerates / diamictites of the Dwyka Formation, but in places rests directly on felsites and granites of the pre-Karoo Basement. A north south striking normal fault cuts across the site and divides the coal resource into distinct western and eastern parts. The fault cuts through the eastern limb of an anticline. A number of northeast-southwest trending, near-vertical dolerite dykes have intruded the coal.

Impact assessment and mitigation: Possible blasting of hard rock in sections of the proposed collection and distribution pipeline routes may impact on underlying geology during the Construction Phase. The permanent displacement of *in situ* rock cannot be mitigated; however, by using appropriate blasting techniques the impacts can be minimised. It is anticipated that blasting activities will result in negligible impacts, and will be restricted to the site only. Impacts of low significance are therefore expected. There will be no additional impacts to geology during the Operational and Decommissioning Phases of the project.

Topography

Baseline: The study area is situated in the eastern region of Mpumalanga, which is characterised by a gently undulating plateau with fairly broad to narrowly incised valleys such as the Olifants River valley.

Impact assessment and mitigation: Low negative impacts on topography will result from temporary stockpiling, compaction of in situ material, excavation, mixing, and replacement of excavated material during pipeline construction. Permanent infrastructure, such as pump stations, will result in moderate negative impacts, which will continue into throughout the life of the project, unless the infrastructure is removed during the Decommissioning Phase.

Soils, land capability and land use

Baseline: The majority of the pipeline routes (47.4 %) are located on arable land with moderate to very deep red and yellow-brown soils with moderate to high agricultural potential. 36.8 % of the pipeline routes are located on mined areas, disturbed areas and areas occupied by semi-permanent infrastructure. Remaining sections are located on grazing land (8.4 %) and temporary (3.2 %), seasonal (3.2 %); and permanent wetlands (1 %).

Impact assessment and mitigation: During the Construction Phase, the major activities that will result in impacts to soil will be as a result of vegetation clearing, stripping, and compaction of soils. The significance rating of the impacts resulting from excavating pipeline trenches is moderate, with limited mitigation potential. The topsoil on rehabilitated sections (specifically along the Kromdraai collection pipeline) is shallow and trenches will definitely penetrate the low quality spoil (coaliferous) material. Mixing this material with the topsoil during backfilling of the trenches will cause coal related salt pollution of the topsoil. Soil pollution could also result from oil and fuel spillages from construction equipment and vehicles. These impacts can, however, be mitigated by preventing topsoil and spoil material mixing and prevention of oil and fuel spillages.

During construction of the pipelines, the total impact of pipeline construction is expected to be ±88 ha of agricultural land and ±86 ha of wilderness/grazing land capability. The area over which the pipeline routes are located will, however, return to the pre-construction land capability subsequent to construction. During the Operational Phase, the activity that will result in high impacts to soils will be as a result of the discharge of 50 Mℓ/day of treated (potable) water from the WRP into the Naauwpoortspruit, in the unforeseen event that the treated water cannot be distributed to the various end users. This additional volume of water could result in erosion if not controlled adequately. This impact could be reduced to moderate, should appropriate mitigation measures be implemented, such as the installation of gabions at the discharge point.

Terrestrial fauna and flora

Baseline: The study area is situated in the Grassland biome, which is characterised as land that is dominated by grass species rather than trees or large shrubs. A large percentage of exotic species are found in the study area and most areas are already highly impacted by mining or anthropogenic activities. However, sensitive floral areas, such as wetlands, are present as well as protected species within the secondary grasslands or riparian zones. No Red Data floral or faunal species were found in the study area.

Impact assessment and mitigation: The vegetation clearing and stripping of topsoil during the Construction Phase will be the primary mechanism impacting fauna and flora. In total ±190 ha of land will be impacted. The disturbance of vegetation clearing will further contribute to the establishment of alien invasive species in the area. These impacts are considered to be moderate to high impacts, but can be reduced to low, should appropriate mitigation measures be implemented. These include conducting ecological audits prior to excavation, and implementing an ongoing alien invasive species control programme.

Aquatic ecology

Baseline: The water bodies associated with the proposed pipeline routes are already in an impacted state. The water bodies have poor habitat availability, which in turn is a limiting factor for aquatic macroinvertebrate diversity. Biotic integrity of the water bodies ranges from moderately impaired to very seriously impaired. No endangered or vulnerable aquatic species were found at any of the water bodies during field surveys.

Impact assessment and mitigation: The construction of the proposed pipeline / watercourse crossings could result in impacts on water quality, on macro-channel, riparian and in-stream habitats, and on macroinvertebrates and ichthyofauna. During the Operational Phase, the removal of mine water discharges from the streams is considered to be moderate to high positive impacts on the aquatic biota due to improved water quality and natural habitats. Accidental spills and leaks (including scouring processes) from the mine water collection system will, however, result in high negative impacts on water quality and aquatic biota. Impact significance will, however, reduce to moderate to low, should appropriate mitigation measures, such as routine pipeline maintenance, be implemented.

Surface water

Baseline: The study area falls in the upper Olifants catchment in the Kromdraaispruit, Klipspruit and Naauwpoortspruit catchments. The Kromdraaispruit has a history of acid conditions due to seeps and decants from other defunct mines in the catchment and discharges from the liming plant at the Kromdraai

Section of Landau Colliery (about 5% of the time). The Klipspruit is a highly impacted catchment with a long history of water quality problems. The current water quality in the catchment is impacted by acid seeps and decants from defunct mines. The WRP is located on the banks of the Naauwpoortspruit, which flows into the Witbank Dam. The river does not have a high base flow as there are limited point source discharges in the catchment. The water quality of the Naauwpoortspruit is highly impacted by local collieries as well as runoff from the urban areas.

Impact assessment and mitigation: The primary source of impacts during the Construction Phase will be as a result of the alteration of stream beds and banks, temporary stream flow reduction and impedance due to pipeline construction across wetlands and streams. Further impacts to surface water resources may occur due to increased turbidity and sedimentation of water sources as a result of exposed soils due to vegetation clearing and soil stripping operations. These impacts are anticipated to be low.

During the Operational Phase, the most significant impact would result from the removal of the discharge from the Kromdraaispruit, which will significantly reduce the flow in the river, which in turn could result in moderate negative impacts on the wetland system in terms of water flow. Neutralised water could, however, be released post closure to maintain the wetland system. Impact significant could therefore be. The removal of the liming plant discharge from the Kromdraaispruit, and 1.6 Mℓ/d decant from Middelburg Steam and Station into the Klipspruit/Brugspruit, will result in moderate positive impacts on the salinity related water quality of the river systems. However, there are other sources of acid water in the Kromdraaispruit Catchment, which might aggravate the acid conditions in the river if the liming plant discharge is removed. This will result in a negative moderate impact.

Groundwater

Context: Since the quality of the mine (feed) water to the WRP will differ from that of the current feed water, the composition of the gypsum sludge may change. Since it is proposed that this gypsum sludge be disposed of into the Yellow Buoy Section of the Blaauwkrans Dump, the quality of future seepage from the Yellow Buoy Section to groundwater may change. *Note*: the brine will be disposed into the existing brine lagoon at the WRP site and/or newly constructed brine lagoons at Blaauwkrans, which are lined facilities. Therefore, seepage to groundwater should not occur.

Impact assessment and mitigation: During the Construction Phase, accidental spillage of oil or other hydrocarbons and pollutants along the proposed pipeline routes and within the construction sites/camps may result in low negative impacts on the groundwater regime. During the Operational Phase, no impacts on the groundwater environment will occur as a result of placing the gypsum sludge from the expanded and upgraded WRP into the Yellow Buoy Section of the Blaauwkrans Dump. It is expected that there will be no negative impact on the groundwater regime as a result of abstracting mine water from the Kromdraai and Excelsior and Navigation Sections of Landau Colliery, as well as from Middelburg Steam and Station Collieries. A high positive impact will, however, be incurred as the polluted (excess) mine water being abstracted, treated and re-used will significantly reduce the volumes of polluted mine water in the region, contribute significantly to cost savings in terms of water provision to end users, and make a contribution to replace water lost to the Ecological Reserve due to wider mining impacts in the Upper-Olifants catchment.

If the water level in the underground void (associated with the rehabilitated Central Pit 1) is higher than the surrounding natural aquifer a hydraulic gradient away from the pit will develop and this may cause the groundwater quality to deteriorate. If the water level in the underground void (associated with the rehabilitated Central Pit 1) is lower than the surrounding aquifer a hydraulic gradient towards the pit will develop, which may result in the formation of a dewatering cone in the natural aquifer. These are both considered to impacts of high significance. Should, however, the water level in the pit be maintained at a similar level than that of the natural aquifer, it will reduce flow between the two aquifers, and impacts can mitigated to moderate.

Air quality

Baseline: The air quality in the study area is already impacted by pollutant sources such as power stations, petrochemical plants, small industries, domestic combustion, motor vehicles, smouldering coal-discard dumps and veld burning.

Impact assessment and mitigation: Vehicle emissions and dust generated by vehicles traversing the construction sites (including the upgraded WRP site) and by excavating pipeline trenches are the only sources of air quality pollution expected during the Construction Phase. Air quality impacts resulting from vehicle emissions and dust are considered to be low within context of existing pollution from industry and motorways in the area. Should the appropriate mitigation measures, such as dust suppression, be implemented, impact significance can be further reduced. The upgraded WRP will make use of membrane-based treatment technology. No odour generation is expected when using this treatment technology. Particulate matter or dust pollution may, however, occur as a result of limestone handling at the WRP site. The impact associated with the release of particulate matter during the handling of limestone is regarded low.

Environmental Noise

Baseline: Ambient noise levels within the study area are fairly low. The proposed distribution pipeline route to KwaGuqa Reservoir is, however, located adjacent to the N4/N12 Highway and is therefore surrounded by the existing noise impacts from the highway. The proposed distribution pipeline route to Reservoir B is predominately located in rural areas; ambient noise levels are therefore low. The section of the distribution pipeline between Reservoir B to Reservoir A is however, located adjacent to roads in urban residential areas where ambient noise levels have already been impacted.

Impact assessment and mitigation: Blasting in areas of hard rock along the proposed pipeline routes will result in impacts on noise levels which will be moderate to high (depending on proximity to existing noise impacts, such as the N4/N12 Highway, the Greenside Colliery Rapid Load-out Terminal (RLT), mining operations, etc), but will take place immediately and on a local scale. Impact significance is therefore expected to be moderate. Impacts on noise levels as a result of movement of heavy machinery and vehicle traffic will also be moderate. These impacts can, however, be mitigated to low. During the Operational Phase, low impacts may result from the conveyance of water through the proposed pipelines, and from the proposed pump stations.

Visual aspects

Baseline: The study area is characterised by mining activities from Greenside Colliery, Kleinkopje and Landau Colliery. Industries in the area, such as Highveld Steel, further contribute to the background industrial visual environment. The discard dumps, mine infrastructure, and Rapid Load-out Terminal are particularly prominent visual features in the study area, especially to commuters travelling along the N12 and N4 highways into eMalahleni.

Impact assessment and mitigation: The primary sources of visual pollution during the Construction Phase will be due to construction activities, dust mobilisation, and construction vehicles traversing the proposed pipeline routes and WRP site. These impacts are considered to be moderate. 'Permanent' infrastructure, such as pump station, will result in moderate negative impacts, mainly due to low receptor sensitivity (i.e. receptors do not occur in close proximity to the sites) and low visual quality of the receiving landscape. Should project infrastructure, such as the pump stations and water balancing/holding facilities, be removed during the Decommissioning Phase, a moderate positive impact on visual aspects will occur, provided that affected sites are rehabilitated (re-vegetated) and become stabilised and self-sustaining.

Archaeological or cultural historical sites

Baseline: Heritage resources such as Stone Age sites, rock paintings and engravings; stone tools; small, inconspicuous stone walled sites from the Late Iron Age farming communities; formal and informal graveyards, etc may occur in the study area.

Impact assessment and mitigation: The Phase 1 Heritage Impact Assessment revealed that no heritage resources of significance occur within the study area or stand to be affected by the proposed project. There will therefore be no impacts on archaeological or cultural historical sites for any phases of the project. Should, however, any heritage resources of significance be exposed during the construction of the project, the South African Heritage Resources Authority (SAHRA) should be notified immediately, all development activities should be stopped and an archaeologist accredited with the Association for Southern African Professional Archaeologist (ASAPA) should be notified in order to determine appropriate mitigation measures for the discovered finds. This may include obtaining the necessary authorisation (permits) from SAHRA to conduct the required mitigation measures.

Wetlands

Baseline: The findings of the wetland baseline assessment indicated that most of the wetlands in the study area have been moderately to seriously modified with extensive loss of natural habitat. The only wetland with natural conditions remaining is the hillslope seep at the Blesbokspruit; this wetland will, however, not be affected by the proposed project in terms of reduced/removed discharges and/or pipeline crossings.

Impact assessment and mitigation: The construction of the pipeline / watercourse crossings will cause moderate to high negative impacts on the wetlands in the study area. For specific sites, the impact resulting from the movement of construction vehicles could result in a high negative impact, as this activity could cause vegetation degradation and the flow of water in the wetland to change over the medium term. Should construction vehicles stay out of the floodlines / riparian zones, impact significance will be reduced to low/none. During the Operational Phase, inundation and flow obstruction due to pipeline location and spills, and spills of untreated water from the collection pipelines, including scour valves, will result in high negative impacts. These impacts will, however, be reduced to low, should spills be prevented and/or contained. Impacts associated with the reduction/removal of mine water discharges from river systems are considered to be low to moderate positive impacts.

Socio-economy

Baseline: The study area for the proposed project is located in the eMalahleni Local Municipality (ELM), situated in the Nkangala District Municipality. The ELM can be described as an urban and rural area, consisting of large farms, dispersed urban settlements, coal mines and power stations. The project area spans a large part of the municipality, encompassing eMalahleni City, Lynville, Clewer, KwaGuqa and Paxton, as well as more rural areas to the north.

Affected landowners: The majority of land affected by the proposed project is owned by Anglo, with other portions belonging to the eMalahleni Local Municipality, the Republic of South Africa, SANRAL, Transnet and Samancor Ltd. A total of four private landowners have been identified as potentially affected by the proposed project, and interviews revealed a generally positive response to the project. However, concerns were raised over the level of disruption pipeline construction activities may have in urban residential areas, particularly along the proposed distribution pipeline to Reservoir A.

Impact assessment and mitigation: The Construction Phase is expected to create around 400 temporary jobs. These will span a period of around 18 months. The relatively small number of job opportunities, combined with their temporary nature will mean this impact will have low positive significance. Should Anglo make use of local labour as far as possible, and liaise with local community structures and government structures to assist in identifying a local labour pool, this impact can be enhanced to moderate.

The additional pipeline route to Reservoir A is likely to have the most significant impacts (moderate impacts) in terms of land access restrictions, environmental intrusiveness (health and safety, dust and noise), and increased traffic. The pipeline runs from the reservoir, located behind Witbank Mall, across a crossroads and down a street lined with businesses. All of these businesses require access from the street, and a number offer off-road parking which may be disrupted. However, with effective construction planning and coordination, each property should be immediately affected for a maximum of 2-3 weeks by construction activities.

The Operational Phase will result in the creation of around 10-20 permanent job opportunities; employment creation is a positive impact. Although employment creation is positive, the limited number of opportunities available means this impact will be of low significance. The major benefit of the proposed project is the impact on potable water, as the project will augment the country's supply of water, producing an additional 25 Mℓ of treated water per day, which is critical given the fact that South Africa is a water scarce country. The impact on potable water supply is a highly positive impact, as it will occur on a regional scale over the long term.

A potential high negative impact associated with the Decommissioning Phase may result from the unavailability and poor quality of potable water for local communities and the wider population. It will not be easy to mitigate this impact and appropriate measures would need to be detailed in the Closure Plan.

Conclusion

The positive value of treating mine affected water in the area to reduce pollution levels, as well as increasing the supply of potable water in the area far outweighs the negative impacts identified, all of which can be managed and mitigated to low to moderate levels of impact.

From an environmental perspective, there is no reason why the proposed eMalahleni Mine Water Reclamation Expansion Project should not be implemented, provided that the mitigation measures and monitoring programmes recommended within this report are implemented diligently.

Table of Contents

TABLES

FIGURES

APPENDICES

APPENDIX A
Specialist Report: Water Balance - Kromdraai and Excelsior Sections of Landau Colliery, and Middelburg Steam and Station Collieries

APPENDIX B
Specialist Report: Human Health

APPENDIX C
MDEDET Approval Letters

APPENDIX D
Public Participation Documentation

APPENDIX E
Comment and Response Report

APPENDIX F
Specialist Reports: Soil, Land Use and Land Capability

APPENDIX G
Specialist Reports: Surface Water

APPENDIX H
Specialist Report: Groundwater

APPENDIX I
Specialist Report: Terrestrial Ecology

APPENDIX J
Specialist Report: Aquatic Ecology

APPENDIX K
Specialist Report: Wetland Ecology

APPENDIX L
Specialist Report: Heritage

APPENDIX M
Specialist Report: Social

APPENDIX N
Proposed Upgraded Water Reclamation Plant Site Layout

APPENDIX O
Pipeline Route Selection Report

APPENDIX P
Water Market Assessment

APPENDIX Q
Water Resource Impact Assessment

APPENDIX R
Waste Assessment

APPENDIX S
Specialist Report: Groundwater

1.0 INTRODUCTION

Anglo American Thermal Coal (Anglo) proposes to expand the capacity of the existing Mine Water Reclamation Scheme in eMalahleni, Mpumalanga Province. The proposed expansion will involve expanding the capacity of the existing Water Reclamation Plant (WRP) at Greenside Colliery to treat approximately 50 Mℓ of mine water per day.

1.1 Existing mine water reclamation scheme

In 2004/2005, a joint initiative project between Anglo and BHP Billiton was undertaken to establish a Mine Water Reclamation Scheme in the eMalahleni (Witbank) area. A collection system was set up to pump excess mine water from Kleinkopje Colliery, the Navigation Section of Landau Colliery, Greenside Colliery and South Witbank Colliery to a central Water Reclamation Plant (WRP) where it is treated to potable water standards, and distributed to the municipal water reservoir for redistribution to eMalahleni. In addition, some treated water is distributed to the mines for their use. This WRP was commissioned and has been operational since October 2007. Refer to Figure 1 for an indication of the layout of the existing WRP.

The main objectives of the Mine Water Reclamation Scheme are:

- To supply the eMalahleni Local Municipality with a supplementary water resource to support local economic growth and job creation; and
- To provide a long-term solution for handling excess mine water in local collieries.

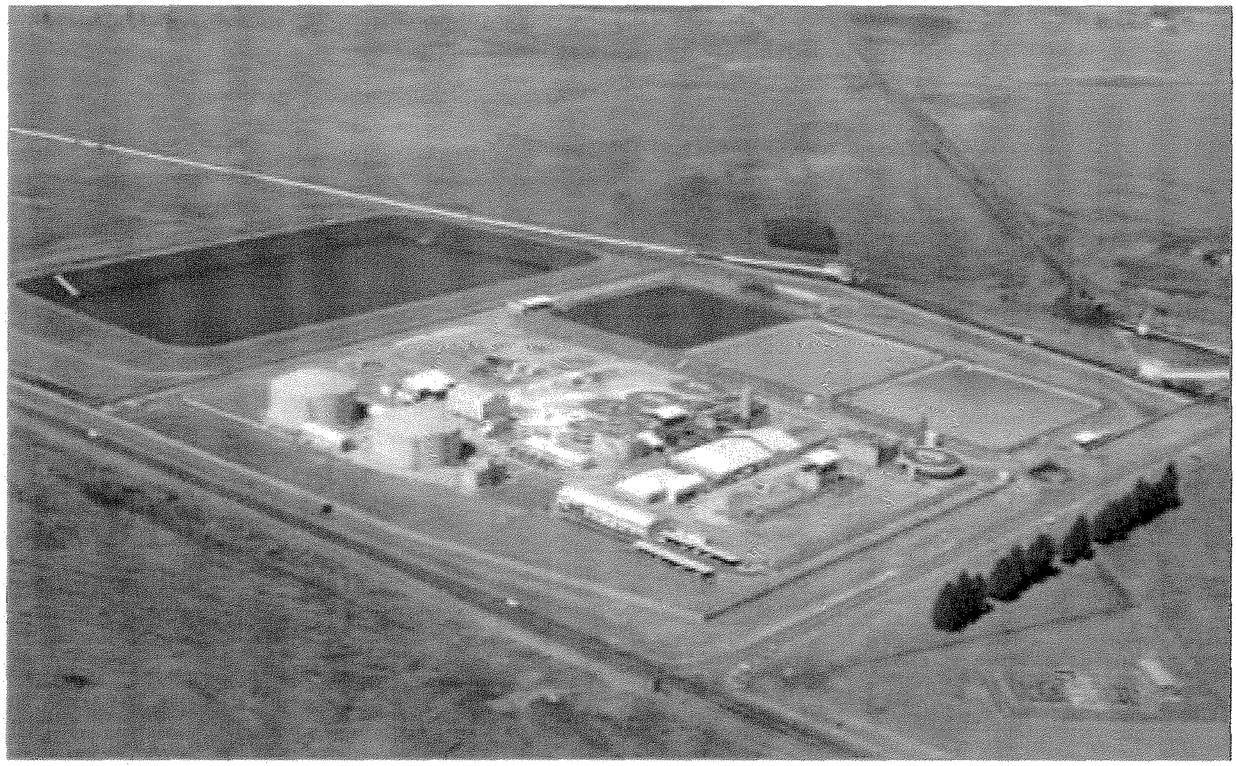


Figure 1: The existing Water Reclamation Plant associated with the eMalahleni Mine Water Reclamation Scheme

Currently, the Mine Water Reclamation Scheme consists of:

- A mine water collection system taking water from Kleinkopje Colliery, the Navigation Section of Landau Colliery, Greenside Colliery and South Witbank Colliery to a central WRP;
- Three mine water storage dams, each with a capacity of 23 megalitres (Mℓ);

- 25 Mℓ/day WRP;
- Two 10 Mℓ potable water storage reservoirs;
- Potable water pump station and distribution pipeline to the Witbank Municipal Reservoir; and
- Brine pond.

An existing mine residue disposal facility located at the Navigation Section of Landau Colliery, namely the Blaauwkrans Dump, is used for disposal of waste (gypsum) sludge.

1.2 The proposed expansion project

The Kromdraai and Excelsior Sections of Landau Colliery will be approaching closure in 2017; a long-term pre-and post-closure water management plan is required for these mines. Furthermore, a number of old defunct mines are located in the same area. Greenside Colliery (of Anglo) carries the environmental responsibilities for two of these mines, namely the Middelburg Steam and Station Collieries, and would like to develop a permanent water management plan for this colliery.

Anglo proposes to incorporate the Kromdraai and Excelsior Sections of Landau Colliery and the defunct Middelburg Steam and Station Collieries into the existing Mine Water Reclamation Scheme by expanding the capacity of the existing scheme. The expansion will (Figure 2):

- Accommodate the additional mine water volumes;
- Increase the existing WRP capacity from 25 Mℓ/day to 50 Mℓ/day; and
- The additional 25 Mℓ/day capacity will allow for the reclamation of mine water from other sources in the area, such as the Navigation Section of Landau Colliery.

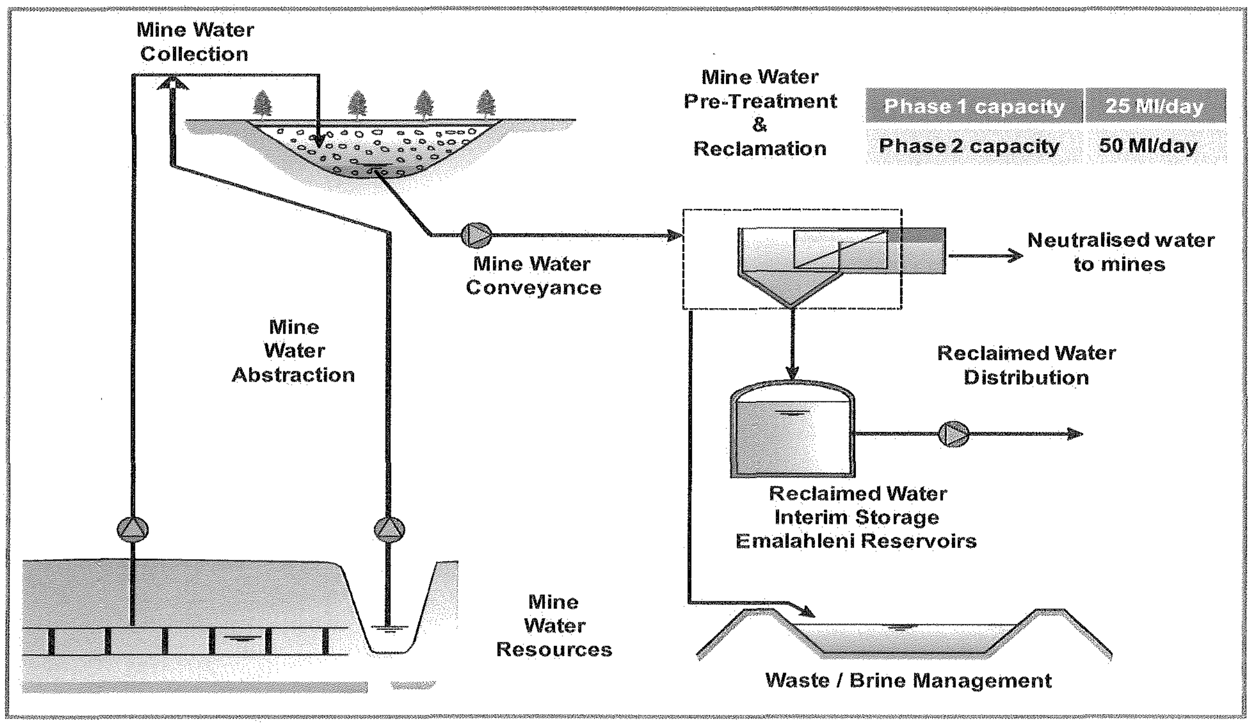


Figure 2: A schematic diagram indicating the proposed expansion of the eMalahleni mine water reclamation scheme

1.3 Environmental legal requirements

The following key legislation is relevant to the proposed project:

- National Environmental Management Act, 1998 (Act 107 of 1998);

- Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002);
- The National Water Act, 1998 (Act 36 of 1998);
- The National Heritage Resources Act, 1999 (Act 25 of 1999); and
- National Environmental Management: Waste Act, 2008 (Act 59 of 2008).

In order to obtain authorisations from the relevant authorities, a number of regulatory processes need to be followed. An integrated approach to conducting these processes is currently being undertaken. The following regulatory processes are being undertaken in parallel:

1.3.1 Environmental Impact Assessment: NEMA

The key legislation pertaining to the Environmental Impact Assessment (EIA) for the proposed project can be summarised as follows:

- National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA); and
- Regulations GN R385, R386 and R387 (April 2006).

The NEMA is the overarching and enabling legislation for environmental protection and management in South Africa. Section 24 of the Act requires that any potential impact on the environment, socio-economic conditions and cultural heritage of activities that require authorisation or permission by law and which may significantly affect the environment must be considered, investigated and assessed prior to the implementation. It also places a duty of care on every person who causes, has caused or may cause pollution or degradation of the environment to take reasonable measures to prevent, minimise and rectify such pollution or degradation.

Regulations GN R385, R386 and R387 published in April 2006 in terms of Section 24 of the NEMA regulate the EIA process. The identification of activities which may have a substantial detrimental effect on the environment is guided by GN R386 and R387, while the EIA process is guided by GN R385. Should activities listed under GN R386 be triggered, a basic assessment procedure needs to be followed. A scoping and EIA procedure needs to be conducted should activities listed under GN R387 be triggered. These procedures are outlined in detail in GN R385.

1.3.1.1 Listed Activities

Some of the activities associated with the proposed expansion project are Listed Activities in terms of the EIA Regulations (GN R386 and R387), dated April 2006, under the NEMA. Table 1 below sets out the activities which have been identified as Listed Activities in terms of the NEMA.

Table 1: Activities which have been identified as Listed Activities in terms of the EIA Regulations, dated April 2006, under the NEMA

No.	Activity
	GN R386, dated April 2006 (activities requiring Basic Assessment)
1(k)	"*Bulk transportation of water in pipelines with an internal diameter greater than 0.36 m and a peak throughput greater than 120 ℓ/s*". Some of the pipelines will have a diameter greater than 360 mm and a peak throughout greater than 120 ℓ/s.
1(m)	"*Any purpose in the one in ten year flood line of river or stream, or within 32 metres from the bank of a river or stream where the flood line is unknown*". A number of pipeline / watercourse crossings are proposed.
1(n)	"*The off-stream storage of water, including dams and reservoirs, with a capacity of 50 000 cubic metres or more*". It is proposed that an underground mine void (associated with a rehabilitated opencast pit) be used for interim storage (balancing) of excess mine water prior to the water being pumped to the WRP. The underground voids have the ability to store in excess of 50 000 cubic metres.
13	"*The abstraction of groundwater exceeding generally authorised volumes*". Mine water be sourced from underground as follows: ▪ Kromdraai and Excelsior Sections of Landau Colliery : 10 Average Mℓ/d – 12 Maximum Mℓ/d ▪ Navigation Section of Landau Colliery: 18 Average Mℓ/d – 22 Maximum Mℓ/d ▪ Middelburg Steam and Station Collieries: 2 Average Mℓ/d – 3 Maximum Mℓ/d
25	"*The expansion of or changes to existing facilities for any process or activity, which requires an amendment of an existing permit or licence or a new permit or licence in terms of legislation governing the release of emissions, pollution, effluent, unless the facility for the process or activity is included in the list of waste management activities published in terms of Section 19 of the NEMWA, 2008, in which case the activity is regarded to be excluded from this list*". An amendment to the scheme's existing Water Use Licence is required. Amendments to the EMPs and Water Use Licences for the participating and affected mines are also required.
	GN R387, dated April 2006 (activities requiring full EIA)
1(n)	"*The transfer of 20 000 cubic metres per day or more between water catchments or impoundments*". An additional ±25 000 cubic metres per day will be transferred from the various sources to the WRP. Also, an additional ±25 000 cubic metres per day will be transferred to the various end users.

Since some of the activities associated with the proposed project are Listed Activities in terms of Regulation GN R387, the project is subject to the scoping and EIA procedure as provided for in Regulations 27 to 36 of the NEMA EIA Regulations GN R385. Consequently, the EIA process adopted for this project is designed to satisfy the requirements of the NEMA. See Chapter 4 for a full description of the EIA process undertaken for the project.

1.3.1.2 Decision Making Authority

The Mpumalanga Department of Economic Development, Environment and Tourism (MDEDET) is the lead authority in terms of the EIA. However, the MDEDET will consult with the following government departments:

- Department of Water Affairs;
- Department of Mineral Resources; and
- eMalahleni Local Municipality.

1.3.2 EMP Addenda: MPRDA

The participating mines (i.e. Greenside Colliery and Landau Colliery) will need to submit EMP Addenda in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA) to the Department of Mineral Resources (DMR). Discussions between Anglo and the DMR are currently underway with regard to the authorisation process (in terms of the MPRDA) for the inclusion of Middelburg Steam and Station Collieries (defunct mine) into the scheme.

1.3.3 Water Use Licence Amendment: NWA

The eMalahleni Mine Water Reclamation Scheme has an existing integrated water use licence (no. 24080138) in place. New water uses in terms of Section 21 of the National Water Act, 1998 (Act 36 of 1998) (NWA) are associated with the proposed expansion project. These water uses include:

- 21(a): Groundwater abstraction from the underground workings at the Navigation, Kromdraai and Excelsior Sections of Landau Colliery;
- 21(c) and (i): Pipeline / watercourse crossings;
- 21(f): Discharge to the Naauwpoortspruit as the ecological flow requirements and as a contingency measure; and
- 21(g): Gypsum waste sludge disposal to the Blaauwkrans Dump.

Section 52 of the NWA allows for the amendment of a licence. An amendment to the scheme's existing licence will therefore be lodged with the Department of Water Affairs (DWA) for authorisation of the new water uses.

1.3.4 SAHRA Authorisation: NHRA

As stipulated in Section 27(18) of the National Heritage Resources Act, 1999 (Act 25 of 1999), no person may destroy, damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of any heritage site without a permit. A Phase 1 Heritage Impact Assessment has been conducted as part of the EIA. The findings of the assessment indicate that no such heritage sites/resources stand to be affected by the proposed project. It is therefore not necessary to acquire a permit from the South African Heritage Resources Agency (SAHRA).

1.3.5 Waste Management Licence: NEMWA

The new National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEMWA) came into effect on 01 July 2009. Section 19 of the NEMWA provides for listed waste management activities and states in terms of Section 19(1), that the Minister may publish a list of waste management activities that have, or are likely to have a detrimental effect on the environment. Such a list was published in GN 718 of 03 July 2009 ("GN 718") identifying those waste management activities that require a Waste Management Licence in terms of the Act.

On the same day (i.e. 03 July 2009), the Acting Minister of Water and Environmental Affairs published a notice ("GN 7195") amending the activities identified in terms of Section 24 of the NEMA and listed in GN R386 and GN R387 of 21 April 2006. In terms of this notice certain Listed Activities (namely waste related activities) have been deleted from Regulations GN R386 and GN R387 or amended.

No Environmental Authorisation can therefore be obtained for waste related activities (save for limited instances, such as for example, in respect of residue stockpiles at mining operations), but a waste management licence for these activities is needed. The process requirements for an application for such a licence include following the relevant process in the EIA Regulations (either Basic Assessment or Scoping and EIA, depending on which category the waste management activity falls under).

In terms of the proposed project, the following waste related activities will be undertaken:

- Disposal of additional brine into the existing brine ponds at the WRP site;
- Disposal of additional gypsum waste sludge at the Blaauwkrans Dump at the Navigation Section of Landau Colliery; and
- The treatment of mine water at the WRP.

Subsequent to discussions with the Department of Environmental Affairs (DEA), the DEA indicated that an application for a waste management licence does not need to be lodged with the department based on the following:

- The brine and gypsum disposal facilities for the scheme were authorised under the scheme's existing water use licence. The additional brine and gypsum wastes can be disposed of under the existing licence until the Minister of Water and Environmental Affairs requests that an application for a waste management licence be submitted to the department; and
- The treatment of wastewater is considered a listed waste activity. The treatment of mine water to potable water standards is not considered by the department to be such an activity. However, the WRP needs to be registered as a water care works in terms of the previous Water Act, 1956 (Act 54 of 1956).

1.3.6 Water care works registration (WA)

The WRP has been registered in terms of Regulation 2834 of the previous Water Act, 1956 (Act 54 of 1956) for the erection, enlargement, operation and registration of water care works.

1.3.7 Other

1.3.7.1 Servitude Registration

Registration of servitudes for the pipelines and rezoning where a pipeline route is located on private land will be conducted.

1.3.7.2 Contractual Agreements

Existing contractual agreements underpinning long-term contract requirements will be updated or new contractual agreements will be put into place with regard to:

- Water supply contract with the eMalahleni Local Municipality;
- Contracts between the applicant and mines transferring polluted water to the scheme; and
- Waste disposal contract with the mine receiving the waste residue from the scheme.

1.3.7.3 By-laws

The mine water collection system, WRP site and distribution system are all located within the eMalahleni Local Municipality (ELM). The following by-laws in terms of the municipality are applicable to the proposed project and will be adhered to during construction and operation:

- Public Health By-laws;
- Waste Management By-laws; and
- Public Open Spaces By-laws.

Copies of these by-laws will be kept on site for reference purposes.

1.4 Details of Environmental Assessment Practitioner (EAP)

The applicant, Anglo American Thermal Coal (Anglo), appointed, Golder Associates Africa (Pty) Ltd (Golder), an independent environmental consultant, to undertake the EIA for the proposed expansion of the eMalahleni Mine Water Reclamation Scheme.

Golder is experienced in environmental management and assessment and is familiar with the EIA requirements of the NEMA. The company is well known for its integrity and independence as well as for its skill in assisting I&APs to participate in the EIA process.

Dr. Brent Baxter of Golder is the Environmental Assessment Practitioner (EAP) for this project. He is a registered Environmental Assessment Practitioner (Reg. No. 0077/06), as well as a registered Professional Natural Scientist (Reg. No. 400056/07). He has more than 15 years experience as a consulting environmental scientist and EIA Project Manager.

Neither Golder, nor Dr. Baxter, has any vested interest in the proposed project or the applicant company.

1.5 Structure of this report

This Final Environmental Impact Assessment Report is structured as follows:

- Chapter 1 is the introduction and gives an overview of the proposed project, the proponent, and the Integrated Regulatory Process;
- Chapter 2 describes the proposed project, covering mine water resources, mine water collection system, upgrading of the Water Reclamation Plant, potable (treated) water distribution system, and waste disposal;
- Chapter 3 describes the study area. It presents a summary of knowledge about the existing physical, biological, social and cultural environment upon which the proposed project may impact;
- Chapter 4 describes the need and desirability of the proposed project;
- Chapter 5 provides a description of alternatives that were examined prior to and during the EIA;
- Chapter 6 provides a summarised description of the EIA and public participation processes;
- Chapter 7 describes the potential impacts of and mitigation for the proposed project;
- Chapter 8 provides the Environmental Management Plan for the project;
- Chapter 9 contains the Environmental Impact Statement;
- Chapter 10 contains the EAP opinion and recommended conditions; and
- Chapter 11 provides a list of references used throughout the report.

2.0 PROJECT DESCRIPTION

2.1 Project location and components

The proposed expansion project is located in eMalahleni, Mpumalanga Province. The N12 highway runs through the project area from southwest to northeast into eMalahleni. The R555 runs almost parallel to the highway, entering eMalahleni to the west.

The various components of the proposed expansion project include the following:

- Collection of excess mine water from Landau Colliery (Kromdraai, Excelsior and Navigation Sections), and the defunct Middelburg Steam and Station Collieries, for which Greenside Colliery has environmental responsibility;
- Installation of conveyance systems to transfer excess mine water to the existing WRP;
- Upgrading of the existing WRP where mine water is treated to potable water standards;
- Distribution of treated water to an existing municipal water reservoir; and
- The disposal of waste generated during the mine water treatment process at existing mine waste disposal facilities and/or at newly constructed facilities at Blaauwkrans Dump site at Navigation. In terms of integrated waste management, downstream uses of the waste will also be assessed.

The location of the various project components are indicated on Figure 3 and discussed in the sections to follow.

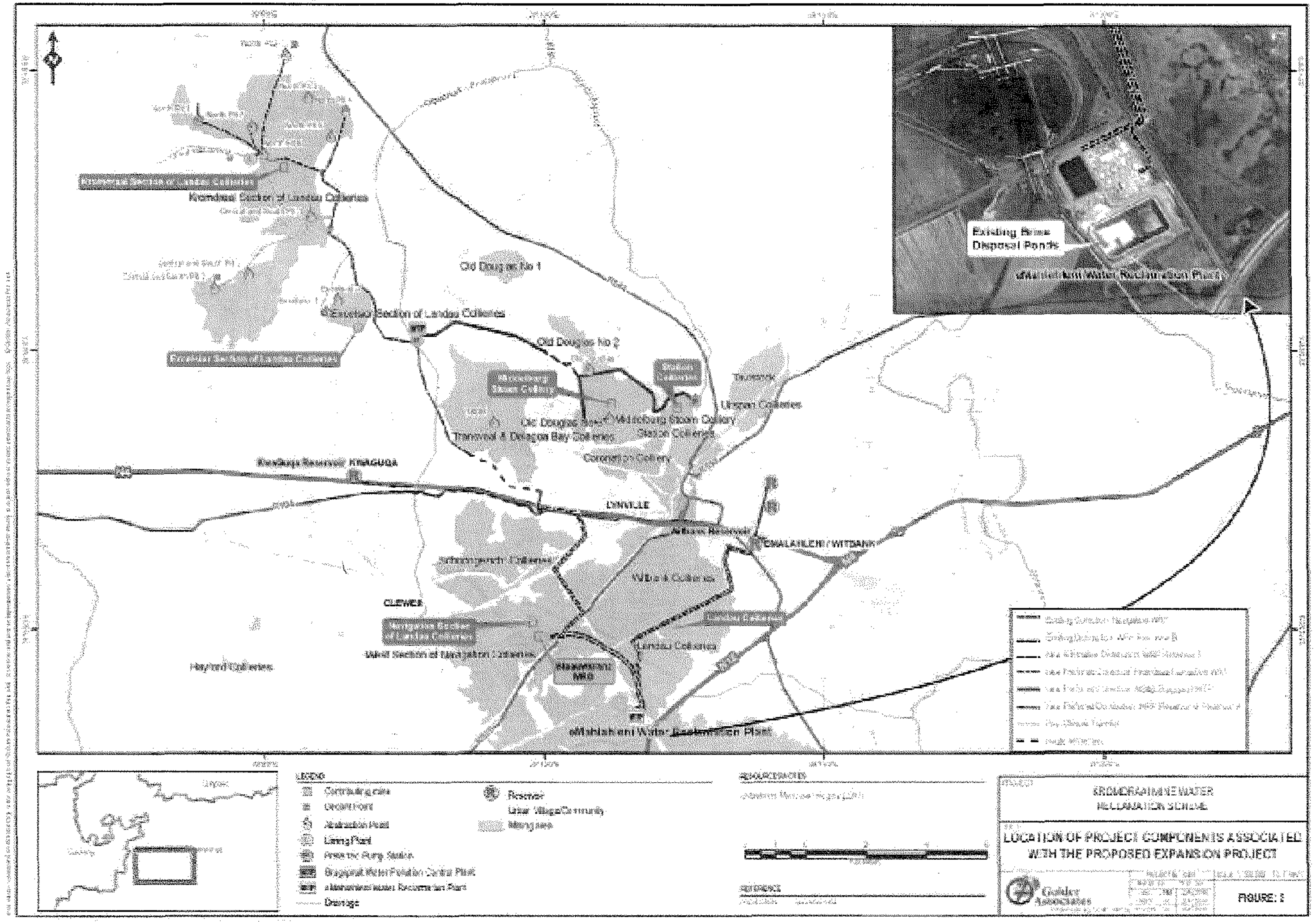


Figure 3: Location of project components associated with the proposed expansion project

2.1.1 Mine water resources

Currently, the Mine Water Reclamation Scheme collects 25 Mℓ/day from Kleinkopje Colliery, the Navigation Section of Landau Colliery, Greenside Colliery and South Witbank Colliery (Table 2).

The proposed project will entail the collection of an additional 20 Mℓ/day from Landau Colliery (Excelsior, Kromdraai and Navigation Sections) and Middelburg Steam and Station Collieries. Additional water may be sourced from other mines in the area; this is still under investigation (Table 2).

Table 2: Existing and proposed additional mine water sources included in the Mine Water Reclamation Scheme (average Mℓ/day)

Phase 1 Existing mine water sources	**Kleinkopje Colliery**	**Navigation Section of Landau Colliery**	**Greenside Colliery**	**South Witbank Colliery**	**Total**
	13 Mℓ/day	2.5 Mℓ/day	6.0 Mℓ/day	3.5 Mℓ/day	**25** Mℓ/day
Phase 2 Additional mine water sources	**Kromdraai and Excelsior Sections of Landau Colliery**	**Navigation Section of Landau Colliery**	**Middelburg Steam and Station Collieries**	**Other**	**Total**
	10 Mℓ/day	8 Mℓ/day	2 Mℓ/day	5 Mℓ/day	**25** Mℓ/day

Additional mine water sources for inclusion into the scheme could include the following:

- Non-Anglo Mines (ownerless)
  - Defunct Old Douglas1, 2, and 3 Collieries; and
  - Defunct Transvaal and Delagoa Bay Colliery (T&DB).

The inclusion of the above-mentioned mine water sources into the scheme may, however, complicate and delay the proposed expansion project. It is, however, important to note that the project team has considered the possibility of including these mine water sources into the scheme during the design of the project components; the collection pipelines have been designed to have sufficient capacity to accommodate these additional sources, if required. These water sources may therefore be included into the scheme at a later stage, subject to independent environmental assessment and licensing/permitting at that stage.

2.1.2 Mine water collection

2.1.2.1 Kromdraai and Excelsior

Currently, at the Kromdraai and Excelsior Sections, excess mine water is pumped from various abstraction and decant points (see Figure 3) and conveyed to a Liming Plant located at Kromdraai. Here, the mine water is neutralised, and the treated water is either used by the mines as process water or is discharged to the Kromdraaispruit. Currently, ± 8 Mℓ/day of neutralised water is discharged from the Liming Plant into the Kromdraaispruit.

As part of the expansion project, during the life of the mine, it is proposed that excess mine water be pumped to a holding (balancing) facility located at the existing Kromdraai Liming Plant. From here, the water will be pumped (via a pipeline and pump station) to the existing scheme's WRP (located at Greenside Colliery) via the Brugspruit Water Pollution Control Works (WPCW). Once the Kromdraai and Excelsior Sections of Landau Colliery have closed, and the Liming Plant has been decommissioned, the excess mine water will be pumped past the holding facility to an underground mine void (associated with a rehabilitated opencast pit, namely Central Pit 1), and from there, be pumped to the WRP via the same pipeline and pump system as described above.

The Kromdraai and Excelsior collection sub-system will consist of the following elements:

- Mine water will continue to be abstracted from the various points indicated on Figure 3 via new and existing borehole pumps.
- Conveyance of the abstracted water to a holding / balancing facility located at Kromdraai.

  During the life of the mine, the abstracted water will be transported via new and existing pipelines to the existing Liming Plant at Kromdraai and temporarily stored in a new holding/balancing sump, prior to being pumped to the WRP. Excess mine water (over and above the volume that will be conveyed to the WRP) will be neutralised at the existing Kromdraai Liming Plant and used by the mine or discharged into the Kromdraaispruit. Upon implementation of the proposed project, during the life of the mine, 3 – 7 Mℓ/day may still need to be discharged.

  Subsequent to mine closure, and the decommissioning of the Liming Plant, the abstracted water will be conveyed via new and existing pipelines to an underground mine void (associated with a rehabilitated opencast pit, namely Central Pit 1), prior to being pumped to the WRP. Discharges of neutralised water from the Liming Plant to the Kromdraaispruit will therefore cease.

- Conveyance of the water from the holding / balancing sump at Kromdraai to the WRP via the Brugspruit Water Pollution Control Works and Navigation holding/balancing sump.

  A new end-suction pump station located at the Liming Plant will be used to pump the water from the storage/balancing sump at the existing Kromdraai Liming Plant to the Brugspruit Water Pollution Control Works. At the Brugspruit Works, the water will be routed through a new concrete sump (capacity of approximately 1 000 m^3), and pumped via a new submersible pump to a new storage/balancing sump at Navigation, from where the water will be pumped to the WRP.

  Upon mine closure, the then existing pumps at the Liming Plant collection sump will be used to pump the water from the underground mine void to the Brugspruit WPCW.

- Collection pipeline

The mine water collection pipelines extending from the abstraction points to the Navigation holding/balancing sump will be HDPE pipelines with a diameter ranging from 100 – 630 mm, covering a distance of approximately 50 km. The entire pipeline will be buried (trenching), where possible (Figure 4). Roads / railway lines and watercourses will be crossed by the proposed pipeline (refer to Figure 5 for an indication of the location of these crossings. Pipelines will be laid across roads and railway lines by pipe jacking or excavation trenches; trenches will be excavated to lay pipes through watercourses.

Figure 4: Typical pipeline excavation trench

During construction of the pipeline, a servitude (right of way) width of 10 – 20 m will be required, whereas a servitude (right of way) width of 3 – 10 m will be required during the operation of the pipeline. These widths will, however, vary along the length of the pipeline, in accordance with the availability of space, any sensitive landscapes, etc.

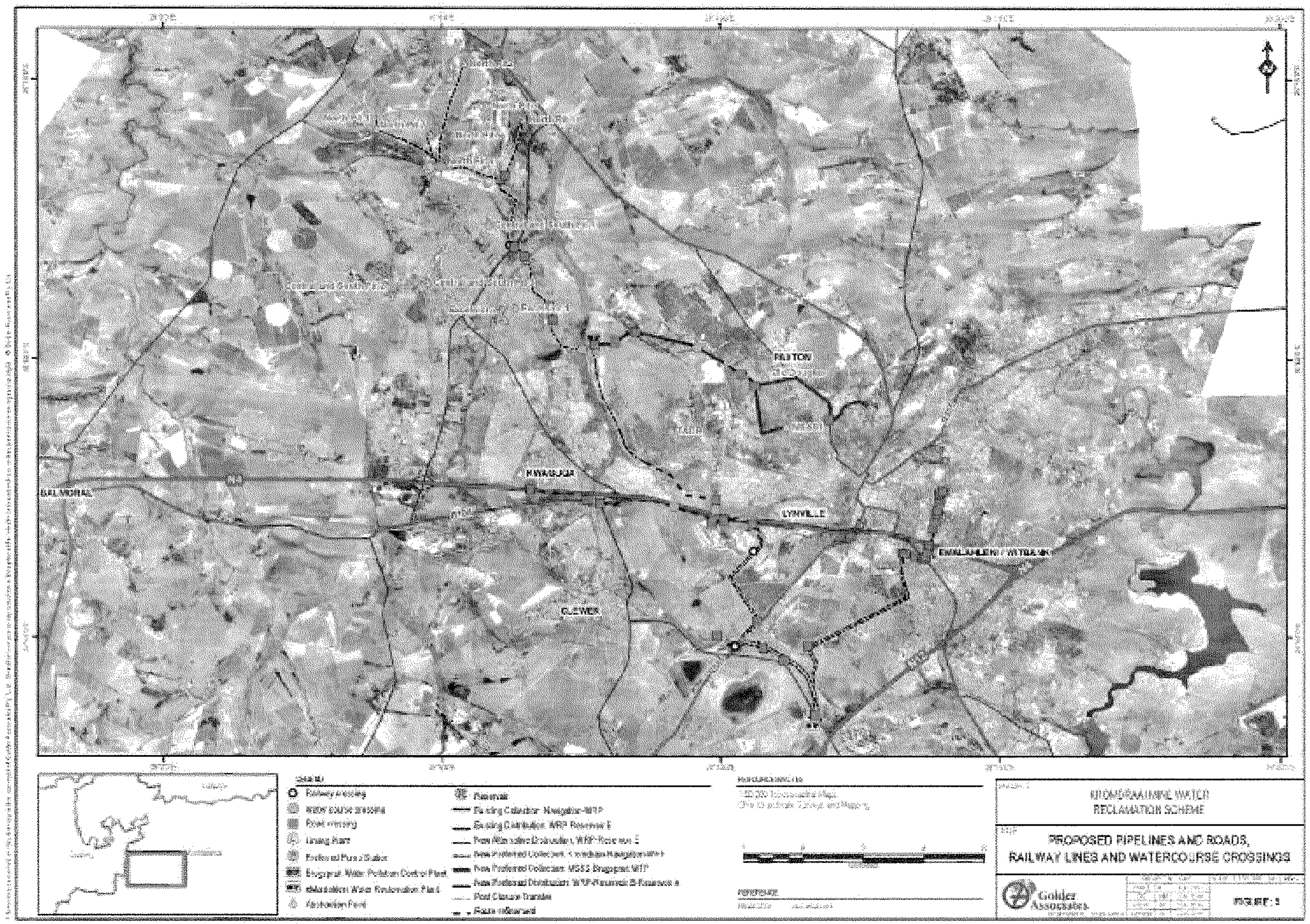


Figure 5: Proposed pipelines and roads, railway lines and watercourse crossings

Scour valves will be placed on the lowest points along the length of the pipeline to ensure that the pipe can be drained, in case of failure or for maintenance purposes. As the scour valves will be located at the lowest points along the pipeline, any settled solids will be easily removed. Scour valves are normally situated inside an enclosed chamber to ensure that maintenance can be done. Water discharged from the scour valves will be contained and not released into the environment.

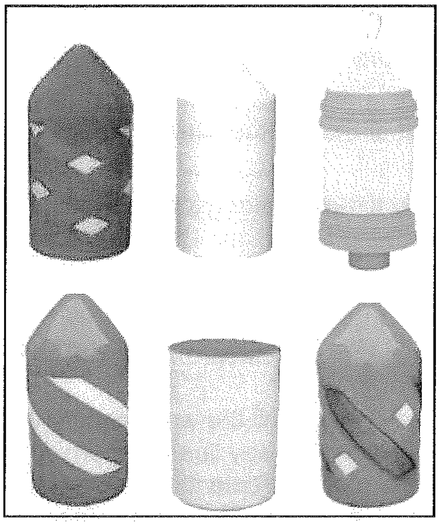


Figure 6: Examples of foam pigs

Low pH, mineral rich water, such as that which will be transported via the Kromdraai collection pipeline, precipitates when exposed to air. When water containing these salt / metal precipitates is transported via pipelines, the precipitates are deposited on the pipe walls (scaling). This builds up over time and decreases the internal diameter of the pipe consequently increasing the head losses over the length of the pipe.

To prevent excessive scaling, the pipelines would need to be cleaned internally on a regular basis. This will be done by means of pigging. The pig (Figure 6) will be placed inside the pipe and then pumped from one pig station to the next, removing the built up material as it travels. The proposed pipeline will be fitted with pigging stations at least every 1 000 m and a pig catcher installation at the end of each line (Figure 7).

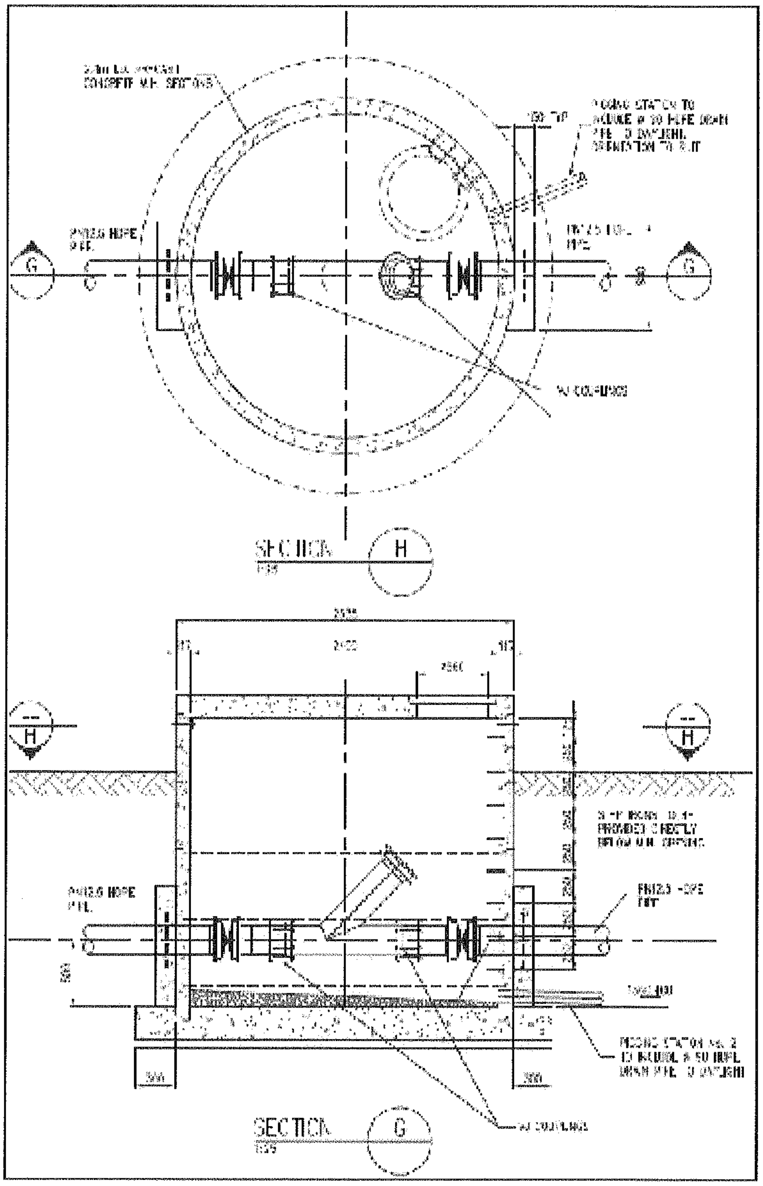


Figure 7: Typical in-line pigging station

Air valves will be placed on the apex (highest) points along the pipeline, relative to the hydraulic gradient. The main purposes of the air valves will be to ensure that, at start-up/commissioning of the pipeline, air bubbles in the pipeline can be released, and that pressure spikes are stabilised out during operation. Air valves will be situated inside an enclosed chamber to ensure that maintenance can be done.

The Kromdraai collection route is as follows (for details, refer to the map set which accompanies this report, on CD):

- The Kromdraai collection pipeline route runs from the Kromdraai abstraction points in a south easterly direction to cross the Klipspruit at an existing road crossing. (It is important to note that subsequent to the route selection process, a minor route refinement to this section of the pipeline has been identified, since mine water will no longer be abstracted from North Pit 3, but from North Pit 1 and 2.);
- It continues in an easterly direction up to the eastern boundary of the Excelsior Section;
- From here, it runs in a southerly direction, following the eastern boundary of the Excelsior mine property from where it turns in an easterly direction to cross the Brugspruit directly to the south of Brugspruit WPCW where the pump station will be situated;
- From the Brugspruit WPCW, the pipeline route runs in a southerly direction along the old Douglas No. 3 and T&DB workings and eventually crosses the N4 highway, following Schonland Drive in a southerly direction;
- The pipeline route then turns in an easterly direction to follow the R104 (Collins Avenue), from where it turns in a southerly direction to run just outside the mined out area of Schoongezicht Collieries up to the railway line from Witbank to Clewer; and
- The pipeline route then follows the eastern boundary of the Anglo Property all the way south to the R555 where it turns in a south westerly direction and runs parallel to the railway line for approximately 1 km, up to the existing pipeline servitude registered by Anglo. The pipeline route then runs within the existing pipeline servitude in a westerly direction to the new Navigation holding/balancing sump.

During the scoping phase, a number of stakeholders have suggested refinements to the proposed collection pipeline route; these are discussed in Section 5.1.6.3 and were assessed as part of the EIA.

2.1.2.2 Middelburg Steam and Station

Currently, at the defunct Middelburg Steam and Station Collieries, excess mine water is decanting on surface; the decant reports to a number of evaporation dams located adjacent to the Blesbokspruit. As part of the expansion project, it is proposed that the mine water be pumped at volumes which prevent decanting on surface, and be conveyed to the scheme's existing WRP via the Brugspruit WPCW.

The Middelburg Steam and Station collection sub-system will consist of the following elements:

- Abstraction of excess mine water from 2 points ,namely MS&S 1 and MS&S 2 (refer Figure 3). It is proposed that the water be pumped from underground at MS&S 1 via new borehole pumps, and via new submersible pumps at MS&S 2.
- Conveyance of abstracted water from MS&S 1 and MS&S 2 to the WRP via the Brugspruit WPCW and Navigation holding/balancing sump.
  At the Brugspruit Works, the water will be routed to the new concrete sump (refer to Section 2.1.2.1 above), and pumped via the new submersible pump to the new Navigation holding/balancing sump, and from there to the WRP.
- Collection pipeline

  The mine water collection pipelines extending from MS&S 1 and MS&S 2 to the Brugspruit WPCW will be HDPE pipelines with a diameter of 100 – 200 mm, and will cover a distance of ± 18 km. The entire length of the pipelines will be buried, where possible. Roads / railway lines and watercourses will be crossed by the proposed pipelines – refer to Figure 6 for an indication of the location of these crossings. Roads and railway lines will be crossed by pipe jacking or excavation trenches, whereas watercourses will be crossed by means of excavation trenches.

  During construction of the pipelines, a servitude (right of way) width of 10 – 20 m will be required, whereas a servitude (right of way) width of 3 – 10 m will be required during the operation of the pipeline. These widths will, however, vary along the length of the pipeline, in accordance with the availability of space, any sensitive landscapes, etc. As with the Kromdraai and Excelsior collection pipeline, scour valves will be placed on the lowest points along the length of the pipeline, and air valves will be placed on the apex (highest) points along the pipeline. To prevent excessive scaling, the pipelines will be cleaned internally on a regular basis by means of pigging.

It is important to note that the same section of the Kromdraai and Excelsior collection pipeline which extends from the concrete sump at the Brugspruit WPCW to the WRP will be used for the Middelburg Steam and Station collection sub-system. This section of the pipeline has thus been designed to accommodate the mine water sources from both the Kromdraai and Excelsior sections of Landau Colliery, and Middelburg Steam and Station Collieries.

The Middelburg Steam and Station collection pipeline route is as follows (for details, refer to the map set which accompanies this report, on CD):

- The collection pipeline route runs from the abstraction points (MS&S 1 and MS&S 2) in a westerly direction just north of the Old Douglas No. 3 and T&DB workings to the Brugspruit WPCW, from where it will tie into the Kromdraai collection pipeline route to the WRP.

During the scoping phase, a number of stakeholders have suggested refinements to the proposed collection pipeline route; these are discussed in Section 5.1.6.3 and were assessed as part of the EIA.

2.1.2.3 Navigation

Future mining at the Navigation Section of Landau Colliery, will result in excess mine water to be managed. As part of the expansion project, it is proposed that this excess mine water be collected and conveyed to the scheme's existing WRP. The Navigation collection sub-system will consist of the following elements:

- Abstraction of excess mine water from four boreholes (two existing boreholes and two new borehole) located on site via submersible pumps (3 duty and 1 standby pump);
- Collection pipeline.
  The abstracted water will be conveyed to the WRP via a new 500 m^3 holding/balancing sump (which will also collect the water from Kromdraai and Excelsior, and MS&S). The existing 500 mm diameter HDPE pipeline which runs from Navigation to the scheme's existing WRP will be utilised to convey the water from Navigation to the WRP.

2.1.3 Upgrade of the existing Water Reclamation Plant in terms of capacity

The existing WRP at Greenside Colliery currently has a capacity to treat 25 Mℓ/day of mine water, and has a footprint of 8 hectares (ha). The WRP footprint was originally designed to accommodate a future expansion (double-up). To accommodate the proposed additional excess mine water, it is proposed that the existing WRP be upgraded to treat 50 Mℓ/day (average Mℓ/day) of mine water[1]. Components for the upgrade include the addition of reverse osmosis components, additional chemical storage, new limestone plant, etc. This can be accommodated without expanding the existing footprint of the plant (Figure 8). Refer to APPENDIX N for a site layout of the proposed upgraded WRP.

Prior to treatment, the additional water sources will be temporarily stored in the existing mine water storage dams located at the WRP (the additional mine water feed sources, i.e. Kromdraai and Excelsior, and Navigation Sections of Landau Colliery as from Middelburg Steam and Station Collieries, will be blended into the current feed to the WRP at the mine water storage dams, and the resulting blend will be treated by the upgraded WRP).

The current water treatment process is based on a number of steps, including:

- Neutralisation and metals removal;
- Desalination;
- Reverse Osmosis; and
- Disinfection (using chlorine).

[1] The upgraded WRP will be designed to treat a peak flow of 60 Mℓ/day

The same treatment process will be used to treat the additional mine water sources. Treated water will be temporarily stored in the existing potable water storage reservoirs located at the WRP.

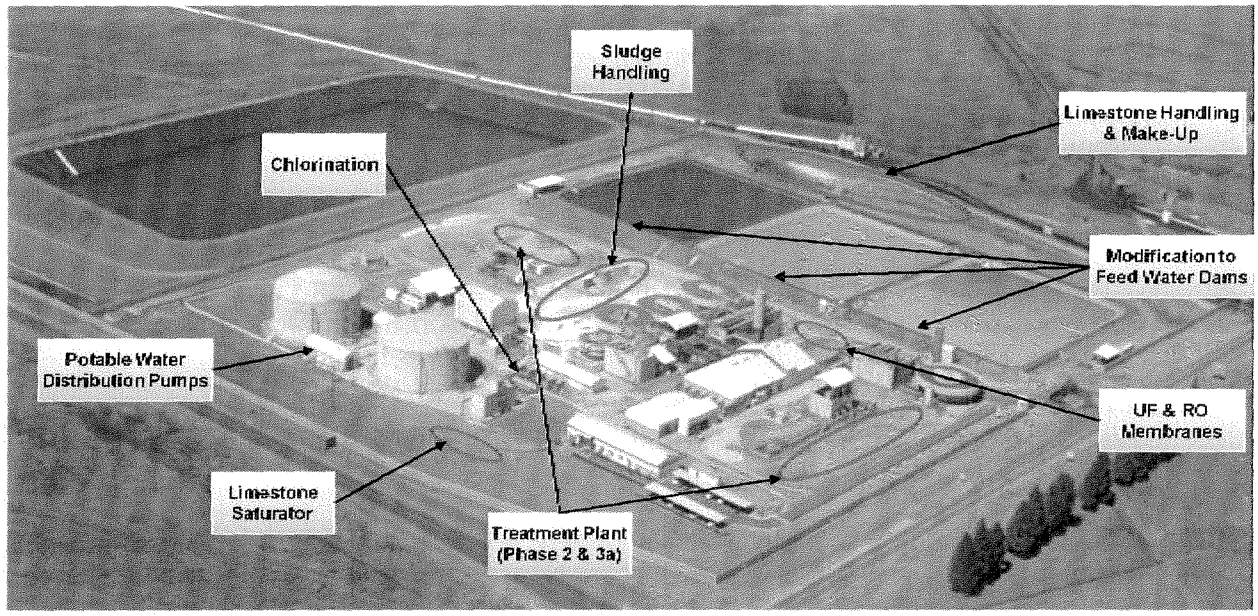


Figure 8: Existing WRP site indicating areas where proposed expansion infrastructure will be placed

2.1.4 Treated water distribution

Currently, water treated to potable standards at the WRP is distributed to the municipal water reservoir, referred to as the Witbank Reservoir (Reservoir B), via a distribution pipeline. In addition, some treated water is distributed to the mines for their use.

The expansion project will ensure an additional supply of 20 Mℓ/day to the municipality. Together with the municipality, the city's distribution system has been reviewed. Based on the outcomes of the review, the following proposals are made in terms of the final distribution of the additional 20 Mℓ/day (Figure 9):

- 5 Mℓ/day of the 20 Mℓ/day is distributed to the Witbank Reservoir (Reservoir B) via a new pipeline located within the existing distribution pipeline servitude, which was permitted as part of Phase 1 of the scheme. The remaining 15 Mℓ/day is distributed to Reservoir A via a new pipeline; or
- 5 Mℓ/day is distributed to the Witbank Reservoir (Reservoir B) via the existing distribution pipeline, and 15 Mℓ/day is distributed to the KwaGuqa Reservoir (Reservoir E) via a new distribution pipeline.

It is also proposed that 5 Mℓ/day be pre-treated (neutralised) to industrial water quality standards to be supplied to Greenside Colliery and the Phola Plant located south west of the WRP for use as process water. Pre-treated (neutralised) water will be conveyed to Greenside Colliery and the Phola Plant via existing mine pipelines.

In the unforeseen event that the treated water cannot be distributed to the various end users, it will be discharged into the Naauwpoortspruit adjacent to the WRP.

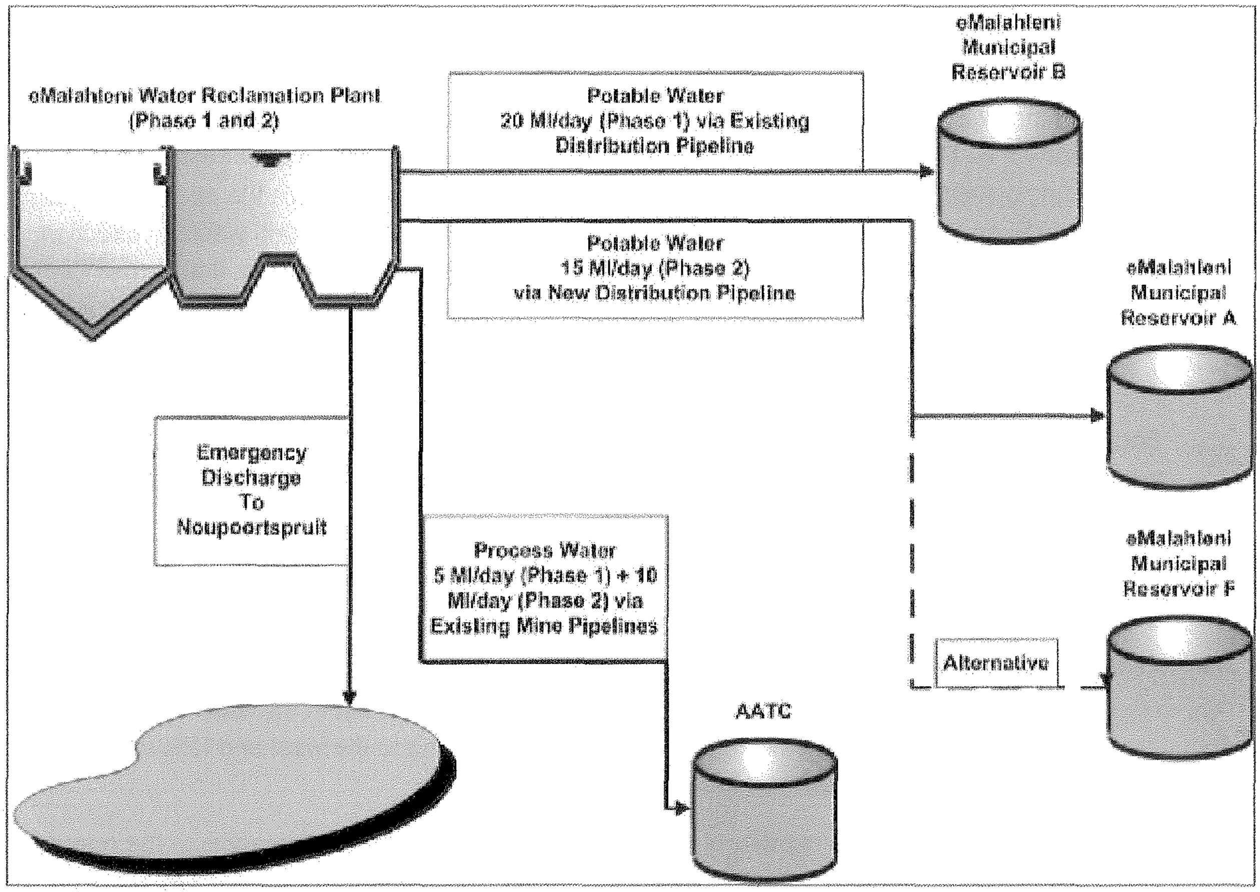


Figure 9: Treated water distribution system

The distribution system will consist of the following elements:

- Pump stations

  As part of the expansion project, it is proposed that a new pump station (2 duty pumps and 2 standby pumps) be constructed at the WRP site to cater for the additional 20 Mℓ/day to be distributed to the Reservoirs A and B. Alternatively the existing pump station at the WRP will be upgraded to accommodate the additional 5 Mℓ/day to be distributed to the Witbank Reservoir (Reservoir B) with a new pump station (3 duty pumps, and 1 standby pump) to be constructed at the WRP site to cater for the 15 Mℓ/day to be distributed to the KwaGuqa Reservoir (Reservoir E).

- Distribution pipelines

  Should the treated water be conveyed to Reservoirs A and B, a new distribution pipeline will be installed to convey treated water from the WRP to Reservoirs B and A. The pipeline will be an HDPE pipeline with a diameter of ± 630 mm, and will cover a distance of roughly 11 km.

  The distribution pipeline route to Reservoir A is as follows (for details, refer to the map set which accompanies this report, on CD):

  - The existing distribution pipeline servitude which runs from the WRP to the Witbank Reservoir (Reservoir B) runs in a northerly direction for the first few kilometres, and then runs in a north easterly direction through the Witbank Collieries mine site and eventually enters the Witbank Reservoir just south of the N4 highway; and

- From the Witbank Reservoir (Reservoir B), the pipeline would be extended in a northerly direction to Reservoir A. The distribution pipeline will be extended north, crossing under the highway though an existing culvert, running on the western side of Woltemade Street within the existing Municipal servitude up to Christiaan de Wet Street. From there, it will turn in a north westerly direction, following Christiaan de Wet until it reaches Nicol Street. At the intersection, it will cross Christiaan de Wet Street and then Nicol Street and run on the northern side of Nicol Street until it is adjacent to Reservoir A. From there, it will cross Nicol Street once again and head towards the tie-in point to the Reservoir.

Should 15 Mℓ/day be distributed to the KwaGuqa Reservoir (Reservoir E), a new distribution pipeline will be installed. The pipeline will also be an HDPE pipeline, will have a diameter ranging between 400 – 630 mm, and will cover a distance of ± 16 km.

The distribution pipeline route to KwaGuqa Reservoir (Reservoir E) is as follows (for details, refer to the map set which accompanies this report, on CD):

- The new distribution pipeline route from the WRP to the KwaGuqa Reservoir will run within the same pipeline route as the Kromdraai collection pipeline route, but in the opposite direction. Subsequent to crossing the N4 highway, the route will swing to the west and follow the highway up to the KwaGuqa Reservoir.

During the scoping phase, a number of stakeholders have suggested refinements to the proposed distribution pipeline route; these are discussed in Section 5.1.6.3 and were assessed as part of the EIA.

As with the collection pipelines, scour valves and air valves will be installed on these lines on the low and high points respectively. No pigging stations will be required on the distribution pipelines.

- New inlet infrastructure at Reservoirs A, B and/or E will be required.
- The existing Reservoirs A, B and/or E will be used to store the treated water prior to distribution to the public.

2.1.4.1 Treated water quality

See Section 4.3.3.

2.1.5 Waste

Two main waste streams, namely gypsum sludge and brine, are currently generated at the WRP and are disposed of separately (see Table 3).

Table 3: Main waste streams generated at the WRP

Waste type	Description
Gypsum sludge	Gypsum sludge is formed when lime is added to the mine water and metals such as calcium, iron, and manganese precipitate. The gypsum is dewatered to produce a gypsum cake. As part of the existing project, the Department of Water Affairs approved the disposal of the gypsum with the Blaauwkrans coal discard at Navigation. Currently, this waste is being disposed of at Blaauwkrans Dump (Yellow Buoy Section) (Figure 10).

Waste type	Description
Brine	Brine, which is a liquid salty concentrate, is generated from the Reverse Osmosis Plant and contains similar elements as the gypsum sludge, but is not dewatered. A brine waste facility was built at the WRP site to accommodate the liquid brine waste (Figure 8). The brine waste is prevented from reaching the environment through a system of controls: a double liner, a leachate collection layer and an under-drainage system below the double liner.

The additional brine will continue to be disposed of into the existing brine pond located at the WRP site. When this facility reaches full capacity (anticipated to be in January 2015 – see APPENDIX R), the brine will then be disposed of at a new brine pond to be constructed at that time at the Blaauwkrans Dump at Navigation (Figure 10). Two future brine ponds at Blaauwkrans were already permitted as part of Phase 1 of the scheme.

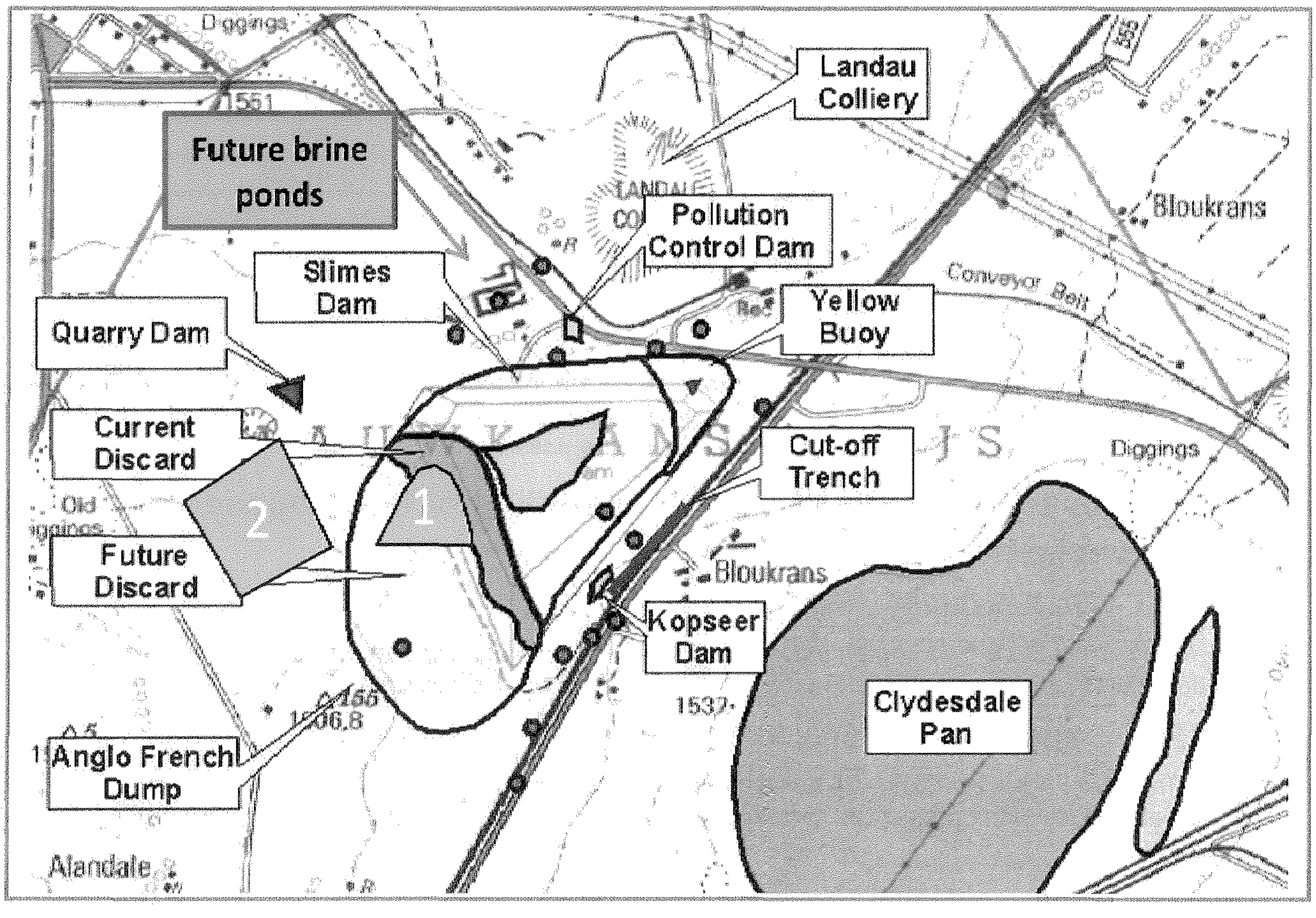


Figure 10: Layout of the Blaauwkraans Dump at Navigation Section of Landau Colliery showing the location of the Yellow Buoy Section (in bright yellow), the modules proposed for gypsum deposition (in green), and the site for the future brine ponds (in blue)

In terms of the additional gypsum sludge volumes, it is proposed that the gypsum sludge continues to be disposed of at Blaauwkrans Dump. When this facility reaches full capacity (anticipated to be reached by June 2013 – refer to APPENDIX R), the gypsum sludge will then be disposed of at a new facility to be constructed at that time at the Blaauwkrans Dump site at Navigation. Two future modules for disposal of gypsum cake at Blaauwkrans were already permitted as part of Phase 1 of the scheme.

Anglo is currently investigating the re-use of gypsum sludge in building products and other by-products.

Chemical characterisation of the gypsum sludge from the WRP was conducted in 2010. The results are indicated in Table 4. Mass balance modelling results were used to indicate future gypsum sludge quality as a result of the WRP expansion and changes in feed water quality (i.e. Kromdraai, Excelsior and Navigation Sections of Landau Colliery, and Middelburg Steam and Station Collieries). The results indicate that the expansion will have significantly higher concentrations of magnesium, aluminium and iron compared to the existing gypsum compositions (Table 4). For details, refer to APPENDIX H.

Table 4: Elemental compositions of current gypsum sludge (in mg/kg) based on 2010 analyses and estimated sludge composition associated with the future expansion project, based on mass balance modelling

Determinant	Gypsum sludge (current)	Gypsum sludge (future)*
Aluminium	34	6 091
Calcium	212 040	79 655
Iron	167	23 685
Magnesium	5 200	99 567
Manganese	152	1 880
Potassium	48	69
Silicon	-	89
Sodium	160	306
Sulphur	-	61 836

**It should be noted that the mass balance modelling results are indicative and based on simplifying assumptions of the treatment process.*

2.2 Staffing

Approximately 400 additional employment opportunities will be created for skilled and unskilled workers during the Construction Phase. This will be over an 18-month period. Ten (10) to twenty (20) permanent jobs will be created for the routine operation and maintenance of the new pipeline and pump system. Focus will be on employing labour from the local community where possible.

2.3 Phased development and scheduling of the proposed project

This proposed project can be divided into the following phases:

2.3.1 Pre-Feasibility Phase

A Pre-feasibility Study was completed in July 2009. During this phase, the technical, financial and environmental/social aspects of the project were investigated and evaluated.

2.3.2 Definitive Feasibility Phase

The Definitive Feasibility Study will be completed during February 2011. During this phase, the technical and financial aspects of the project are investigated in more detail for the purposes of securing funding for the project.

2.3.3 Implementation (Construction) Phase

It is anticipated that this phase will commence in April 2011.

2.3.4 Commissioning Phase

It is proposed that commissioning of the upgraded WRP will commence in January 2013.

2.3.5 Operational Phase

This proposed project will be operated and maintained over the long term. For the purposes of the financial model, the expansion project has been allocated a life cycle of 20 years.

3.0 BASELINE DESCRIPTION OF THE STUDY AREA

3.1 Geology

The study area is situated in the Central Block of the Witbank Coalfields. The coalfield lithologies comprise sediments of the Dwyka and Vryheid Formations of the coal-bearing Ecca Group, Karoo Supergroup. The sediments have been deposited on an undulating pre-Karoo age basement, which had a significant influence on the nature, distribution and thickness of the sedimentary formations and coal measures.

The geology of the study area is dominated by near horizontally bedded successions of shales, sandstones and coal layers. This succession of sedimentary rocks overlies the well-consolidated conglomerates / diamictites of the Dwyka Formation, but in places rests directly on felsites and granites of the pre-Karoo Basement.

A north south striking normal fault cuts across the site and divides the coal resource into distinct western and eastern parts. The fault cuts through the eastern limb of an anticline. A number of northeast-southwest trending, near-vertical dolerite dykes have intruded the coal.

3.2 Climate

The study area is situated in the Mpumulanga Highveld Region in the summer rainfall region of southern Africa. The climate is temperate with warm summers and cold, dry winters. Precipitation usually occurs in summer, as mist, rain and hail; convectional thunderstorms are common and the source of most precipitation. Hail can be expected to occur an average of 6 days per year. The average annual rainfall is between 624 mm and 713 mm with 85 % of this falling in the high rainfall months between October and March. The highest rainfall in 24 hrs was 129 mm, recorded at Ogies on 19 December 1986.

The highest mean daily maxima of >25°C occur in the period December to February. Average maximum temperatures in the winter months (May - August) vary between 16.9°C and 20.1°C. Sharp frosts are common in winter. In summer, average minimum temperatures do not drop below 12.7°C, in contrast to the June/July minima of 0°C and 0.2°C respectively. An extreme maximum temperature of 34.7°C has occurred in January, whilst an extreme minimum of -12.4°C has been recorded in July. Frost can be expected from the beginning of May until mid-September, with an average of 58 frost days per year.

The prevailing wind direction throughout the year is from the northwest, but storm winds (i.e. high velocity winds) generally blow from the southeast, with the strongest winds occurring in late winter and early spring. Maximum evaporation occurs in summer, from October to January, due to high summer temperatures.

When mean annual evaporation (approximately 1 700 mm) is compared to rainfall, it can be seen that there is a net monthly deficit throughout the year, which results in an average annual water deficit of 1 010 mm.

3.3 Topography

The study area is situated in the eastern region of Mpumalanga, which is characterised by a gently undulating plateau with fairly broad to narrowly incised valleys such as the Olifants River valley. The general elevation of the area lies between 1 400 m and 1 600 m above mean sea level (mamsl). To the west of Witbank lies a high point of 1650 m, although the town lies at an average altitude of approximately 1 560 m.

3.4 Soil

A soil, land capability and land use assessment was conducted for the proposed project. The aim of this study was to describe the soils along the collection and distribution pipeline routes and to assess potential impacts of the pipelines on soil, land capability and land use in the study area. The results of the study are presented below. For details, refer to APPENDIX F.

Kromdraai collection pipeline

The portion of the Kromdraai collection pipeline located at the Kromdraai Section of Landau Colliery consists of rehabilitated land which was previously mined by opencast methods and mined areas (no topsoil) currently disturbed by mining related activities. The soils associated with the rehabilitated land are dominated by the Witbank 1000 soil Form and Family and consist of shallow to moderately deep, yellow-brown and red, loamy sand soils underlain by coaliferous material. The soils associated with the areas currently disturbed by mining related activities are also dominated by Witbank 1000 soil. These soils have a low to moderate agricultural potential.

Sporadic occurrences of undisturbed soils do occur (soil types Hutton 2100, Clovelly 2100 and Clovelly 1100). These soils are well-drained soils with little or no disturbance and are dominated by red and yellow-brown loamy sand to sandy loam soils, and have moderate to high agricultural potential.

Smaller sections along this pipeline route consist of imperfectly- or poor drained soils (i.e. hydromorphic soils) which are dominated by grey, leached, sandy soils, namely Fernwood 1110 and Longlands 1000, and grey saturated soils underlain by clay, namely Katspruit 1000. These soils are associated with permanent, seasonal or temporary wetlands with low agricultural potential.

The remaining sections of the Kromdraai collection pipeline route north of the N4 highway are dominated by Clovelly 2100 and Clovelly 1100 soils. These soils are well-drained soils with little or no disturbance and are dominated by red and yellow-brown loamy sand to sandy loam soils. These soils have moderate to high agricultural potential.

The pipeline route south of the N4 is, however, dominated by Clovelly 2100 and Clovelly 1100 soils with sections disturbed by various non-mining related activities such as loading zones, trenches, diggings, partly excavated areas, eroded areas and footprints of demolished infrastructure. Sporadic occurrences of Longlands 1000 soils occur along this section of the pipeline route, indicating the presence of seasonal wetlands with low agricultural potential.

Middelburg Steam and Station collection pipeline

The majority of the Middelburg Steam and Station collection pipeline route consists of Hutton 2100, Clovelly 2100 and Clovelly 1100 soils. Various sections of this pipeline route are disturbed mainly by non-mining related activities. In these sections the natural soil horizon sequences of the A- and B-horizons are disturbed although the topsoil is mostly not completely removed. These sections are dominated by the Witbank 1000 soil Form and Family and consist of shallow, disturbed, yellow-brown, loamy sand soils with low agricultural potential. A small section of this pipeline route consists of Longlands 1000 soils.

Navigation collection pipeline

The Navigation collection pipeline is dominated by Avalon 1100 and Avalon 2100 soils. Avalon 1100 soils are moderately deep, moderately drained, yellow brown, loamy sand to sandy loam soils underlain by soft plinthite with moderate agricultural potential. Avalon 2100 soils are moderately deep to deep, imperfectly drained yellow brown, loamy sand soils, underlain by soft plinthite subject to wetness which might be human induced.

Distribution pipeline to KwaGuqa Reservoir

The majority of the distribution pipeline to the KwaGuqa Reservoir consists of Hutton 2100, Clovelly 2100 and Clovelly 1100 soils. Smaller sections along this pipeline route consist of imperfectly- or poor drained soils (i.e. hydromorphic soils) (Fernwood 1110, Longlands 1000, and Katspruit 1000) or have been disturbed by various non-mining related activities.

Distribution pipeline to Reservoir A

The proposed pipeline route from the WRP to Reservoir B and to Reservoir A is dominated by soils previously disturbed during road and pipeline construction, residential or industrial development. In these soils the natural soil horizon sequences of the A- and B-horizons are disturbed although the topsoil is mostly not completely removed and in many cases the original surface is covered with gravely imported soil material. Sporadic occurrences of undisturbed soils are, however, present along the route (soil types Clovelly, Hutton and Avalon).

3.5 Land capability

In terms of land capability, most sections of the pipeline routes (47.4 %) are located on arable land with moderate to very deep red and yellow-brown soils with moderate to high agricultural potential. 36.8 % of the pipeline routes are located on mined areas, disturbed areas and areas occupied by semi-permanent infrastructure, classified as 'wilderness'. The remaining sections are located on grazing land (8.4 %) and temporary (3.2 %), seasonal (3.2 %); and permanent wetlands (1 %).

For details, refer to APPENDIX F.

3.6 Land use

In terms of current land uses, most sections of the pipeline routes (40.6%) are situated within vacant mine property which are fenced off or barricaded by trenches with no specific land uses taking place. 31.8 % of the route occurs along areas that could be vacant or utilised from time to time by local farmers for grazed. Some sections (2.6 %) are currently mine land or are areas partly occupied by mining infrastructure. Some sections of the route are located along the edge of maize fields (3.6 %) and on patches of bluegum trees (3.6 %). The remaining sections (17.8 %) are located in between roads and residential areas, along the edge of a sewage treatment plant and local dam, and there are several cross road and rail crossings.

Refer to APPENDIX F for details.

3.7 Surface water

A surface water specialist study was conducted as part of the EIA, starting with a baseline assessment using available hydrology and water quality information was undertaken. The results of the baseline assessment are summarised below and detailed in APPENDIX G.

The eMalahleni Mine Water Reclamation Expansion project falls in the upper Olifants catchment in the Kromdraaispruit, Klipspruit and Naauwpoortspruit catchments.

The Kromdraaispruit is a tributary of the Saalklapspruit, which in turn is a tributary of the Wilge River. The confluence of the Wilge River with the Olifants River is immediately upstream of Loskop Dam. The Kromdraaispruit has a history of acid conditions due to discharges from the Kromdraai Colliery liming plant, seeps and decants from other defunct mines in the catchment such as the Blackstone Colliery adjacent to Kromdraai. Kromdraai is discharging about 8 Mℓ/d of neutralised mine water into the spruit. This discharge forms the bulk of the base flow in the river. As a result of the seeps and discharge, wetland systems have developed in the spruit.

The confluence of the Klipspruit with the Olifants River is downstream of Witbank Dam and upstream of Loskop Dam. The Klipspruit is a highly impacted catchment with a long history of water quality problems. The current water quality in the catchment is impacted by acid seeps and decants from defunct mines some of which belong to the DMR. The flow in the Klipspruit is impacted on by discharges (totalling 40 Mℓ/d) from the Klipspruit and Ferrobank sewage treatment plants. As a result there is a significant base flow in the river. The water quality is impacted on by these discharges as well as runoff from the urban areas, stock grazing of the wetland vegetation and domestic use such as the washing of clothes in the river.

The WRP is located on the banks of the Naauwpoortspruit, which flows into the Witbank Dam. The river does not have a high base flow as there are limited point source discharges in the catchment. The water quality of the Naauwpoortspruit is highly impacted by local collieries as well as runoff from the urban areas.

3.8 Groundwater

The quantity of water that can be abstracted from the mines in order to prevent decanting of excess underground mine water to surface was determined - refer to Section 4.1 for details.

3.9 Terrestrial Ecology

An ecological study on the terrestrial aspects of the proposed project was undertaken. The study aimed to present baseline descriptions of floristic elements and fauna occurring within the study area, and to highlight sensitive biological and environmental attributes that may potentially be impacted by the proposed project. The findings of the study are summarised below; for more detail, refer to APPENDIX I.

3.9.1 General

The study area is situated in the Grassland biome. The Grassland biome is characterised as land that is dominated by grass species rather than trees or large shrubs.

3.9.2 Site specific

3.9.2.1 Flora

The vegetation species found during the site survey were identified and can be seen in Appendix C of APPENDIX I. A large percentage of exotic species were found and most areas were already highly impacted by mining or anthropogenic activities. However, sensitive areas such as wetlands were also identified as well as protected species within the secondary grasslands or riparian zones. Based on physiognomy, moisture regime, rockiness, slope and soil properties, ten vegetation communities were recognised. Although these communities were recorded as such, there is some variation within them, due to external influences such as overgrazing, overutilisation and other anthropogenic impacts. These communities are described in Table 5 below:

Table 5: Identified vegetation communities along the proposed pipeline routes

Vegetation community	Description
Rehabilitated mining area	Previously mined areas that have been rehabilitated. Rehabilitation species predominantly consist of grass species including *Pennisetum clandestinum* and *Eragrostis sp*
Mining area	Areas that have been impacted by mining activities. These regions are of a low ecological integrity and very little to no species are found here due to the level of disturbance.
Acacia mearnsii woodland	Areas that are dominated by trees, a woodland region that consists of a single species, *Acacia mearnsii.*
Secondary grassland	This vegetation community has been disturbed by previous cultivation attempts, grazing or other developments. The primary vegetation is now lost and has been replaced by secondary growth. Species representing this community include grass species and invasive species: *Eragrostis curvula; Cenchrus ciliaris; Hyparrhenia hirta; Eragrostis rigidior; *Melinis repens; *Bidens pilosa; *Conyza albida; *Conyza bonariensis; *Schkuhhria pinnata; *Tagetes minuta; *Leonotis leonurus; *Argemone ochroleuca; *Asclepias fruticosa; *Datura stramonium; *Solanum sisymbrifolium* etc.
Woodland	Consists of exotic and indigenous trees. Natural vegetation has been infiltrated by exotic species. However, indigenous species dominate this area. Species include: *Searsia lancea* and *Erythrina lysistemon*
Wetland region	Sensitive area due to unique ecology. Area contains wetland indicator species and includes: *Bulbostylis capillaries; Cladium mariscus; Cyperus compressus; *Cyperus eragrostis; *Cyperus esculentus; Cyperus laevigatus; Phragmites australis; Typha capensis* etc.

Vegetation community	Description
Disturbed area	Area disturbed by previous grazing or cultivation attempts followed by high level of anthropogenic impacts from surrounding informal settlements. Polluted areas dominated by exotic species: **Bidens pilosa; *Bidens bipinnata; *Bidens formosa; *Conyza albida; *Conyza bonariensis; *Gomphrena celosioides *Schkuhhria pinnata; *Tagetes minuta; *Leonotis leonurus; *Argemone mexicana *Argemone ochroleuca; *Asclepias fruticosa; *Datura stramonium; *Ricinus communis; *Solanum sisymbrifolium; *Solanum mauritianum; Phytolacca octandra etc.* Also a road reserve area that consists of cut grass, horticultural flowers or disturbed areas dominated by exotics.
Eucalyptus woodland	Areas that are dominated by trees, a woodland region that consists of a single genus, *Eucalyptus sp.*
Farmland	Cultivated areas containing no natural vegetation. Cultivation species include *Zea mays* (Mielies).

*Exotic species indicated by **

Red Data species

No Red Data species were found during the survey. However, protected species, namely *Brunsvigia radulosa* and *Gladiolus ecklonii*, were found in the vicinity of the proposed Kromdraai and Middelburg Steam and Station collection pipeline routes. The *Brunsvigia radulosa* was found in the grassland adjacent to, or within the riparian zone, of the proposed Kromdraai collection pipeline route (approximately 25.8252S and 29.1398E) and Middelburg Steam and Station collection pipeline (approximately 25.9347S and 29.1943E) The *Gladiolus ecklonii* was found in numbers along the northern section of the Kromdraai collection pipeline route where the route traverses rehabilitated mining land (approximately 25.7600S and 29.0847E).

3.9.2.2 Fauna

Mammals

Mammals were identified through visual observation of the species, prints or faeces. Species identified during the survey are listed in Table 6. No Red Data species were encountered. The Red Data mammal known to occur in this area is the Serval (*Felis (Leptailurus) serval*). The probability of occurrence of this species within the proposed project area is seen as moderate due to the high level of disturbance in certain areas and possible historical persecution of these cats due to them being seen as "problem animals". However, natural areas do occur in close vicinity that can represent habitat for the species.

Table 6: Mammals species identified during the survey

Species Name	Common Name
Canis mesomelas	Black-backed jackal
Phacochoerus aethiopicus	Warthog
Cynictis penicillata	Yellow mongoose
Lepus sp.	Hare

Avifauna

During the survey, all bird species encountered or bird calls identified were listed (Table 2 of APPENDIX I). Some of these include the Crowned Plover (*Vanellus coronatus*), Yellow-eyed Canary (*Serinus mozambicus)* and Cape Sparrow (*Passer melanurus*). No Red Data species were recorded during the surveys.

One of the endangered species, namely the Whitewinged Flufftail (*Sarothrura ayresii*), is a poorly known, secretive bird living in wetland habitat. Its populations have suffered decline due to habitat destruction and degradation. It is, however, believed to be unlikely to be found within the study area, due to the wetlands within the study area not presenting suitable habitat (Barnes, 2000). The Wattled Crane (*Grus carunculatus*), which may occur in the study area, is classified as Vulnerable both in terms of IUCN Red Listing and TOPS regulations. This is due to this bird's small population of an estimated 230 animals, vastly reduced range and the lowest reproductive potential of all crane species. Failure to address loss of wetland habitat on privately owned land will result in further decline and probably regional extinction (Barnes, 2000). The Vulnerable Blue Crane (*Anthropoides paradisea*) and Southern Crowned Crane (*Balearica regulorum*) have been recorded in this region previously and therefore have a high probability of occurrence within the study area.

Herpetofauna

During the field survey, no Herpetofauna species (reptiles) were encountered. However, trails of *Serpentes* (snake) species were found, but species level identification was not possible. Based on previous encounters and findings in the study area, snake species occurring within the study area might include the Puff Adder (*Bitis arietans*) and Brown House Snake (*Lamprophis capensis*). Red Data species within the proposed project area include the Transvaal Grass Lizard (*Chamaesaura aenea*). The probability of occurrence of this species within the study area is seen as moderate due to the fact that the proposed pipeline routes cross grassland vegetation communities, the habitat type of this species. The grasslands are, however, already disturbed.

Arthropoda

Arthropods identified during the site survey can be seen in Table 4. No Red Data butterflies list exists for Mpumalanga; therefore, the probability of occurrence for Red Data species could not be determined.

Table 7: Arthropods found during the site survey

Species Name	Common Name
Conocephalus caudalis	Meadow Katydid
Thermophilum homoplatum	Two-spotted ground beetle
Musca domestica	House fly
Chrysomya albiceps	Banded blowfly
Henosepilachna bifasciata	Cucurbit ladybird
Colias electo	Yellow lucerne butterfly
Tachypompilus ignitus	Spider hunting wasp
Hemipepis tamisieri	Spider hunting wasp
Oncopeltus famelicus	Milkweed bug
Spilostethus pandurus	Milkweed bug

3.10 Aquatic ecology

An aquatic ecology assessment was conducted for the proposed project (APPENDIX J). The survey included assessments of *in situ* water quality, habitat assessment, aquatic macroinvertebrates and ichthyofaunal diversity. Nine sites were selected at points where the proposed pipeline routes intersect drainage lines (see Figure 1 of APPENDIX J and Table 8 below).

Table 8: Description of aquatic ecology assessment sites

Site	Description
Site 1	Situated in the Klipspruit at the mine service road crossing point (Kromdraai collection pipeline route).
Site 2	Situated in the Brugspruit next to the Water Pollution Control Works. This site is associated with the proposed Kromdraai collection pipeline route.
Site 3	Situated in an unnamed tributary of the Brugspruit at an existing bridge on a small dirt road. This site is associated with the Middelburg Steam and Station collection pipeline.
Site 4	Situated on the Brugspruit, between the R104 and the N4. This site is associated with Route Refinement 3 on the proposed distribution pipeline route to KwaGuqa.
Site 5	Situated in an unnamed tributary of the Brugspruit. The site is situated between the R104 and the N4 (along Route Refinement 1 of the proposed Kromdraai collection pipeline route).
Site 6a	Situated on the Brugspruit, between the R104 and the N4 (along Route Refinement 2 of the proposed Kromdraai collection pipeline route).
Site 7	Situated in the Naauwpoortspruit on an existing tar road in close proximity to the WR.
BS	Situated in the Blesbokspruit, downstream of the Middelburg Steam and Station Collieries decant.
KS	Situated in the Kromdraaispruit on the Vosman Road downstream of the Kromdraai Liming Plant discharge point.

The results of the survey can be summarised as follows:

- The water bodies associated with the proposed pipeline routes are already in an impacted state;
- Based on *in situ* water quality analysis, the pH value at Site 1, Site 3, BS and KS were acidic. Dissolved oxygen was below guideline values at all sites except site KS. Total dissolved solid concentrations were high at sites 3, BS and KS, contributing to the severely impaired biotic integrity recorded within the area;
- The water bodies within the study area have poor habitat availability. The absence of adequate Stones-In-Current habitat and increased channelisation contribute to the poor habitat availability at the sites. Poor habitat availability is a limiting factor for aquatic macroinvertebrate diversity at all sites;
- Biotic integrity at the sites range from moderately impaired to very seriously impaired;
- No fish species were recorded at any of the sites; and
- No endangered or vulnerable aquatic species were found at any of the sites.

For details, refer to APPENDIX J.

3.11 Wetlands

A wetland assessment was undertaken as part of the EIA (APPENDIX K). The main objectives of the wetland study were to delineate and classify the wetlands in the study area, assess the integrity and importance of the wetlands, and propose suitable mitigation measures.

Sixteen sites were selected; these sites are either associated with proposed pipeline/watercourse crossings or stand to be impacted as a result of reduced discharges (see Figure 2 of APPENDIX K and Table 9 below).

Table 9: Location of wetland assessment sites

Site	Description
WC 1	This wetland forms part of the Klipspruit. A mine service road runs across the wetland at the point of the proposed pipeline crossing site (Kromdraai collection pipeline route).
WC 2	This wetland forms part of the Brugspruit. The site is situated next to the Brugspruit Water Pollution Control Works; a formal settlement is located upstream. Mining activities are taking place to the west of the wetland (Excelsior Section of Landau Colliery). This wetland is associated with the proposed Kromdraai collection pipeline route.
WC 3	This wetland is situated on an unnamed tributary of the Brugspruit. This wetland is associated with the Middelburg Steam and Station collection pipeline. A small dirt road crosses the channel with culverts beneath it.
WC 4	This wetland forms part of the Brugspruit and is situated between the R104 and the N4 (along the proposed distribution pipeline to KwaGuqa). Two roads currently cross the wetland.
WC 5	This wetland is a tributary of the Brugspruit. The wetland is situated between the R104 and the N4 (along the proposed distribution pipeline to KwaGuqa and Kromdraai collection pipeline). Two roads currently cross the wetland.
WC 6 (original)	This wetland is a tributary of the Brugspruit. The wetland is situated between the R104 and the N4 (along the proposed distribution pipeline to KwaGuqa and Kromdraai collection pipeline). At site WC6, building material and rubble has been dumped on the channel edge where the road crosses the wetland. An artificial channel has been constructed next to the wetland to collect storm flows.
WC 6 (route refinement)	This wetland is a tributary of the Brugspruit. It is a route refinement of WC 6 (Route Refinement 3 along the proposed distribution pipeline to KwaGuqa).
WC 7	During the site visit, it was evident that there was no functioning wetland present at this site. There may have been a wetland located at this site in the past as the soils suggest temporary zones, but no other evidence of an existing wetland was found during the survey.
WC 8	This wetland forms part of the Klipspruit. This very broad wetland is situated in between the Navigation Section of Landau Colliery, cultivated areas, roads, and a conveyor belt. The wetland is associated with the proposed Navigation and Kromdraai collection pipelines.
WC 9	This wetland is associated with the proposed Kromdraai collection pipeline near the Navigation Section of Landau Colliery. The wetland is crossed by an existing road. This wet area has been degraded by crop cultivation.
BS	This wetland forms part of the Blesbokspruit. The reason for the permanent inundation is due to decant of water from the Middelburg Steam and Station Collieries.
BS seep	This wetland forms part of the Blesbokspruit. The site is situated adjacent to Site BS and is not influenced by the decanting water as the source of water to the wetland is seeping from higher up on the slope.
KS	This wetland forms part of the Kromdraaispruit and is located downstream of the discharge from the Kromdraai Liming Plant.
WC 10	This wetland (dam) is associated with the proposed distribution pipeline to Reservoir B. The wetland has been heavily impacted upon by grazing and

Site	Description
	anthropogenic disturbance. It is also situated in very close proximity to subsided areas due to underground coal mining activities. This wetland was possibly created as a water source for cattle.
WC 11	This site is associated with the proposed distribution pipeline to Reservoir B. This site was found to be heavily impacted upon. The soils did not show any sign of wetland soils, and instead consisted of fine coal up to a depth of 50 cm, with a layer of red soil on top. No running surface water was found to indicate a functioning wetland and the channel was overgrown with *Eucalyptus camaldulensis*. The channel is possibly an artificial furrow that was constructed to drain water into the wetland situated further downstream.
WC12	This wetland is associated with the proposed distribution pipeline to Reservoir B. A pipeline runs through the middle of the pan with the northern section having a high integrity and the southern section having a lower integrity. Existing roads and small man-made structures cross the pan.

The findings of the wetland baseline assessment are as follows

- Most of the floral species found within the sites are indicative of disturbed habitats;
- The Present Ecological Status of the Sites KS, WC 5, 6, 10 and 11 is below the acceptable range. These wetlands have been seriously modified with extensive loss of natural habitat. The hillslope seep at site BS is mostly unmodified with natural conditions remaining. The remaining wetlands are all moderately modified;
- Sites WC 5, 6, 10 and 11, and the valley bottom at site BS, are not considered be ecologically important or sensitive. The hillslope seep at site BS is considered to be an ecologically important and sensitive wetland. The remaining wetlands are ecologically important and sensitive only at a provincial or local scale;
- The habitat integrity of all the channelled wetlands has been moderately to largely modified. A loss of natural habitat and biota has occurred at the wetlands associated with the project;
- Sites WC2 and the hillslope seep at site BS scored “very high” for natural services with unmodified natural conditions. The valleybottom wetland at site BS has a large loss of basic ecosystem functions. The remaining wetlands have a moderate loss of natural services and functions; and
- The human services at sites WC3 and WC9 are outside of the acceptable range with people rarely relying on or benefitting from these wetlands. Sites KS, WC8, WC10 and WC12 (South) scored “low” with people having low dependency on this wetland. The remaining wetlands occasionally benefitted local people.

For more details, see APPENDIX K.

3.12 Sensitive landscapes

Sensitive habitats

As part of the terrestrial ecology study (APPENDIX I), sensitive areas where defined as follows:

- Low sensitivity areas with a low ecological integrity. These areas have been severely impacted by anthropogenic sources and are dominated by exotic species. The conservation importance and ecological function of these areas are identified as low. Regions such as urban/rural development and industrial complexes fall into this category;

- Moderate sensitivity areas which include areas such as secondary grassland. The ecological integrity is not as degraded as low sensitivity areas. Habitat capabilities are high and the conservation importance is considered to be moderate due to the possible presence of protected or endangered species; and
- High sensitivity areas which include wetlands and ridges. The ecological functioning and conservation importance of these sites are high.

Most sections of the proposed pipeline routes either fall within the low or moderate sensitivity areas. One section of the proposed Kromdraai collection pipeline route is considered to be a high sensitivity area. This section is located just north of the N4 highway and is rated as highly sensitive due to the presence of a protected floral species, namely *Brunsvigia radulosa*.

Wetlands

As indicated in Section 3.11 above, the hillslope seep at site BS was considered to be an ecologically important and sensitive wetland. This wetland will, however, not be affected by the proposed project in terms of proposed pipeline routes and/or reduced discharge volumes.

3.13 Sites of cultural / historical importance

A Phase I Heritage Impact Assessment (HIA) for the expansion of the existing eMalahleni Mine Water Reclamation Scheme was done in accordance with Section 38 of the National Heritage Resources Act (No. 25 of 1999) (APPENDIX L).

As part of the assessment, a brief literature survey relating to the pre-historical and historical context of the study area was conducted. Based on the result of the literature survey, the following heritage resources may exist in the study area:

- Stone Age sites, rock paintings and engravings;
- Stone tools;
- Small, inconspicuous stone walled sites from the Late Iron Age farming communities such as the Sotho, Swazi and Ndebele;
- Farmsteads and dwellings built during the second half of the 19^{th} century and well into the early 20^{th} century from a wide variety of stone types, including sandstone, ferricrete ('ouklip'), dolerite ('blouklip'), granite, shale and slate. These structures are considered to be part of a unique stone based architectural heritage;
- Farm homesteads with outbuildings that may be older than sixty years; and
- Formal and informal graveyards.

To determine whether any of the above heritage resources stand to be affected by the proposed expansion project, the proposed mine water collection and treated water distribution pipeline routes as well as stands for pump stations and other components for the proposed expansion of the eMalahleni Mine Water Reclamation Scheme were surveyed using a vehicle, while selected, sensitive spots or stretches along the pipelines routes were surveyed on foot.

The survey revealed that no heritage resources of significance occur within the study area or stand to be affected by the proposed project. For more details, refer to APPENDIX L.

3.14 Environmental noise

The primary character of the study area along the proposed collection pipeline routes is rural, interspersed with mining activities. Ambient noise levels are therefore fairly low. The proposed distribution pipeline route to KwaGuqa Reservoir is, however, located adjacent to the N4/N12 Highway and is therefore surrounded by the existing noise impacts from the highway. The proposed distribution pipeline route to Reservoir B is predominately located in rural areas; ambient noise levels are therefore low. The section of the distribution pipeline between Reservoir B to Reservoir A is however, located adjacent to roads in urban residential areas where ambient noise levels have already been impacted.

The location of the WRP is surrounded by the existing noise impacts from the N4/12 Highway to the south and the Greenside Colliery Rapid Load-out Terminal (RLT) directly to the north. Ambient noise levels are further impacted by mining activities of Greenside and Kleinkopje Collieries and Navigation Section of Landau Colliery that all occur within 3 km of the WRP site. Golder (2005)

3.15 Visual aspects

The study area is characterised by mining activities from Greenside Colliery, Kleinkopje and Landau Colliery. Industries in the area, such as Highveld Steel, further contribute to the background industrial visual environment. The discard dumps, mine infrastructure, and Rapid Load-out Terminal are particularly prominent visual features in the study area, especially to commuters travelling along the N12 and N4 highways into eMalahleni. Golder (2005)

The N12 highway is the major receiving feature of any visual impact in the study area (specifically during the construction of the distribution pipeline to KwaGuqa Reservoir). Along this route, however, vehicles are travelling at an average of 100 – 120 kilometres per hour and their occupants will be exposed to the visual impact for a short period of time only.

The proposed distribution pipeline route from Reservoir B to Reservoir A will be located adjacent to roads in urban residential areas, e.g. Woltemade Street, Christiaan de Wet Street, and Nicol Street. These roads will be major receiving features of visual impacts during pipeline construction.

3.16 Air quality

The main sources of pollutants in the Mpumalanga Highveld region are power stations, petrochemical plants, small industries, domestic combustion, motor vehicles, smouldering coal-discard dumps and veld burning. Pollutants emitted by these sources include sulphur dioxide, nitrogen oxides, carbon monoxide, hydrocarbons and carbon dioxide. The atmospheric conditions in the Highveld region are not conducive to the rapid dispersion of pollutants, particularly in winter. A high-pressure system prevails over the region and results in high atmospheric stability, clear skies and low wind speeds. Surface inversions occur often in winter and elevated inversions are common. Moist, unstable conditions and rainfall, which promote dispersion and deposition of pollutants, are confined almost exclusively to the summer period.

Golder (2005)

3.17 Socio-economic

The study area for the proposed project is located in the eMalahleni Local Municipality (ELM), situated in the Nkangala District Municipality. The ELM can be described as an urban and rural area, consisting of large farms, dispersed urban settlements, coal mines and power stations. The project area spans a large part of the municipality, encompassing eMalahleni City, Lynville, Clewer, KwaGuqa and Paxton, as well as more rural areas to the north.

The eMalahleni economy is dominated by the electricity sector and mining activities; the main contributors to the GGP of the area. As can be expected from a predominantly mining area, the largest employment sector in the study area is mining and quarrying (13%) The bulk of the population in eMalahleni is urbanised with only 11 % of the population residing in the non-urban areas.

Statistics for age distribution, education and employment indicate a degree of in-migration into eMalahleni LM as the municipality reports a higher percentage population of working age, higher education levels and lower unemployment levels than the wider district and provincial areas. This data suggests that skills levels may be high in the area and recruitment for employment opportunities should take advantage of this.

Perhaps due to the level of in-migration into the area, the ELM Integrated Development Plan (IDP) notes that one of the most prominent challenges facing the municipality is the housing backlog in the area. Although the majority (57 %) of households live in a house or brick structure on a separate stand or yard, 27% of households in the ELM are recorded as being in informal dwellings in informal settlements.

Affected Landowners

Based on a 20 m buffer zone during the Construction Phase and a 10 m buffer zone during the Operational Phase of the project, affected landowners were identified and consulted. The majority of land affected by the proposed project is owned by Anglo, with other portions belonging to the eMalahleni Local Municipality, the Republic of South Africa, SANRAL, Transnet and Samancor Ltd. Interviews were conducted with key representatives of these organisations to identify social concerns and issues in order to further predict potential impacts relating to the project. All representatives had a good knowledge and understanding of the proposed project and had a positive reaction to the expansion, seeing the provision of clean water to communities as essential. A total of four private landowners have been identified as potentially affected by the proposed project, and interviews revealed a generally positive response to the project. However, concerns were raised over the level of disruption pipeline construction activities may have in urban residential areas, particularly along the proposed distribution pipeline to Reservoir A.

See APPENDIX M for full details.

Also, see the map set and property register which accompany this report (on CD).

4.0 NEED AND DESIRABILITY FOR THE PROPOSED PROJECT

The proposed eMalahleni Mine Water Reclamation Expansion Project will:

- Reduce negative environmental impacts associated with excess mine water from contributing mines; and
- Produce positive impacts in terms of additional local water supply.

4.1 Excess Mine Water

- The Kromdraai and Excelsior Sections of Landau Colliery will be approaching closure in 2017; a long-term pre-and post-closure water management plan is required for these mines.
- At the defunct Middelburg Steam and Station Collieries, excess mine water is decanting on surface; the decant reports to a number of evaporation dams located adjacent to the Blesbokspruit. These dams are only evaporating a portion of the decant water with the remaining water flowing into the Brugspruit (via the Blesbokspruit). Greenside Colliery (of Anglo) carries the environmental responsibilities for two of these mines, namely the Middelburg Steam and Station Collieries, and would like to develop a permanent water management plan for this colliery.
- Future mining at the Navigation Section of Landau Colliery, will result in excess mine water, which will need to be managed.

The proposed eMalahleni Mine Water Reclamation Expansion Project will be the solution in terms of water management for each of the above-mentioned mines.

4.1.1 Kromdraai and Excelsior Sections of Landau Colliery

Golder conducted a feasibility study for the long term management of water for the Kromdraai and Excelsior Sections of Landau Colliery. As part of this study, a water balance model was developed (APPENDIX A). The model was capable of simulating the following:

- Runoff and recharge based on current soil and land cover data;
- Impact of life of mine progression on mine water make; and
- Storage and pumping options associated with the water levels in the various in-pit pond areas.

Water management at the Kromdraai and Excelsior Sections of Landau Colliery is an important aspect of the mine's operations from both an environmental and operational perspective. At Kromdraai, opencast coal mining is currently being undertaken. The same coal reserve was previously mined underground by Coronation Colliery using the bord-and-pillar method.

There are currently three operational opencast pits at Kromdraai, namely the Central Pit, South Pit and the Excelsior block pit. Mining in the North Block has been completed; this block is currently being rehabilitated. (The mentioned blocks are indicated in Figure 11: Central Pit – "C", South Pit – "S", Excelsior – "E" and North – "N").

The mining method at Kromdraai and Excelsior has a bearing on the volume of water that requires treatment. Water flows into the mine workings are assumed to be mainly from surface ingress of rainwater as mining progresses.

A liming plant at Kromdraai neutralises water that is pumped out of the opencast pits and old workings. On average, the liming plant treats in the region of 10 000 m^3/day of water pumped from the pits and advance dewatering of the old underground workings.

The main storage areas and possible future pumping points were identified by Hodgson (2009a) (Figure 11). Table 10 gives the contributing areas, storage volumes and expected dates when mining is completed.

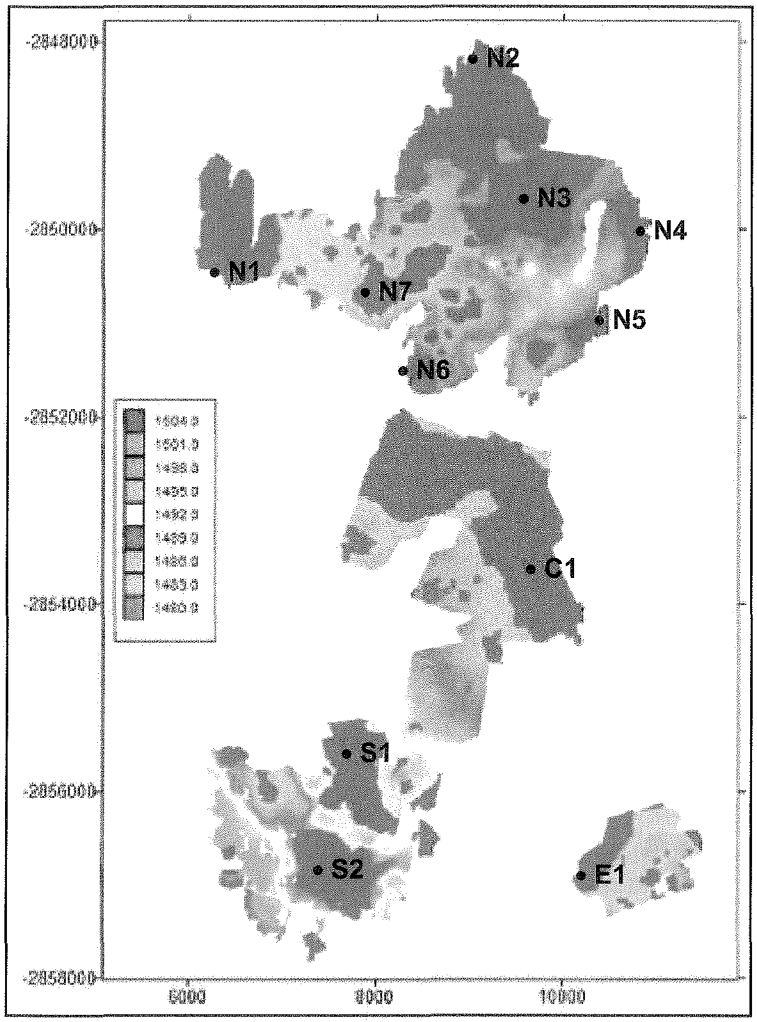


Figure 11: General plan of Kromdraai and Excelsior Sections of Landau Colliery showing the location of the main storage areas and proposed pumping points (Hodgson, 2009a)

Table 10: Data used for in the water balance around the respective low pit areas at Kromdraai and Excelsior

	Mining areas contributing water (m^2)	Storage volume (m^3)	Lowest floor levels (masl)	Mining completion date
N1	1 006 000	1 540 000	1 445	Completed
N7	1 453 000	243 000	1 462	Completed
N6	1 006 000	154 000	1 470	Completed
N4	2 014 000	192 000	1 470	Completed
N2	1 608 000	1 320 000	1 462	Completed
N3	1 308 000	222 000	1 462	Completed
N5	260 000	40 500	1 476	Completed
C1	4 895 000	8 300 000	1 445	2017
S2	1 353 000	380 276	1 484	2017
S3	1 558 000	497 900	1 482	2013
E3	1 076 000	614 000	1 458	2016

A water balance modelling tool for Kromdraai was developed in Goldsim software to simulate the current and future (post closure) water system. The water management model includes water flows associated with the mining operations and the surface water reticulation. The model predicts recharge of rainfall to the workings allowing prediction of pumping rates.

Areas within the pits with large storage capacity are referred to as in-pit pond areas. When these areas are full of water they spill over to the adjacent in-pit areas or decant to the environment. Pumping rates are specified for in-pit pond areas from which water may decant to the environment. Three control levels with different pumping rates are specified in the model. Different pumping rates are used in order keep the carbonaceous backfill discard material covered with water as much as possible without allowing decant or seep to the environment.

From the modelling results, the following can be concluded:

- Available data indicates that in-pit pond areas N2, N3, N5 and N7 do not require pumping as overflows could effectively be pumped away at lower lying in-pit pond areas;
- Water levels for in-pit pond area N6 may be controlled at N7 as there is a larger balancing volume to be used and any excess decant from N6 which should then be minimal could be gravity fed to the central collection point;
- Recharge is determined to be 30 % of rainfall which may be reduced by improving rehabilitation to increase the fraction of runoff;
- Mine water make is in the order of 10 Mℓ/day (average);
- In-pit pond area C1 has sufficient storage to allow constant pumping rates for long periods of time; and
- In-pit pond area N4 has insufficient storage and may decant. The decant may collect in the Dixon Dam and be pumped separately.

The following average pumping rates from the pits were determined using the model:

- 4.7 Mℓ/day from the 3 in-pit ponds in North Pit;
- 1.85 Mℓ/day from the 2 in-pit pond areas in South Pit; and
- 0.6 Mℓ/day from the 1 in-pit pond area in Excelsior.

The water from North, South and Excelsior in-pit ponds will be pumped to the in-pit pond in the Central Pit, which has a storage capacity of 8.3 million m^3. The average volume pumped from the Central Pit for treatment was captured to be 9.85 Mℓ/day. This pump rate is the total, which includes the pumping from other pits.

4.1.2 Middelburg Steam and Station Collieries

Middelburg Steam and Station Collieries (MSSC) is a defunct colliery that was mined using bord-and-pillar underground mining methods in the 1970s. Decant flows from the mine are currently discharging into the Brugspruit. Figure 12 shows the location of the mining area and decant point. A series of evaporation ponds was built to capture and evaporate the decant water. These dams are only evaporating a portion of the decant water with the remaining water flowing into the Brugspruit (via the Blesbokspruit).

Golder carried out supplemental monitoring at MSSC to determine the volume of water decanting from MSSC. This data was used to determine the mine water make of MSSC, which was calculated at 1.94 Mℓ/day (average per day). From the data measured a peak pumping rate of 3.8 Mℓ/day may be expected.

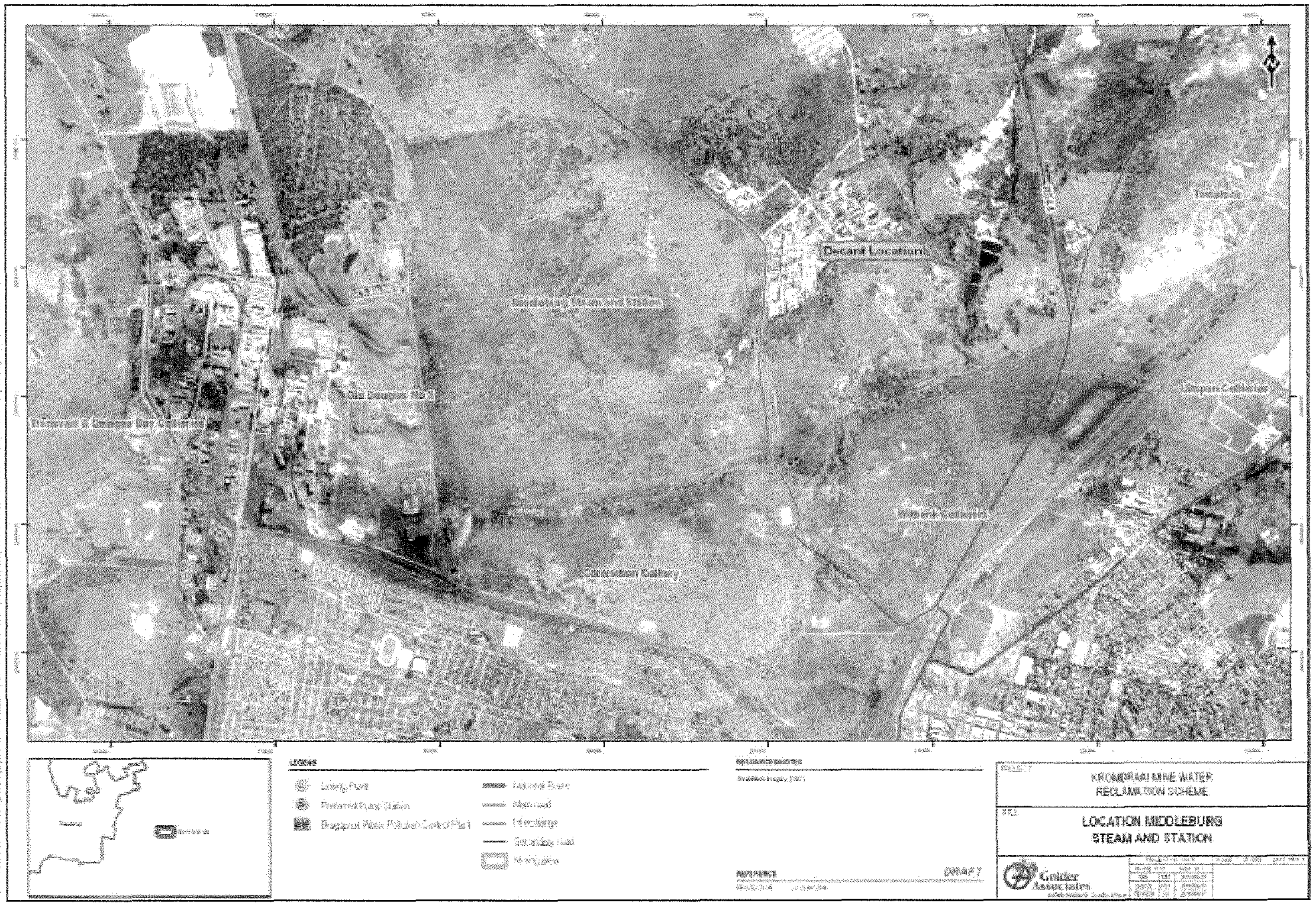


Figure 12: Location of Middelburg Steam and Station Collieries underground mining area and decant point

4.1.3 Navigation Section of Landau Colliery

Hodgson (2009b) developed a mine water balance for the South African Coal Estates (SACE) Complex, which includes the Navigation Section of Landau Colliery. The model indicates that water make at Navigation will increase significantly between 2014 and 2016 (Figure 13). This is due to the planned dewatering of the 2 seam underground workings at Navigation.

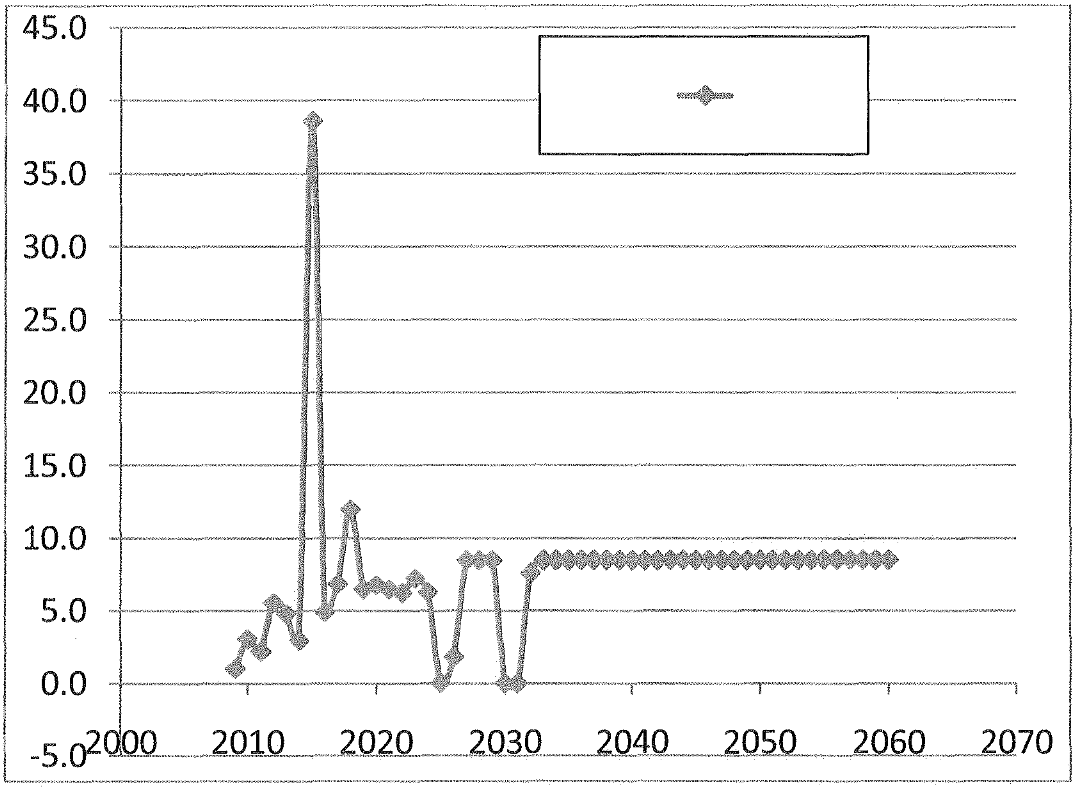


Figure 13: Modelled excess mine water at Navigation, excluding water used locally at the mine (Hodgson, 2009b)

Based on the model results, Hodgson (2009b) suggests a pumping rate of approximately 18 Mℓ/day during this period (i.e. between 2014 and 2016). Thereafter, an average pumping rate of ± 8 Mℓ/day can be expected.

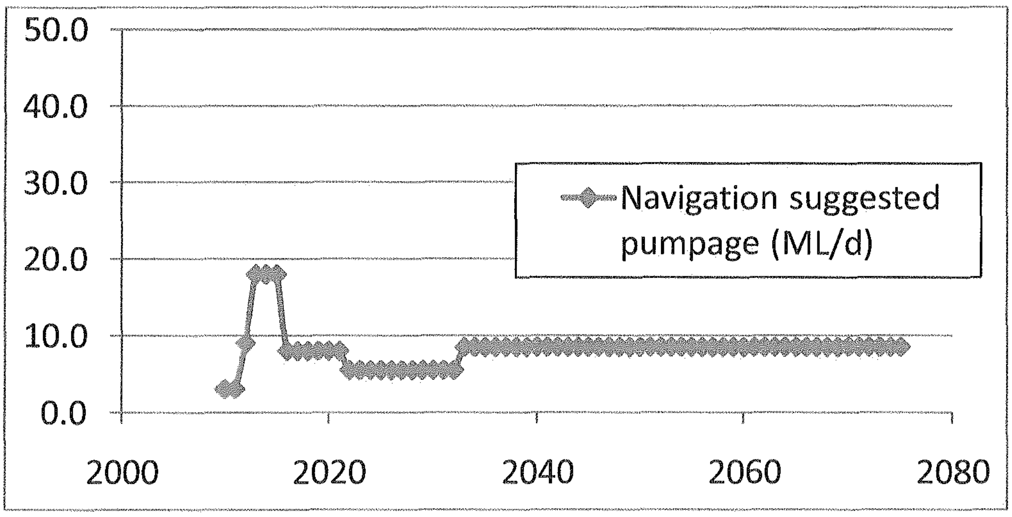


Figure 14: Suggested mine water pumping rates at Navigation (Hodgson, 2009b)

4.2 Municipal water requirements

During the pre-feasibility study (2009), an investigation was conducted to get an understanding of the local water markets to aid the feasibility of the proposed expansion project (APPENDIX P) . The following aspects were considered:

- Draft Upper and Middle Olifants River Water Resources Development Plan to confirm the future water requirements by different user sectors in the relevant catchments;
- eMalahleni Stategic Development Framework residential and industrial / commercial growth areas;
- eMalahleni and Nkangala Water Master Plans;
- Local water requirements; and
- Historic and current water tariffs for the residential and industrial/commercial sectors in the area.

As outlined in APPENDIX P, the current water supply from the Witbank Dam and the eMalahleni WRP are as follows:

- Witbank Dam

  The dam has a volume of 104 Mm³ and an assured yield of 75 000 m³/d. (The 98 % assurance yield is 28 million m³/year (DWAF, 2009)). The allocated abstraction permits allow for the abstraction of 27.3 million m³/annum (74 794 m³/d, a volume already exceeded by *de facto* abstractions of up to 38.6 million m³/annum or approximately 106 000 m³/d (eMalahleni, 2006).

- eMalahleni Water Reclamation Project

  The WRP delivers 20 000 m³/d of treated water to the eMalahleni bulk supply system.

The total current water requirement of the eMalahleni Local Municipality is approximately 126 000 m³/d increasing to above 136 000 m³/d in 2015 (should water conservation and demand management be implemented) or by 2010, should this current situation continue.

The eMalahleni Local Municipality must therefore urgently develop a supplemental water supply to satisfy the requirements for domestic, industrial and commercial users.

The expansion of the existing Mine Water Reclamation Scheme has a number of positive features from the perspective of the Municipality:

- The expansion of the scheme will deliver additional potable water to the municipality, without any capital expenditure on the existing municipal water infrastructure;
- The potable water cost will be more affordable compared to the interbasin transfer from Vaal River water;
- The municipality and mines can partner to maximise the local benefits of the project in terms of job creation, investment in infrastructure and capacity building in water technology;
- A potential pollution threat in the form of decant mine water to the local water resources can be converted into a long-term sustainable water supply; and
- There is scope for additional modules to supply the long-term water shortfall to the Municipality.

4.3 Water Quality

The current water supply to eMalahleni is dependent on the intake water from Witbank Dam and the existing WRP. The current potable water quality is typically a South African National Standard (SANS) 241 Class 1 water. Class 1 is fit for lifelong consumption.

The untreated water in the mines is variable in terms of quality, depending on the specific mine of origin. In general, the mine water quality can be described as gypsiferous with high concentrations of calcium, magnesium and sulphate. The water treatment process will effectively remove all heavy metals in the raw water.

4.3.1 Mine water qualities

The additional mine water feed sources, i.e. Kromdraai and Excelsior, and Navigation Sections of Landau Colliery as from Middelburg Steam and Station Collieries, will be blended into the current feed to the WRP at the existing mine water storage dams, and the resulting blend will be treated by the upgraded WRP. The typical mine water quality from the additional mine water feed sources is reflected in Table 11.

Table 11: Mine water qualities of future feed water sources to the WRP (blend) in comparison to existing feed water sources (Keyplan, 2010)

Water Quality Parameter	Existing feed water concentration (75th percentile)	Future feed water blend typical concentration (75th percentile)
pH	3.48	2.75
Total dissolved solids(mg/L)	3 404.5	5 491.46
Suspended solids (mg/L)	82.08	162
Calculated Acidity (mg/L)	189	3 043.08
Calcium, Ca (mg/L)	523.5	279.3
Magnesium, Mg (mg/L)	266.8	149.3
Sodium, Na (mg/L)	68.04	32.2
Potassium, K (mg/L)	14.45	8.39
Chloride, Cl (mg/L)	22.1	21.95
Sulphate, SO_4 (mg/L)	2 476.6	4 028
Nitrate, NO_3 (mg/L)	14.92	2.92
Iron, Fe (mg/L)	18.67	765.4
Manganese, Mn (mg/L)	9.5	53.5
Aluminum, Al (mg/L)	18.89	144.2
Fluoride (mg/L)	0.2	0.2
Ammonia as N	5.32	29.79

In comparison to the quality of the existing feed water sources, the new feed water sources are more acidic, and have higher concentrations of iron, aluminium, and manganese. A number of process retrofits will be required to allow the current WRP to cope with the quality of the new feed blend.

4.3.2 Existing reclaimed (treated) water quality

The water reaching the eMalahleni Local Municipality will be of potable quality. The Water Reclamation Plant is specified to produce water of a quality that falls within the SANS 241 Class 1 standard: Class I is suitable for lifelong consumption. The WRP is fitted with online instrumentation to constantly monitor the product water quality. The product water is also stored batch-wise in reservoirs and quality tested again, before it is pumped to the municipal water supply reservoirs. Any water that does not comply with the standards is not added to the municipal water supply, but is recycled to the WRP for re-processing.

In the WRP, there is continuous on-line water quality monitoring of the following key parameters:

- Conductivity;
- Turbidity;
- pH;
- Temperature; and
- Chlorine residual.

This allows for immediate action should any of the key parameters indicate an unacceptable water quality.

Two grab samples per day (to reflect the water quality transferred to each of the potable water reservoirs) are analysed for a standard range of physical, chemical and microbiological parameters. An additional monthly sample is tested for an extensive range of physical, chemical and microbiological parameters. All analyses are done by an appropriately accredited laboratory.

The summary statistics of daily and weekly water quality analyses results for the period June 2008 to September 2009 with the relevant drinking water standards and guidelines are provided in the table below (Table 12). Values of parameters that exceeded the standards and guidelines are shaded.

Table 12: Reclaimed Water Quality of existing WRP – Physical and Chemical

Water Quality Parameter	Mean Value	99th Percentile	SANS Limit Class 1	Guideline	Guideline Reference
pH	7.9 (median)	10.0	5.0 – 9.5	6.5 – 8.5	DWAF 1996
Conductivity (mS/m)	20.1	37.2	<150 (t/a)	70 (t/a)	DWAF 1996
Turbidity (NTU)	1.4	7.9	<1 (t/a)	<1 (t/a)	DWAF 1996
Total Alkalinity (as $CaCO_3$) (mg/ℓ)	12.8	24.4	Not regulated	100-200	DWAF 1996
Colour (Pt-Co)	6.2	42.6	<20 (t/a)	<15 (t/a)	DWAF 1996
Total Dissolved Solids (mg/ℓ)	122	231	<1000 (t/a)	<450 (t/a)	DWAF 1996
Suspended Solids (mg/ℓ)	1.9	17.6	Not regulated	Quantitative criteria not prescribed	DWAF 1996
Ammonia as N (mg/ℓ)	1.17	3.6	<1	<1	DWAF 1996
Nitrate and Nitrite as N (mg/ℓ)	2.7	5.2	<10	11 (t/a)	WHO 2006
Sulphate as SO_4 (mg/ℓ)	43.6	103	<400	250 (t)	USEPA 2006
Sodium as Na (mg/ℓ)	20.8	40.8	<200	30 (t)	USEPA 2006
Calcium as Ca (mg/ℓ)	10.1	24.3	<150	200 (t)	WHO 2006
Magnesium as Mg (mg/ℓ)	0.84	3.06	<70	100 (t)	WHO 2006
Potassium as K (mg/ℓ)	4.4	9.2	<50	100 (t)	DWAF 1996
Zinc as Zn (mg/ℓ)	0.04	0.34	<5	10	DWAF 1996
Manganese as Mn (mg/ℓ)	0.01	0.04	<0.1	5 (health), 0.1 (t/a)	DWAF 1996
Aluminium as Al (mg/ℓ)	0.02	0.12	<0.3	<0.15	DWAF 1996
Iron as Fe (mg/ℓ)	0.01	0.14	<0.2	0.1	DWAF 1996
Barium as Ba (mg/ℓ)	0.013	0.07	Not regulated	0.5	WHO 2006
Antimony as Sb (mg/ℓ)	0.004	0.01	<0.01	0.021	WHO 2006
Arsenic as As (mg/ℓ)	0.007	0.01	<0.01	0.01	DWAF 1996
Cadmium as Cd (mg/ℓ)	0.002	0.003	<0.005	0.005	DWAF 1996
Chromium as Cr (mg/ℓ) (assumed to be total Cr)	0.00.7	0.01	<0.1	0.05	WHO 2006

Water Quality Parameter	Mean Value	99^{th} Percentile	SANS Limit Class 1	Guideline	Guideline Reference
Cobalt as Co (mg/ℓ)	0.007	0.01	<0.5	0.05	WHO 2006
Copper as Cu (mg/ℓ)	0.008	0.03	<1	1	DWAF 1996
Lead as Pb (mg/ℓ)	0.007	0.01	<0.02	0.01	DWAF 1996
Mercury as Hg (mg/ℓ)	0.001	0.001	<0.001	0.001	DWAF 1996
Nickel as Ni (mg/ℓ)	0.007	0.01	<0.15	0.07	WHO 2006
Selenium as Se (mg/ℓ)	0.007	0.01	<0.02	0.02	DWAF 1996
Vanadium as V (mg/ℓ)	0.007	0.01	<0.2	0.1	DWAF 1996
Chloride as Cl (mg/ℓ)	13.3	21	<200	250	USEPA 2006
Fluoride as F (mg/ℓ)	0.14	0.23	<1	2	USEPA 2006
Phenols (mg/ℓ)	0.004	0.005	<0.01	<0.01	DWAF 1996

Values or concentrations that exceed the SANS limit are shaded. If a SANS limit is not proposed, the concentration was compared with the listed guideline

t/a – the guideline is based on a taste threshold or other undesirable aesthetic effects

t – the guideline is based on a taste threshold

Except for pH, turbidity and ammonia (NO_3 as N), all of the recorded water quality parameters were within the limits prescribed by the SANS, WHO or DWAF. The pH of water does not have direct health consequences except at extreme levels (APPENDIX B). The median pH of all samples was 7.9, and the pH of less than 10 % of the samples exceeded the SANS standard of 9.5 for Class 1 water (the 90^{th} percentile was 9.4). Considering these results, the recorded exceedances of the SANS standards do not present a health risk. Turbidity is not directly related to health issues and ammonia is not of health significance at the recorded concentrations. However, exceedances of the guidelines might affect the acceptability of the final product to consumers, because of the negative aesthetic (visual) and/or organoleptic properties (i.e. perception by a sensory organ) at the reported concentrations.

The June 2008 to August 2009 results of the daily microbiological analyses results are indicated in Table 13. The relevant drinking water standards and guidelines are also included in Table 13. Values of parameters that exceeded the standards and guidelines are shaded.

Table 13: Reclaimed water quality of existing WRP – microbiological

Parameters	Statistical Results				SANS241:2005	Guideline	Guideline Reference
	Minimum	Median	95^{th} percentile	Maximum			
Total coliform bacteria / 100 mℓ	0	0	0	60	Not regulated	0 - 5	DWAF 1996
Faecal coliform bacteria / 100 mℓ	0	0	0	30	Note detected in 95% of samples	0	
Heterotrophic plate count / mℓ	0	0	151	4 968	5 000 in 95% of samples	100	

SANS241:2005 – Limits for Class 1 water

Median – Parameter value for 50% of water samples

95th percentile – 95 per cent of the water samples had a result equal to or less than the given value

The results in Table 13 indicate the microbiological quality of the product water is acceptable and within the guidelines for SANS Class 1 water. The maximum number of coliform bacteria was 60 per 100 mℓ, but this occurred only once in a daily water sample from June 2008 to August 2009.

The results of recent (2009-2010) radiological analyses results are indicated in Table 14. Gross alpha and beta counts as well as radionuclide-specific activities are presented in the below table.

Table 14: Reclaimed water quality of existing WRP – radiological

Gross Radioactivity				
Samples	**Activity concentration in mBq/litre**	**SANS241:2005**	**Guideline in mBq/litre**	**Guideline Reference**
Alpha activity in mBq/litre	-57*	Not regulated	500	WHO 2006
Beta activity in mBq/litre	110	Not regulated	1 000	

Radionuclide-specific activity			
Radionuclide	**Activity in mBq/litre**	**Guideline in mBq/litre**	**Guideline Reference**
U-238	9.35	10 000	WHO 2006
U-234	17.0	10 000	WHO 2006
Th-230	69.1	1 000	WHO 2006
Ra-226	0.28	1 000	WHO 2006
Pb-210	1.1**	100	WHO 2006
Po-210	1.1	100	WHO 2006
U-235	0.431	1 000	WHO 2006
Th-227	6.20	10 000	WHO 2006
Ra-223	4.3	1 000	WHO 2006
Th-232	6.18	1 000	WHO 2006
Th-228	1.3	1 000	WHO 2006
Ra-224	2.16	1 000	WHO 2006

** Negative radioactivity values indicate that the activity recorded in the water sample during analysis was not significantly higher than background activity*

*** The result was not available at the time of compilation of this report, but the value was estimated based on the Po-201 value. It is reasonable to assume that the radionuclide-specific activity of Pb-210 will be approximately equal to the activity of P0-210.*

It is clear from Table 14 that the screening radioactivity parameters (alpha and beta radiation) and the activities associated with each of the individual radionuclides detected in the water sample submitted for radiological assessment were all less than guideline activity concentrations. Radioactivity detected in the product water therefore does not present a potential health hazard.

4.3.3 Future reclaimed (treated) water quality subsequent to the proposed expansion

The future concentrations of various constituents in the final product water were estimated (modelled) based on weighted flows for the additional feed water sources. The estimated concentrations are presented in Table 15. A number of heavy metals were not included in the model; these are indicated as "not modelled" in the table. Microbiological and radiological parameters were also not modelled.

Table 15: Estimated reclaimed water quality of subsequent to proposed expansion project – chemical and physical

Water Quality Parameter	Estimated Value	SANS Limit Class 1 (Ideal)	Guideline	Guideline Reference
pH	5.44	5.0 – 9.5	6.5 – 8.5	DWAF 1996
Ammonia as N (mg/ℓ)	Not modelled	<1	<1	DWAF 1996
Nitrate (mg/ℓ)	8.3	<10	11 (t/a)	WHO 2006
Nitrate as N (mg/ℓ)	1.9	<10	11 (t/a)	WHO 2006
Sulphate as SO_4 (mg/ℓ)	117.1	<400	250 (t)	USEPA 2006
Sodium as Na (mg/ℓ)	45	<200	30 (t)	USEPA 2006
Calcium as Ca (mg/ℓ)	9.2	<150	200 (t)	WHO 2006
Magnesium as Mg (mg/ℓ)	4.7	<70	100 (t)	WHO 2006
Potassium as K (mg/ℓ)	10.8	<50	100 (t)	DWAF 1996
Zinc as Zn (mg/ℓ)	Not modelled	<5	10	DWAF 1996
Manganese as Mn (mg/ℓ)	0	<0.1	5 (health), 0.1 (t/a)	DWAF 1996
Aluminium as Al (mg/ℓ)	0	<0.3	<0.15	DWAF 1996
Iron as Fe (mg/ℓ)	0	<0.2	0.1	DWAF 1996
Barium as Ba (mg/ℓ)	Not modelled	Not regulated	0.5	WHO 2006
Antimony as Sb (mg/ℓ)	Not modelled	<0.01	0.021	WHO 2006
Arsenic as As (mg/ℓ)	Not modelled	<0.01	0.01	DWAF 1996
Cadmium as Cd (mg/ℓ)	Not modelled	<0.005	0.005	DWAF 1996
Chromium as Cr (mg/ℓ) (assumed to be total Cr)	Not modelled	<0.1	0.05	WHO 2006
Cobalt as Co (mg/ℓ)	Not modelled	<0.5	0.05	WHO 2006
Copper as Cu (mg/ℓ)	Not modelled	<1	1	DWAF 1996
Lead as Pb (mg/ℓ)	Not modelled	<0.02	0.01	DWAF 1996
Mercury as Hg (mg/ℓ)	Not modelled	<0.001	0.001	DWAF 1996
Nickel as Ni (mg/ℓ)	Not modelled	<0.15	0.07	WHO 2006
Selenium as Se (mg/ℓ)	Not modelled	<0.02	0.02	DWAF 1996
Vanadium as V (mg/ℓ)	Not modelled	<0.2	0.1	DWAF 1996
Chloride as Cl (mg/ℓ)	19.6	<200	250	USEPA 2006
Fluoride as F (mg/ℓ)	0.4	<1	2	USEPA 2006
Phenols (mg/ℓ)	Not modelled	<0.01	<0.01	DWAF 1996

The modelled substance concentrations are all within the SANS limits (Table 15). Consumption of potable water delivered by the expanded WRP is therefore not associated with potential health risks in the case of those substances for which modelled concentrations were available. Potential health risks associated with the other substances that were not modelled cannot be assessed with certainty. Keyplan (Pty) Ltd is of the opinion that the resultant water quality subsequent to the proposed expansion will not be worse than the quality before the expansion (APPENDIX B). If this is the case, ammonia may be a problem and may have a detrimental effect on consumer acceptability. However, the design of the expanded WRP includes the inclusion of a dedicated ammonia stripper. This should decrease the concentration of ammonia.

The heavy metals and radioactivity that were not modelled may be tentatively assessed based on the assumption that the resultant water quality subsequent to the expansion will not be worse than before the expansion. If this is indeed the case, the substances that were not modelled are not expected to result in significant health risks, provided that concentrations in the product water of the expanded WRP are not higher than concentrations measured in the current product water. The same applies to microbiological parameters.

4.4 Environmental Considerations

The mine water of the Mpumalanga Highveld Coalfields is characterised by high salinity, primarily constituted of calcium, magnesium and sulphate salts. The salinity contribution from other salts such as sodium and chloride is relatively small. The mine water in the Coalfield is therefore of a typical gypsiferous nature. Some of the mine water is also acidified with typical pH levels in the range of 2.8 – 3.4 (Table 11). Such acidic mine water typically has high metal concentrations, specifically iron, aluminium and manganese. The older mine workings produce acidic water and in many of the mines the long-term trend is towards slow, but steady acidification of the mine water (Middelburg Steam and Station Collieries).

The excess water in coal mines may accumulate to levels where it may overflow from the mine at a particular decant point. This water may cause substantial deterioration of groundwater and surface water quality in the catchment, and may seriously compromise the ecological integrity of surrounding aquatic systems. Although efforts are made by the mines to intercept this water at these decant points, it would be preferable to pump the water from the mines prior to decanting. This scheme presents such an opportunity, and furthermore the water may be treated and used to supplement the eMalahleni Local Municipality's water supply. The Kromdraai and Excelsior Sections of Landau Colliery will also generate decant mine water after closure. This project will ensure that water from all contributing mines will be intercepted, prior to decanting to surface water resources.

4.5 Financial Related Aspects

The methodology on how the costs associated with the eMalahleni Mine Water Reclamation Scheme are provided for is outlined in Sections 4.5.1 and 4.5.2 below.

4.5.1 Cost of post-closure water treatment

Each year the cost of planned closure and the cost of immediate closure, including water treatment costs, are determined for each (Anglo) mine as part of the annual budgeting cycle. Closure costs are calculated every three years by an independent consultant. This was last done during 2008 and will be repeated in 2011. For the years in-between, the costs are adjusted for inflation with the producer price index as well as for major changes in the mining plan.

Water treatment costs include operating costs, maintenance costs and replacement capital costs of plant infrastructure for a period of 20 years of water production. In calculating these costs, the following rules and assumptions are applied:

- A decision tree is used to determine the volumes of water that can be applied towards irrigation, that can be treated passively and that needs to be treated actively, respectively;
- As a rule, the plant will have been built during the operating life of a mine and the cost for the original plant is therefore excluded from post-closure treatment costs; the exception is when a mine has not built the original plant yet, in which case the cost of the original plant is included in the cost of immediate closure;
- Only treatment technologies feasible at the time of calculation are considered;
- All costs are in the ruling money value at the time of calculation; and

- Treatment costs are offset with income from the sale of the water only where an existing contract is in place; i.e. for the eMalahleni Mine Water Reclamation Plant, only the income from 20 Ml/day under the existing contract with the eMalahleni Local Municipality is taken into account.

The following factors are not taken into account:

- The time value of money, i.e. the value of monetary deposits made today will have increased by the time the mine closes;
- Advances in treatment technology pushing down the treatment costs between now and the time of mine closure;
- Income expected from future water supply contracts;
- Treatment of polluted water after closure will only start once the water in the mine has reached the decant level, a process that may take up to eleven years after closure; and
- It is expected that after the mine has filled up to the decant level, the quality of the decant will slowly improve, decreasing the cost of treatment.

The omission of the above factors in the calculation of the cost of water treatment after mine closure all result in a conservative cost estimate. In addition, when working with real interest rates (i.e. nominal rate minus inflation), any costs beyond the chosen 20 year horizon have a negligible effect on the present value of the liability. It is therefore highly likely that the provision for water treatment for 20 years will in reality be adequate to treat the water indefinitely.

4.5.2 Financial provision for post-closure water treatment

At the moment, two different mechanisms are used to provide for the cost of closure. These are:

- Environmental rehabilitation trusts in accordance with Section 10(1)(cH) of the Tax Act; and
- Bank guarantees from a registered South African bank.

The environmental rehabilitation trust is used to collect the cost of closure over the remaining life of the mine. The bank guarantee covers the shortfall between the balance in the trust and the cost of planned or immediate closure, whichever is greater, and is lodged with the Department of Mineral Resources.

5.0 ALTERNATIVES EXAMINED PRIOR TO AND DURING THE EIA

Section 29(1) of the EIA Regulations GN R385, dated April 2006, under the National Environmental Management Act, 1998 (Act 107 of 1998) stipulates that a Scoping Report must contain (b) "*a description of the proposed activity and any feasible and reasonable alternatives that have been identified*".

The project team has considered various operational and technical alternatives during the pre-feasibility and feasibility studies for the proposed project; these are outlined in Section 5.1.1.

A detailed corridor and route selection process in terms of environmental/social and technical/financial criteria was undertaken for the pipelines. The criteria and assessment methodology used during the route selection process is outlined in Section 5.1.6.1. The preferred pipeline routes (from an environmental/social perspective) are described in Sections 2.1.2 and 2.1.4. Route refinements (alternatives) to the pipeline routes identified during the scoping and EIA phases are indicated in Section 5.1.6.3.

Lists of directly affected properties and landowners associated with the preferred pipeline routes and route refinements are provided in the map set (which accompanies this report, on CD).

5.1 Alternatives Being Considered

5.1.1 Project scheme configuration

The pre-feasibility study initially investigated three main scheme configuration options and four sub-options, which included:

- Option 1(a) : Centralised water treatment of mine water to potable standards at a new WRP near the Brugspruit Water Pollution Control Works;
- Option 1(b): Centralised water treatment of mine water to potable standards at a new WRP near the existing Brugspruit Water Pollution Control Works, with pre-treatment at the Kromdraai Liming Plant;
- Option 2(a): Centralised water treatment of mine water to potable standards at the existing scheme's WRP, which would be expanded/upgraded to accommodate the additional water sources;
- Option 2(a)(1): Centralised water treatment of mine water to potable standards at the existing scheme's WRP, which would be expanded/upgraded to accommodate the additional water sources, with conveyance of mine water from Middelburg Steam and Station Collieries via South Witbank Colliery underground workings;
- Option 2(b): Centralised water treatment of mine water to potable standards at the existing scheme's WRP, which would be expanded/upgraded to accommodate the additional water sources, with pre-treatment of mine water at the Kromdraai Liming Plant and the Brugspruit Water Pollution Control Works (WPCW);
- Option 2(b)(1): Centralised water treatment of mine water to potable standards at the existing scheme's WRP, which would be expanded/upgraded to accommodate the additional water sources, with conveyance of mine water from Middelburg Steam and Station Collieries via South Witbank Colliery, and pre-treatment of mine water at the Kromdraai Liming Plant and Brugspruit WPCW; and
- Option 3: Distributed water treatment of mine water to potable standards at three new WRPs located at Kromdraai, the existing Brugspruit WPCW, and Middelburg Steam and Station Collieries.

A fatal flaw analysis eliminated the following options:

- Option 1(b), distributed pre-treatment plants is not viable from an operational, economy of scale and cost perspective;
- Option 1(a)(1), the conveyance of mine water via South Witbank Colliery was not considered viable from a contractual, legal, technical and engineering perspective;
- Option 2(b), distributed pre-treatment plants is not viable from an operational, economy of scale and cost perspective; and

- Option 2(b)(1), because the conveyance of mine water via South Witbank Colliery was not considered viable from a contractual, legal, technical and engineering perspective.

The three short-listed options were then optimised as indicated below, and assessed against qualitative, quantitative and risk criteria provided in Table 16:

- Option 1: Centralised treatment of mine water to potable standards at a new WRP located near the existing Brugspruit WPCP. Mine water from defunct non-Anglo mines will be treated separately to a standard suitable for discharge to the catchment;
- Option 2: Centralised treatment of mine water from Anglo mines to potable standards at the existing scheme's WRP (expanded/upgraded to accommodate the additional water). Mine water from defunct non-Anglo mines to be treated at a new WRP located near the existing Brugspruit WPCW to a standard suitable for discharge to the catchment; and
- Option 3: Distributed treatment of mine water from Anglo mines to potable standards at two new WRPs located at Kromdraai and at Middelburg Steam and Station Collieries; mine water from defunct non-Anglo mines to be treated at a new WRP located near the existing Brugspruit WPCW to a standard suitable for discharge to the catchment.

Table 16: Criteria used to assess the three short-listed project scheme configuration options

Assessment Type	Assessment Criteria
Qualitative Assessment	**Impacts and viability** ▪ Engineering ▪ Constructability ▪ Impacts (Environmental and Catchment Management Resources) ▪ Regulatory approvals ▪ Legal ▪ Operability **Anglo Corporate Requirements** ▪ Shareholder value (the scheme should not detract from current shareholder value) ▪ Reputation (the scheme should enhance the reputation of the corporation) ▪ SHE Policy /Anglo Environmental Way / Footprint (the scheme should as a minimum comply with the corporations Safety, Health and Environmental policies, and add credence to the company's sustainability initiatives) ▪ Closure liabilities (the scheme should minimise or eliminate associated closure liabilities) ▪ Social and labour best practices (the scheme should demonstrate adherence to current labour law) ▪ Corporate social investment (the scheme should comply with corporate social responsibility best practice standards) **Strategic considerations** Project / Business / Anglo Corporate
Quantitative Assessment	▪ Capital cost ▪ Operational and maintenance cost ▪ Life-cycle cost
Risk Assessment	▪ Risk profile and ranking

Based on the findings of the qualitative, quantitative and risk assessments, Option 2 was identified as the preferred project scheme configuration option, mainly due to the following reasons:

- Flexibility in terms of water quality and volume;
- Requires a less complex regulatory approval process;
- It is a brownfield project;
- Optimised waste generation;
- Its design can accept water of poor quality;
- It is aligned with Anglo Corporate requirements;
- It has a lower present cost;
- Meets regional requirements for mine closure and water demand; and
- Full implementation of the proposed expansion project can accommodate future requirements.

5.1.2 Institutional setup for the implementation of the scheme

It is important to note that prior to the implementation of the existing water reclamation scheme, alternative institutional models were considered.

In order to propose an appropriate institutional structure, it was necessary to identify the particular attributes required of the scheme to:

- Render it attractive to the various regulatory authorities, but in particular the Department of Water Affairs as the custodian of the national water resources;
- Receive support from the local Water Services Authority, eMalahleni Local Municipality; and
- Present a structure that allows for a measure of control over investment capital, as well as the contractual relationship(s) between the participating mines and the scheme lead agent and between the lead agent and receiving potable water users.

During a meeting held with the Department of Water Affairs in November 2004, criteria to facilitate and optimise management of the scheme were listed as:

- Autonomy and independence;
- Protection for investor capital;
- Involvement of Water Sources Authorities to ensure compliance with statutory obligations;
- Black Economic Empowerment;
- Establishment of a long term management vehicle for mine water, which will remain robust even after mine closure; and
- Development of a strategy comprising measures to ease/expedite licensing.

Interaction with regulatory authorities and further assessment of statutory requirements elucidated additional aspects affecting the comparative feasibility of the alternative institutional models. These additional aspects were incorporated in the institutional model evaluation.

A number of different institutional models were identified, including the following:

- Mines as lead implementing agent, acting through:
  - A water user association; and
  - A private water company.
- Local authorities acting as lead implementing agent through:
  - The local authority itself;
  - A municipal utility; and
  - A water board.
- Mines and local authorities collectively acting as lead implementing agents.

The alternative institutional models were screened, using the following evaluation criteria:

- Independence and autonomy;
- Protected capital investment;
- Simple model, with short supply chain,
- Water Services Authority actively involved;
- Promotion of BEE involvement;
- Long term viability;
- Simple and feasible licensing;
- Competency and available resources; and
- Ability to mobilise capital.

The screening was done in a qualitative manner and did not involve ranking of the model. The following system was used for rating the different models in terms of specific criteria:

- Poor performance, inability to meet requirements of the specific criterion (score = 1).
- Reasonably acceptable, will meet most requirements of the specific criterion (score = 2).
- Good performance in terms of meeting all success factors for the specific criterion (score = 3).

The screening of alternative institutional models indicated the following:

- Mines are best positioned to take the lead in launching a collective mine water collection, treatment and re-use scheme. The mines can readily mobilise resources and provide the seed capital investment. Local authorities are constrained on both these aspects;
- A simple structure will assist in keeping the cost of a scheme down and will streamline licensing. The setting up of new municipal structures may take some time, while the mines are in a position to expedite the launching of such a scheme;
- The involvement of the Water Services Authority is essential in the success of the scheme. It is necessary to have direct representation by the Water Services Authority on the controlling board/committee, if the local authorities do not initially act as lead implementing agent; and

- A new implementing entity, such as a private water company, will provide maximum opportunity for BEE involvement.

From an initial assessment of these institutional models, Model 1(b) (i.e. mines as lead implementing agent, acting through a private water company) was identified as most suitable for such a scheme. In this institutional model, a separate private company is established for the purpose of providing water services, including mine water collection, treatment and distribution to the Local Authority. However, it will take some time to set up such a dedicated Mine Water Company in terms of all applicable legislation. It was thus proposed that a lead mine will act as the project proponent and implementer. The scheme has, however, been set up in a fashion which will allow future conversion to a dedicated and separate Mine Water Company. Figure 15 shows the institutional model to implement the project.

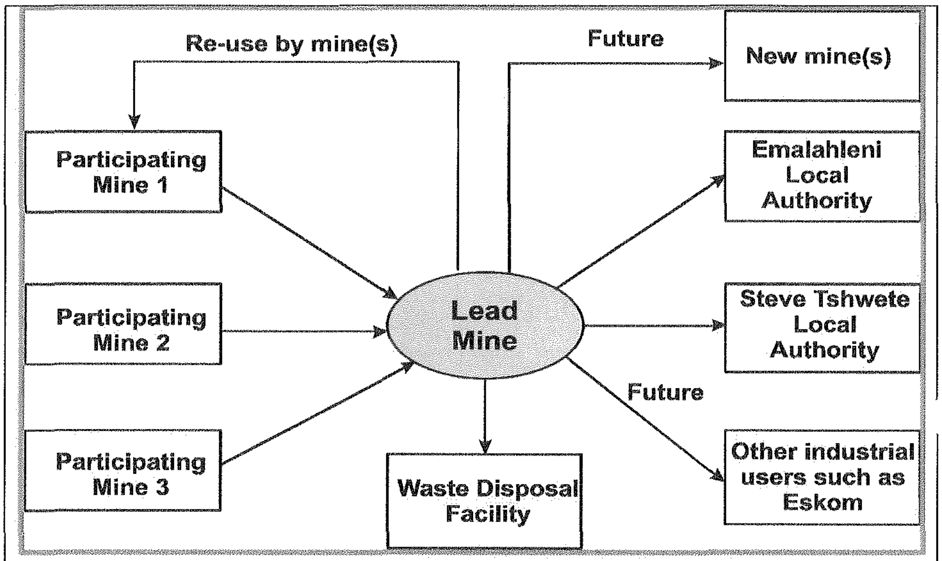


Figure 15: Institutional model for scheme implementation

Financial provision has been made by all mines to cover post-mining environmental liabilities which include mine water desalination and treatment.

5.1.3 Mine Water Collection System

Centralised Mine Water Holding /Balancing Facility at Kromdraai and Excelsior

The alternatives for the centralised mine water holding/balancing facility at Kromdraai and Excelsior subsequent to mine closure included the following:

- A surface dam; and
- An underground mine void associated with a rehabilitated opencast pit, namely Central Pit 1.

The preferred option is to hold/balance the water in the underground mine void. Constructing, operating and maintaining a surface dam would involve high costs. Also, constructing a surface dam would result in an additional footprint impacting on the environment.

Centralised Mine Water holding/Balancing Facility at Brugspruit WPCW

The options for the centralised mine water holding/balancing facility at the Brugspruit WPCW included:

- Installation of a concrete sump; and
- Construction of a dam.

The preferred option is to hold/balance the mine water in a concrete sump as opposed to a dam as there is limited space available for dam construction at the Brugspruit WPCW. A concrete sump requires a smaller footprint than a dam.

5.1.4 Distribution of Treated Water

The following alternatives have been considered with regards to the distribution of treated water to the municipal reticulation network:

- Distribution to the existing Municipal Reservoir B (Witbank Reservoir);
- Distribution to the existing Municipal Reservoirs A and B;
- Distribution to the existing KwaGuqa Reservoir; and
- Distribution to both Municipal Reservoir B (Witbank Reservoir) and KwaGuqa Reservoir.

Subsequent to consultation meetings with the eMalahleni Local Municipality, it has been ascertained that water is needed to supply growing development areas at KwaGuqa and north of the Witbank Reservoir. The preferred options are therefore:

- To distribute treated water to both Municipal Reservoirs A and B; or
- To distribute treated water to both Municipal Reservoir B (Witbank Reservoir) and KwaGuqa Reservoir.

Since both alternatives are still under investigation, both options were assessed during the impact assessment phase.

5.1.5 Waste Disposal Site

The expansion project will yield additional brine and gypsum sludge waste streams. The following alternatives have been considered for the disposal of these wastes:

- Option 1: Disposal at existing waste disposal facilities in the existing eMalahleni Mine Water Reclamation Scheme;
- Option 2: Disposal at newly constructed waste disposal facilities located at the Blaauwkrans Dump at Navigation (i.e. brownfields site); and
- Option 3: Disposal at newly constructed waste disposal facilities at greenfields site.

In the interim, the preferred waste disposal alternative is Option 1, as there is sufficient capacity in the existing facilities to accommodate the additional waste streams for the short term. In the long term, Option 2 is the preferred option, as this has been authorised and will result in time and cost savings. This will also not result in an additional footprint impacting on the environment as will be the case with a new greenfield site.

5.1.6 Pipeline Corridors

The following pipeline corridors have been identified (refer to Figure 16):

- Kromdraai collection pipeline corridor;
- Middelburg Steam and Station collection pipeline corridor; and
- Distribution pipeline corridor.

Within the Kromdraai collection pipeline corridor, alternatives have been identified with regard to the following sections:

Corridor running north to south from Kromdraai to the existing scheme's WRP

- Option 1: western corridor which runs along the existing railway line servitude.
- Option 2: eastern corridor which runs past the Brugspruit WPCW and along the border of T&DB.

The western corridor (Option 1) was eliminated for the following reasons:

- The corridor does not cater for inclusion of mine water sources over and above Kromdraai and Excelsior (such as Middelburg Steam and Station Collieries and non-Anglo owned defunct mines);
- A number of parties are registered users of the railway line servitude. This may result in lengthy and complex negotiations; and
- The corridor has engineering and constructability complexities due to limited space in the servitude along some sections.

The preferred option is therefore the eastern corridor (Option 2), which was subsequently taken through to route selection.

Corridor running north to south from Brugspruit WPCW to the existing scheme's WRP, adjacent to Brugspruit

- Option 1: western corridor which runs along the western side of the Brugpsruit.
- Option 2: eastern corridor which runs along the eastern side of the Brugpsruit.

The western corridor was eliminated for the following reason:

- The corridor runs through the populated formal and informal settlements of Hlalanikahle and KwaGuqa to the west of the Brugspruit. This could result in some re-settlement.

The preferred option is therefore the eastern corridor (Option 2).

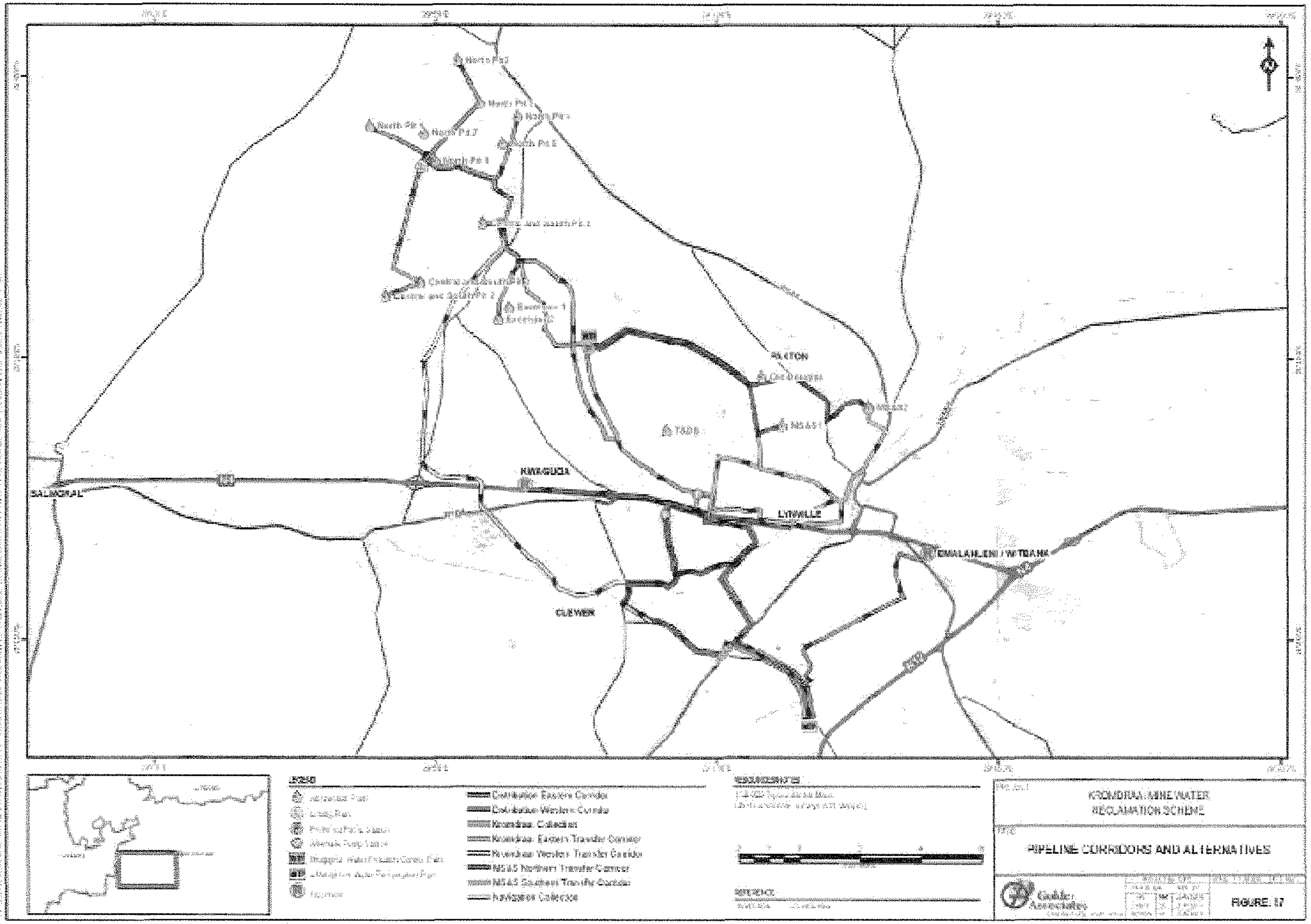


Figure 16: Pipeline corridors and alternatives

5.1.7 Pipeline Routes

Wherever possible, pipeline routes were aligned within existing servitudes, or along existing linear infrastructure, such as railway lines, power lines and roads, in order to avoid fragmentation of the environment. The following pipeline routes have been identified and were taken through to a route selection process (refer to Figure 17):

- Kromdraai collection pipeline route:
  - Excelsior:
    - Excelsior 1
    - Excelsior 2.
  - N4 crossing:
    - N4 crossing 1
    - N4 crossing 2
    - N4 crossing 3.
- Middelburg Steam and Station collection pipeline route:
  - North
  - South 1
  - South 2
  - South 3.
- Distribution pipeline route:
  - East
  - West 1
  - West 2
  - West 3.

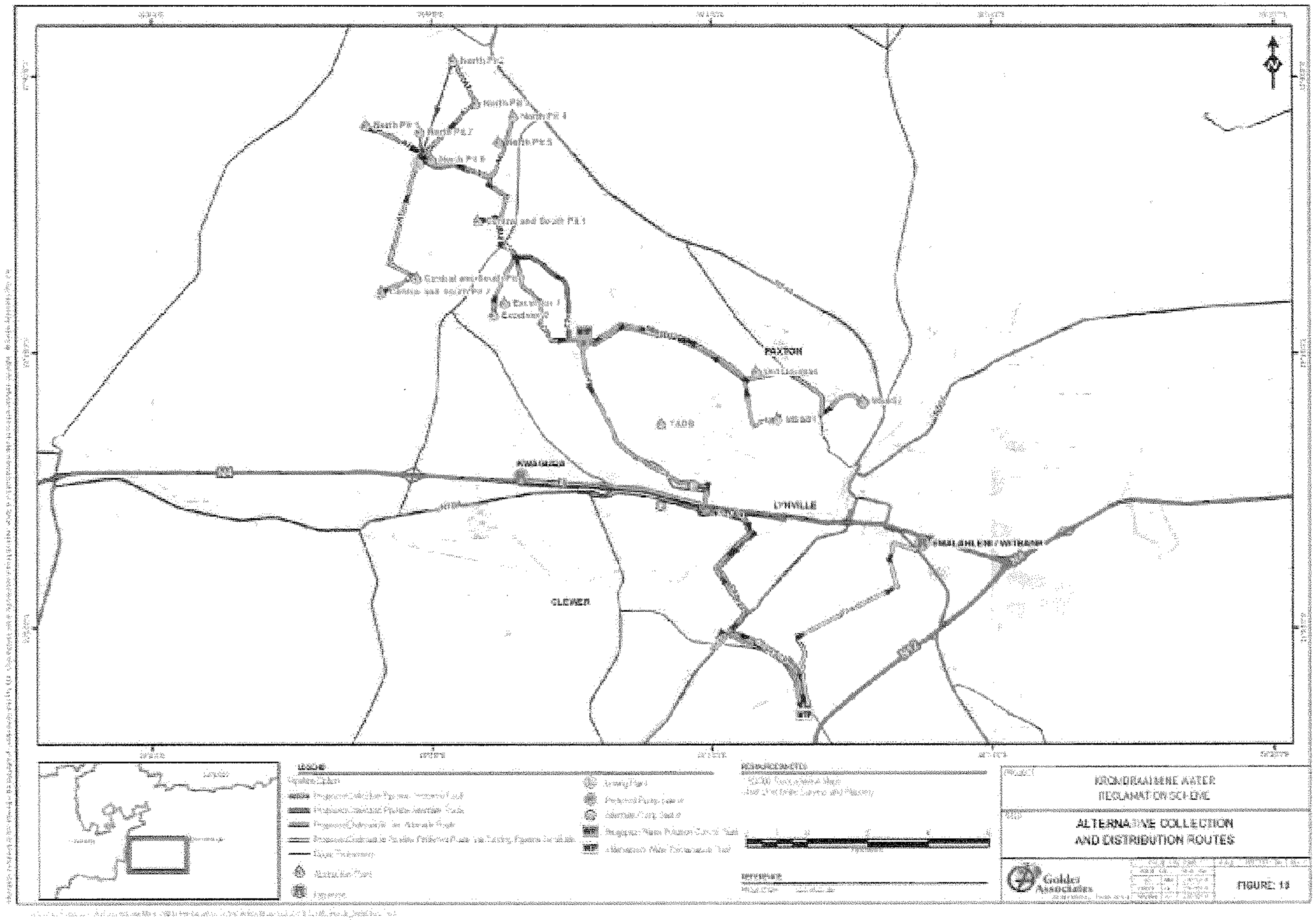


Figure 17: Alternative collection and distribution pipeline routes

5.1.7.1 Environmental Assessment Criteria and Methodology for Route Selection

Each alternative pipeline route was assessed in terms of environmental and social criteria to develop an environmental and social sensitivity score. The environmental and social criteria used were as follows:

▪ Streams and rivers	▪ Homesteads within 1 000 m of the proposed route	▪ Infrastructure within 250 m of the proposed route (including reservoirs, windmills, pipelines, power lines, etc)
▪ Wetland areas (including vleis, pans, etc)	▪ Informal dwellings and labourers' housing within 1 000 m of the proposed route	▪ Sub-division of crop land
▪ Seepage areas, gullies, etc	▪ Grassland representative of 'natural' condition and/or with high faunal/floral diversity	▪ Sub-division of pasture land
▪ Burial sites within 250 m of the proposed route	▪ Farm boundaries crossed, or paralleled by the proposed route	▪ Provincial roads and secondary farm roads

A score was calculated for sections of the routes to enable branching alternatives to be evaluated. The environmental and social score, together with the technical and financial score, were used to identify favoured / preferred routes. Refer to APPENDIX O for an indication of the results of the route selection assessment undertaken.

5.1.7.2 Description of Preferred Pipeline Routes

A description of the various pipeline routes are provided in Sections 2.1.2 and 2.1.4. Refer to the map set, which accompanies this report (on a CD), for the pipeline routes.

5.1.7.3 Pipeline Route Refinements

Subsequent to the route selection process, a number of stakeholders have suggested refinements to the proposed pipeline routes. These refinements are described below and were assessed as part of the impact assessment. See Figure 18 for an indication of the potential pipeline route refinements.

Kromdraai Collection Pipeline

- Route Refinement 1

  A stakeholder commented that, since a road servitude exists along the X16 which runs south of the Sewage Treatment Plant located near KwaGuqa, the proposed Kromdraai collection pipeline route could run alongside this servitude. This section of the proposed pipeline route has thus been re-aligned to follow the existing servitude.

- Route Refinement 2

  In light of the planned residential expansion south of the N4 highway, directly west of the existing Schoongezicht residential area, a stakeholder suggested that the Kromdraai collection pipeline route be kept as close to the N4 as possible. This section of the proposed pipeline route has therefore been re-aligned to run between the N4 and the R104, so as not to restrict the planned residential development.

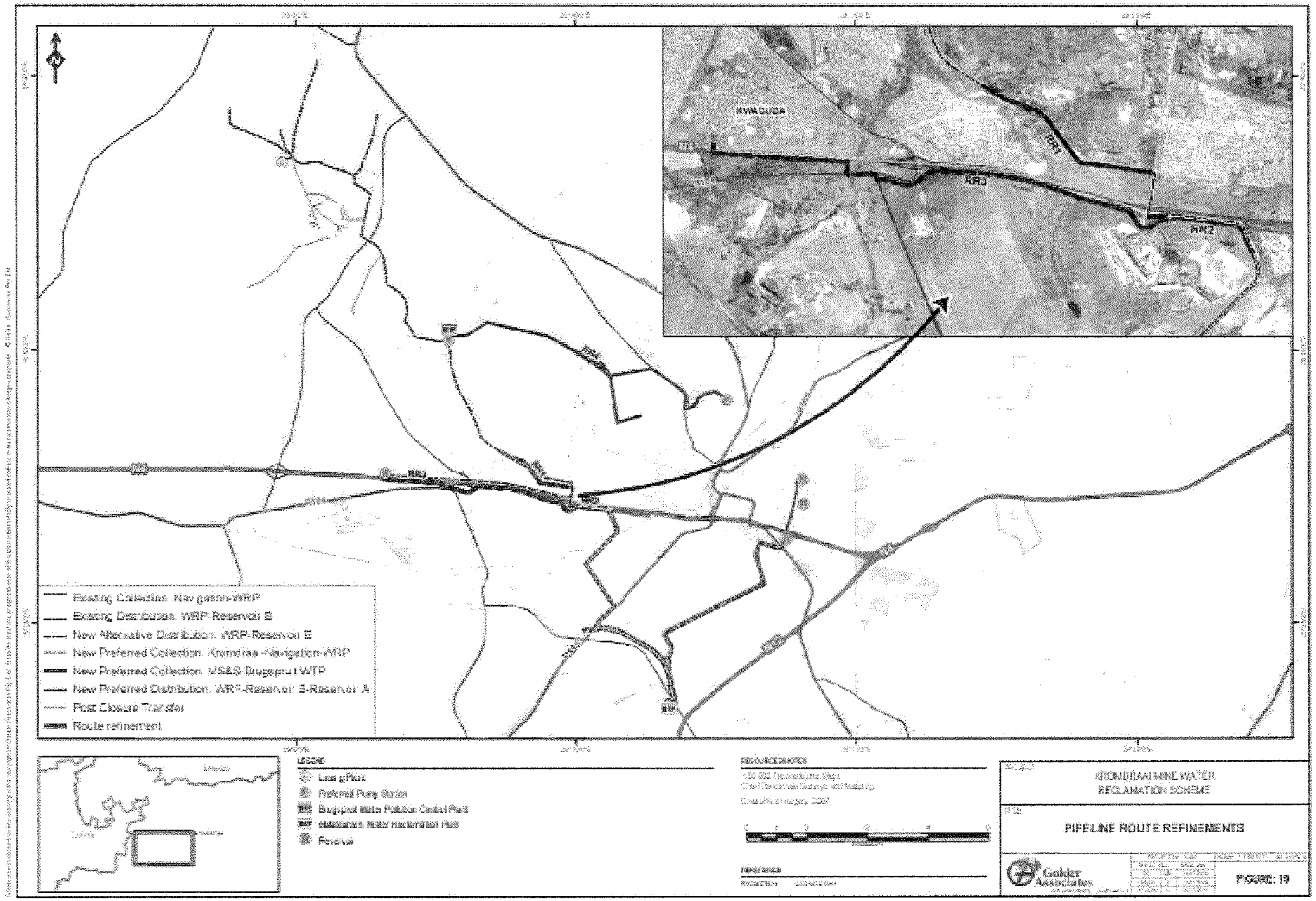


Figure 18: Pipeline route refinements

Middelburg Steam and Station Collection Pipeline

- Route Refinement 4

  The original proposed Middelburg Steam and Station collection pipeline route was routed along an existing powerline servitude which currently traverses Portion 9 of the farm Driefontein 297IR. A stakeholder revealed that this route traverses the footprint of the planned tailings facility and requested the route to be refined/re-aligned. Therefore this section of the pipeline route on Portion 9 has been refined/re-aligned to run along the eastern boundary of the property and then run along the servitude across Portion 27 to join the original alignment.

Distribution Pipeline Route

- Route Refinement 3

  Instead of the distribution pipeline route crossing the N4, turning west and then following the highway (on the northern side) up to the KwaGuqa Reservoir, the route has been re-aligned to run on the southern side of the highway, so as to cross the N4 highway further west to reach the KwaGuqa Reservoir. The reason for the re-alignment is due to the original pipeline route running through an informal settlement which has expanded to the edge of the N4. The re-alignment to the southern side of the highway will avoid the need to relocate people during pipeline construction.

5.1.8 No-go alternative

The reliable supply of water from the Olifants River (via Witbank Dam) to the eMalahleni Local Municipality is fully utilised; there is an urgent need to locate additional water sources. Should another local water source not be found, water would have to be imported at high cost from the Vaal Pipeline Scheme.

Potable water supplied by the proposed expanded scheme will be competitively priced when compared to other water schemes, and the proposed expanded scheme will lift the burden for the development of new water infrastructure from the local authority. Furthermore, the amount of excess mine water in the mine workings is increasing, despite efforts to recycle and re-use water, resulting in the release of mine water into the environment. Large volumes of water stored in underground workings may contribute to potentially unsafe working conditions for mine workers. The costs to the environment, public safety, public convenience and municipal expenditure all render the no-go alternative as unacceptable.

6.0 ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

A full EIA process is being followed for the proposed eMalahleni Mine Water Reclamation Expansion Project. An application form in terms of Section 27 of the NEMA EIA Regulations GN R385 was submitted to the Department of Economic Development, Environment and Tourism (MDEDET) on 21 October 2009. An EIA reference number and approval to proceed with the scoping process was issued on 23 October 2009. On 04 May 2010, approval to proceed with the impact assessment was received from the MDEDET (see APPENDIX C of this report for copies of the MDEDET letters).

Public participation, an essential and regulatory requirement for an environmental authorisation process, has been conducted in accordance with the EIA Regulations GN R385 under the NEMA. The EIA process, including the public participation process, is summarised below.

6.1 Scoping Phase

6.1.1 Technical

Because of the need to limit alternatives, and to include landowners in discussions about pipeline routes as early as possible in the EIA process, an extensive pipeline route selection process was conducted during the Scoping Phase as follows:

- Conceptual pipeline routes were rated and ranked from technical, financial, and environmental / social perspectives, and preferred pipeline routes were selected;
- Directly affected landowners along the preferred pipeline routes were identified, where possible, and were consulted with directly;
- The findings of the route selection process were documented in a Pipeline Route Selection Report. This document is appended hereto as APPENDIX O;
- During the comment period on the Draft Scoping Report, a number of stakeholders suggested refinements to the proposed pipeline routes;
- Members of the EIA team and route engineers walked the entire lengths of the various pipeline routes to point out sensitive areas, such as wetlands, sites of historical importance, etc. Based on the findings, additional route refinements were identified in consultation with landowners; and
- The preferred pipeline routes and potential route refinements were documented in the Final Scoping Report and have been carried through as alternatives to be considered in the impact assessment.

Information gathering during the Scoping Phase served to collate all the required information about the proposed project as well as baseline information regarding the biophysical and social environment that would be affected by the proposed project. Based on that information, and the issues that emerged from the landowner, authority and other stakeholder consultation, issues requiring specialist technical assessment were prioritised and translated into terms of reference for the respective specialist studies.

6.1.2 Public Participation

Identification of I&APs

In terms of the 2006 EIA Regulations under the NEMA, stakeholders are required to formally register as Interested and Affected Parties (I&APs) for the EIA. I&APs were initially identified through a process of networking and referral; liaison with potentially affected parties in the study area; advertisements; and a registration process by completing a registration and comment sheet. The registration sheet encourages I&APs to also indicate the names of their colleagues and friends who may be interested in participating.

The stakeholders involved in the Scoping and Impact Assessment phases of the EIA include representatives from several sectors of society, including; local authorities, ward councillors, industry and mining, provincial and national government, directly affected landowners, agricultural organisations, environmental non-governmental organisations (NGOs), business/commerce, residents, NGOs and Community based organisations (CBOs), etc.

The initial stakeholder database for the overall Anglo expansion of the eMalahleni Mine Water Reclamation Scheme comprised a total of 201 stakeholders (APPENDIX D1). This database was used to announce the proposed project to stakeholders.

To date 107 I&APs (APPENDIX D2) have registered for this project. As per the EIA Regulations, future consultation took place with registered I&APs.

Announcement of opportunity to become involved

The opportunity to participate in the EIA and to register as an I&AP was announced in October 2009 as follows:

- Telephonic notification to approximately 40 key stakeholders (including landowners of the properties directly affected by the preferred pipeline routes);
- Distribution (via email/mail) of a letter of invitation to become involved, personally addressed to an initial 201 I&APs, including directly affected landowners, accompanied by a Background Information Document (BID). The BID contained details of the proposed project, maps of the project area and the preferred and alternatives pipeline routes, as well as a registration and comment sheet for I&APs to register for the EIA process (APPENDIX D4). The registration and comment sheet also provided an opportunity for I&APs to indicate how they wished to receive their notifications and documents for comment;
- Placing the invitation letter, BID, registration and comment sheet at 5 public places (i.e. public libraries and the WRP) in the project area;
- Posting the invitation letter, BID, registration and comment sheet on the Golder website at www.golder.com;
- Advertising in two local newspapers (Cosmos Gazette and Witbank News) (APPENDIX D5);
- Placing 46 site notice boards along the proposed pipeline routes, including alternative routes (APPENDIX D6 and D11); and
- Hand delivering 300 BIDs and invitations to private residences and industrial properties along the originally proposed pipeline routes (October 2009), and 50 additional BIDs along proposed pipeline route refinements and the new distribution pipeline route (May 2010).

Obtaining comments and contributions

I&APs could contribute comments/issues in writing by completing and returning comment sheets, sending emails or faxes, verbally by phone, or by attending one-on-one meetings, and the open houses. All issues raised were captured in the Comment and Response Report (APPENDIX E).

Written contributions

A total of 14 comment sheets and written submissions were received either by mail, email or fax during the Scoping Phase.

Consultation with directly affected landowners

All identified landowners or landowner representatives received project information to enable them to take part in the EIA process. Contact with directly affected parties consisted of initial telephonic consultation, provision of a BID, and invitations to register as I&APs and to attend the open house. All identified directly affected parties received hard copies or electronic copies of aerial maps, indicating how their properties may be potentially affected by the proposed project. Landowners and landowner representatives were invited to comment on the proposed project, including pipeline routes, and to enter into discussion about potential route re-alignments, etc.

Authority consultation

Due to the Integrated Regulatory Processes required by the proposed project, a meeting was scheduled for 02 February 2010 to set up an Authority Steering Committee (APPENDIX D8). The purpose of the Authority Steering Committee is to align the various regulatory processes that feed into each other, without having to set up numerous follow-up meetings with individual authorities. At that meeting, the authorities pointed out the various processes that need to be followed for the project. Authorities present also nominated representatives from their respective departments to serve on this Committee. The Authority Steering Committee meetings are arranged and facilitated by the EIA team.

This meeting was attended by representatives of the Department of Mineral Resources (DMR), the Department of Water Affairs (DWA), the MDEDET, the Department of Environmental Affairs (DEA), the eMalahleni Local Municipality (ELM), and others (APPENDIX D8).

A second meeting was held with the Authority Steering Committee on 20 May 2010. This meeting was attended by representatives of the DWA, MDEDET, and the ELM (APPENDIX D10).

Numerous individual meetings were also held with the MDEDET, DEA, DWA (regional and head office), DMR and the ELM to establish specific guidance for individual regulatory processes and to provide feedback on progress of the project (APPENDIX D3).

Public comment on Draft Scoping Report

The Draft Scoping Report was available for public comment for a period of 8 weeks from 23 November 2009 to 20 January 2010. The Draft Scoping Report, including the Comment and Response Report and map set and property register was made available for public comment as follows:

- Left at public places throughout the project area;
- Emailed to registered stakeholders on the database with email addresses;
- Mailed/emailed to I&APs on request;
- Posted on Golder's website, www.golder.com; and
- Distributed at the Open House (see below).

Open house

An open house was held on 03 December 2009 (refer to Figure 19, Figure 20 and APPENDIX D7). The purpose of the open house was to assist I&APs to comment on the contents of the Draft Scoping Report and the Plan of Study for Impact Assessment, and to add additional issues that may be considered necessary. Information was displayed visually and on detailed maps, and was explained in local languages where required. Copies of the Draft Scoping Report and its accompanying reports were available in hard copy and on CD. Relevant legislation, guidelines and other publications were also made available.

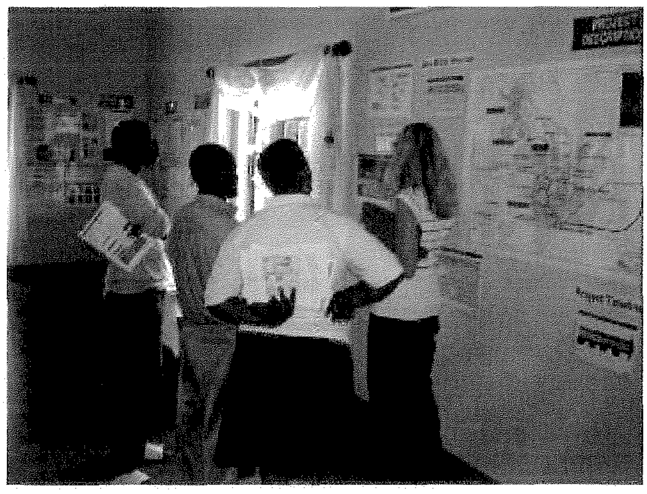


Figure 19: Open House in eMalahleni, 03 December 2009

Figure 20: Open House in eMalahleni, 03 December 2009

Final Scoping Report

The Final Scoping Report was prepared after the end of the public comment period for the Draft Scoping Report. It was updated with additional issues raised by I&APs and new information that had been generated as a result. It was distributed to the authorities and to those I&APs who wished to receive copies during April 2010. A progress feedback letter informing I&APs of the date of submission and availability of the Final Scoping Report was distributed to all registered I&APs (APPENDIX D9).

Approval of the Final Scoping Report and EIA Plan of Study was obtained from the MDEDET on 04 May 2010 (APPENDIX C).

6.2 Impact Assessment

6.2.1 Technical

During this phase, the appointed specialists conducted individual specialist studies to identify, characterise and critically evaluate all potential impacts and the significance of those impacts. This was done using recognised evaluation criteria, as defined in the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998. Baseline data gathering for the EIA specialist studies commenced during the Scoping Phase. As stakeholder issues were received during scoping and the need for additional specialist studies was identified, these were commissioned. The following specialist studies were conducted; (the relevant reports are appended to this report):

- Soil, land use and land capability assessment (APPENDIX F);
- Surface water impact assessment (APPENDIX G);
- Groundwater study (APPENDIX H);
- Terrestrial ecology (APPENDIX I);
- Aquatic ecology (APPENDIX J);
- Wetland ecology (APPENDIX K);
- Heritage impact assessment (APPENDIX L);
- Human health risk assessment (APPENDIX B); and
- Social impact assessment (APPENDIX M).

The individual findings of the specialist studies were integrated into a Draft Environmental Impact Assessment Report (EIAR) which synthesised the main impact assessment findings and recommendations. Alternatives with respect to pipeline routes, i.e. route refinements, were evaluated as part of the specialist investigations. A draft Environmental Management Plan (EMP) was also prepared, based on the recommendations for impact mitigation presented by the specialists. Following the public review of the draft EIAR and EMP, the reports have been updated accordingly for submission to the authorities for a decision.

6.2.2 Public participation

Public participation during the Impact Assessment Phase of the EIA mainly involved a review of the findings of the EIA, presented in the Draft Environmental Impact Assessment Report (EIAR), the specialist studies and the various pipeline route maps.

Consultation during the Impact Assessment Phase of the EIA took place with registered stakeholders (these included the authorities and all affected landowners, which were automatically registered by Golder). In addition, consultation also took place with new landowners that were affected by route changes during the Scoping Phase of the EIA. Stakeholders were informed of the following via letter and telephonic notification (APPENDIX D12):

- MDEDET approval of the Final Scoping Report and EIA Plan of Study;
- Availability of the Draft EIAR; and
- Public meeting.

Distribution of the reports for public comment

The Draft EIAR and its accompanying reports were distributed for comment by way of:

- Leaving the reports in 5 public places throughout the project area;
- Emailing the reports in low resolution to stakeholders on the database with email addresses;
- Mailing hard copies or CDs to landowners, key stakeholders (including community leaders) and other I&APs who have requested a copy;
- Placing the reports on the Golder website, www.golder.com; and
- Making the reports available at the Public Meeting that will be convened.

These reports were made available to the public for a period of 4 weeks from 16 August to 13 September 2010.

Public meeting

A public meeting was held on Monday, 23 August 2010 from 10:00 – 15:00 at Del Amor Conference Centre in Emalahleni (Witbank), attended by 19 I&AP (see meeting agenda and registration list attached in APPENDIX D13). The primary purpose of this meeting was to discuss the content of the draft EIAR and to obtain comments from stakeholders on the draft findings of the EIA. The minutes of this meeting are attached hereto in APPENDIX D13; issues raised during the meeting have been incorporated into the Comment and Response Report.

Authority consultation

The third Authority Steering Committee was held on Tuesday, 07 September 2010 at the eMalahleni Water Reclamation Plant in Witbank. The meeting started at 09:30 – 13:00 and was attended by 7 representatives (see meeting agenda and registration list attached in APPENDIX D14). This meeting was conducted to ensure that each authority is satisfied with the findings of the EIA and conclusions reached. During the meeting, authorities were able to add to the Draft EIAR and assist in ensuring that the level of completeness is enhanced, thus ensuring that the final EIAR and its framework EMP form a comprehensive document that will regulate the construction and operation of the proposed project components. The minutes of this meeting are attached in APPENDIX D14; issues raised have been incorporated into the Comment and Response Report (APPENDIX E).

Final EIAR

The Draft EIAR and Specialist Reports have been amended, as necessary, following comment received during the public review period. The reports have been updated to reflect the comments received. The Final EIAR (this report) and Specialist Reports will be distributed to the authorities and to stakeholders requesting the reports.

6.2.3 Decision-making

The Final EIAR and EMP (this report) are to be submitted to the authorities in October 2010. After the lead authority, the MDEDET, has taken a decision about the project, there will be a 10-day period during which any party may submit a notice of intent to appeal, followed by a 30-day period for the formulation and submission of the appeal. Stakeholders will be advised in writing and by way of advertisements in the media of the authority decision on the EIA, in other words, on whether or not Environmental Authorisation has been granted for the project. Stakeholders will also be advised that the decision may be appealed, and will be provided with guidance on how to do so.

6.3 Summary of key issues raised

This section presents a summary of the key issues that have been identified relating to the proposed eMalahleni Mine Water Reclamation Scheme Expansion Project. The issues raised have been separated into relevant categories and have been captured in the Comment and Response Report (APPENDIX E). The key issues that have been identified are summarised below.

Sustainability of the Project

Stakeholders are concerned about the sustainability of the project, particularly as mine water issues which the project aims to address are long-term issues. Stakeholders suggest that the project should be self-sustaining in terms of the operation and maintenance, and that it does not become the responsibility of government or the public / consumers in future.

Location of the Water Reclamation Plant

Queries were raised in terms of why the mine water could not be treated at the sources instead of conveying the water to a central point for treatment.

Regulatory Requirements

Comments made by stakeholders in this regard relate mainly to the EIA process, the new National Environmental Management Waste Act, 2008 (Act 59 of 2008), the regulatory vehicle under which defunct mines can form part of the scheme, the water use licence application, and the inclusion of the project expansion into the relevant mines' EMPs.

Authority Steering Committee

Stakeholders would like to ensure that relevant authorities at the local municipality, the MDEDET, the DMR and the DWA are part of the Authority Steering Committee for the proposed project so that appropriate guidance can be obtained on the way forward with regard to the project.

Mine Water Sources

Issues relating to the sources of mine water to be treated have been raised by stakeholders, particularly about water originating from the old defunct mining operations.

Water Quality

Stakeholders are concerned about the water quality from the defunct mines as well as the quality of the water currently being supplied from the KwaGuqa Reservoir and to Jacaroo Park. Stakeholders have also enquired as to who has the responsibility for ensuring that the water supplied by the WRP is of good quality.

Pipeline Routing

Stakeholders have indicated that the following aspects should be considered during the routing of the various pipelines:

- Prospecting rights lodged for defunct mines and rehabilitation work done at defunct mines;
- Existing prospecting and mining rights in the study area;
- Future / planned mining and related infrastructure, e.g. slimes dam;
- Future developments, e.g. planned residential expansions;
- Proximity to informal settlements; and
- Existing gas pipelines.

Stakeholders have indicated that the placement of pipelines on public works-owned land is not an issue as long as permissions are sought from the relevant government departments.

Project Impacts on Water Resources

Stakeholders are interested in the extent of the impacts that the proposed project could have on the water resources in the catchment, particularly in terms of water supply and demand. Stakeholders are also concerned about the impact the proposed pipelines will have on the community's "clean groundwater" source used for religious rituals, as well as the impact of discharging water from the plant into the Naauwpoortspruit.

Mine Closure and Financial Responsibilities

Stakeholder concerns exist around who will continue with the abstraction and treatment of mine water, as well as the disposal of wastes, once the mines have closed. Stakeholders are concerned that the public / consumers will end up paying for the costs to treat the mine water to potable water standards after mine closure. Stakeholders suggest that the project should be self-sustaining in terms of the operation and maintenance, and that it does not become the responsibility of government or the public / consumers in future.

Benefits of the Project

Stakeholders have acknowledged that the proposed expansion of the existing WRP will have a positive effect with regards to employment and quality of life for the people living in the area. Stakeholders have indicated that the project will benefit the local communities, particularly in terms of addressing future township growth / expansion and water shortages.

Pipelines Crossing Infrastructure

Stakeholders are concerned about how the proposed pipelines will cross the N4/N12 highway and railway lines, as well as the location of the crossings. Stakeholders have queried as to whether there will there be an emergency plan in place should pipeline leaks/bursts occur, to prevent disruption of railway lines or damage of nearby residents' properties?

Socio-economics

Stakeholders are interested in the impacts of the proposed project on employment and local SMMEs. Stakeholders have also queried about Anglo's vendor registration process.

Project Impacts on Traffic

Stakeholders are concerned about potential impacts on traffic as a result of the pipelines crossing the N4 / N12 highway.

Waste / By-products

Issues relating to the long-term disposal of gypsum sludge and brine have been raised by stakeholders. Stakeholders are also interested in the project regarding the re-use of gypsum sludge in building materials.

7.0 IMPACT ASSESSMENT

7.1 Description of the impact assessment methodology

Potential significance of impacts was based on occurrence and severity, which are further sub-divided as follows:

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Magnitude (severity) of impact	Scale / extent of impact

To assess each impact, the following four ranking scales are used:

PROBABILITY	DURATION
5 - Definite/don't know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (8-15 years)
2 - Low probability	2 - Short-term (0-7 years) (impact ceases after the operational life of the activity)
1 - Improbable	1 – Immediate
0 - None	
SCALE	**MAGNITUDE**
5 - International	10 - Very high/don't know
4 - National	8 - High
3 - Regional	6 - Moderate
2 - Local	4 - Low
1 - Site only	2 - Minor
0 - None	

The significance of the two aspects, occurrence and severity, is assessed using the following formula:

SP (significance points) = (probability + duration + scale) x magnitude

The maximum value is 150 significance points (SP). The impact significance will then be rated as follows:

SP >75	Indicates **high** environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 75	Indicates **moderate** environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates **low** environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that is likely to result in positive consequences/effects.

Potential impacts were assessed using the above calculation and rating system, and mitigation measures were proposed for all relevant project phases (construction to decommissioning). The full impact assessment matrices for the three project phases are tabulated in Table 17, Table 18 and Table 20.

7.2 Summary of environmental components considered

The impact assessment considered the potential impacts of the proposed prospecting shaft development on each of the following environmental components:

- Geology;
- Topography;
- Soil;
- Land capability and land use;
- Fauna and flora;
- Surface water;
- Groundwater;
- Air quality;
- Noise and vibration;
- Sites of heritage significance;
- Sensitive landscapes;
- Visual aspects; and
- Socio-economic.

7.3 Project phases and activities

For the purposes of this impact assessment, the project timeframe was subdivided into the following three phases:

- Construction Phase;
- Operational Phase; and
- Decommissioning Phase.

Potential cumulative impacts were also identified and assessed for each component, where applicable.

The **Construction Phase** marks the beginning of physical changes to the site. During this phase, the following activities will take place:

- Surveying and pegging out of the construction/upgrading areas, pipeline routes, pump stations and new components at the WRP;
- Establishing and, upon completion, rehabilitation of construction sites/camps along the proposed pipeline routes with lay-down yards, machinery, vehicle parking areas, service areas, water supply, portable toilets and temporary waste storage;
- Utilisation of existing access roads to the proposed pipeline routes and pump station sites;
- Transporting materials and personnel to the proposed pipeline routes, pump station sites and WRP;

- Preparation of construction servitudes (10 – 20 m in width) along the pipeline routes;
- Clearing of vegetation and trenching (1 – 2 m in depth) along the pipeline routes;
- Temporary stockpiling of soil, spoil and imported materials along the proposed pipeline routes and pump station sites;
- Possible blasting of hard rock areas along pipeline route;
- Pipe jacking or trenching through, roads/railways/watercourses;
- Dewatering trenches, as required;
- Preparing and laying of pipes;
- Backfilling trenches and marking the routes of the pipelines;
- Installing new storage/balancing sumps and/or pumps stations at the existing Kromdraai Liming Plant, Brugspruit Water Pollution Control Works, Navigation and the WRP;
- Upgrading of the WRP to increase the facility's capacity, e.g. addition of reverse osmosis components, additional chemical storage, new limestone plant, etc.; and
- Installing new inlet infrastructure at Municipal Reservoirs A, B and/or E (KwaGuqa Reservoir).

It is anticipated that the construction phase will take approximately **18 months** to complete.

During the **Operational Phase**, the upgraded WRP will be commissioned and collection, treating and distribution of water will commence. Activities will comprise:

- Abstraction of mine water from underground as follows (average Mℓ/d):
  - Kromdraai and Excelsior Sections of Landau Colliery : 10 Mℓ/d;
  - Navigation Section of Landau Colliery: 8 Mℓ/d; and
  - Middelburg Steam and Station Collieries: 2 Mℓ/d.
- Conveyance of excess mine water from Landau Colliery (Kromdraai, Excelsior and Navigation sections) and the defunct Middelburg Steam and Station Collieries via storage/balancing sumps, underground mine void, pump stations and collection pipelines;
- Treatment of additional excess mine water to potable water standards (20 Mℓ/d) and process water standards (5 Mℓ/d) at the WRP;
- Distribution of an additional 20 Mℓ/d of treated water to an existing municipal water reservoir;
- Discharging treated potable water (50 Mℓ/d) to the Naauwpoortspruit in the unforeseen event that the treated water cannot be distributed to the various end users;
- Maintenance;
- Repairing and replacing infrastructure;
- Storage of treated potable water in Reservoirs A, B and/or E prior to distribution to the public;
- Lighting/illumination at the pump station sites; and

- Disposal of brine and gypsum sludge waste generated during the mine water treatment process at existing facilities at the WRP and at Blaauwkrans Dump at Navigation.

For the purposes of the financial model, the Operational Phase of the expansion project has been allocated a life cycle of **20 years**. It is, however, anticipated that the Operational Phase will continue indefinitely.

Decommissioning Phase: in the unlikely event that the project is decommissioned, plans will be drawn up for dismantling the infrastructure and rehabilitating the sites. This phase is also applicable to pipeline sections that need to repaired or replaced.

7.4 Construction Phase

Table 17 below summarises those impacts directly related to the Construction Phase of the proposed project, and provides a significance rating for each impact before and after mitigation.

Table 17: Environmental Impact Assessment Matrix for the proposed eMalahleni Mine Water Reclamation Expansion Project – Construction Phase

POTENTIAL ENVIRONMENTAL IMPACT: CONSTRUCTION PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
1. Geology												
Possible blasting along pipeline routes could displace sections of hard rock and impact on ambient noise levels, animal life in the study area and generate dust	2	5	1	3	18	**Low**	2	5	1	2	16	**Low**
2. Topography												
During pipeline construction, the temporary stockpiling, compaction of in situ material, excavation, mixing, and replacement of excavated material will affect surface topography	2	3	1	3	14	**Low**	2	3	1	2	12	**Low**
The construction of the storage/balancing sumps and/or pumps stations will further contribute to a permanent alternation of surface topography and drainage	4	5	1	5	44	**Mod**	4	5	1	5	44	**Mod**
3. Soil												
During the excavation of pipeline trenches, the natural soil profile and horizon sequences will be disturbed which will cause the natural functioning of soils in terms of a growth medium and habitat for fauna and flora to cease;	8	2	1	5	64	**Mod**	6	2	1	5	48	**Mod**

POTENTIAL ENVIRONMENTAL IMPACT: CONSTRUCTION PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
and potential soil erosion.												
During backfilling of pipeline trenches, topsoil may be mixed with subsoil or rocky material, reducing soil fertility	6	4	1	4	54	Mod	4	4	1	1	24	Low
During the backfilling of pipeline trenches on rehabilitated land (along the Kromdraai collection pipeline route), topsoil may be mixed with low quality spoil material, resulting in soil pollution	8	4	1	4	72	Mod	4	4	1	1	24	Low
Soil compaction will result from mechanical equipment	2	2	1	4	14	Low	2	2	1	2	10	Low
Soil may be polluted with oil and fuel spillages from mechanical equipment	6	2	1	2	30	Mod	4	2	1	1	16	Low
4. Land capability												
±88 ha of agricultural land and ±86 ha of wilderness/grazing land capability will be affected during pipeline construction.	2	2	1	5	16	Low	2	2	1	5	16	Low
5. Ecology: fauna and flora												
Vegetation clearing and stripping of topsoil during construction.	6	4	1	4	54	Mod	4	2	1	3	24	Low
Noise of machinery and human activities will drive fauna away from the area.	6	2	1	3	36	Mod	4	2	1	3	24	Low
The disturbance of vegetation clearing will further contribute to the establishment of alien invasive species in the area.	8	4	1	5	80	High	4	1	1	2	16	Low
6. Ecology: aquatics												
Pipeline/watercourse crossings will impact on water quality and aquatic biota.	6	2	2	4	48	Mod	4	2	1	2	20	Low
Pipeline/watercourse crossings will impact on macro-channel and riparian habitats.	8	3	2	4	72	Mod	6	2	2	4	48	Mod

POTENTIAL ENVIRONMENTAL IMPACT: CONSTRUCTION PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
Pipeline/watercourse crossings will impact on in-stream habitats.	6	2	2	4	48	Mod	4	2	2	4	32	Mod
Pipeline/watercourse crossings will impact on macroinvertebrates and ichthyofauna biota.	6	2	2	4	48	Mod	4	2	2	4	32	Mod
7. Surface water												
Alternation of stream bed and banks, temporary stream flow reduction and impedance due to pipeline construction across watercourses. Further impacts to surface water resources may occur as a result of increased sedimentation of water sources as a result of exposed soils due to vegetation clearing and soil stripping operations.	4	1	1	4	24	Low	2	1	1	1	6	Low
8. Groundwater												
Accidental spillage of oil or other hydrocarbons and pollutants along the proposed pipeline routes and within the construction sites/camps may result in groundwater contamination.	2	2	1	2	10	Low	2	2	1	1	8	Low
9. Air quality												
Vehicle emissions and dust generated by vehicles traversing the construction sites and by excavating pipeline trenches will contribute to dust and PM_{10}.	2	2	2	4	16	Low	2	2	1	4	14	Low
10. Noise												
Blasting in areas of hard rock along the proposed pipeline routes will increase ambient noise levels.	8	1	2	4	56	Mod	6	1	2	4	42	Mod
Other construction related activities, such as movement of heavy machinery and vehicle traffic, will also result in temporary impacts on noise levels in the study area.	6	2	2	3	42	Mod	4	2	2	3	28	Low

POTENTIAL ENVIRONMENTAL IMPACT: CONSTRUCTION PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
11. Heritage												
n/a	-	-	-	-	-	-	-	-	-	-	-	-
12. Wetlands[2]												
Bed disturbance, vegetation removal and habitat degradation as a result of construction of pipeline / watercourse crossings.	8	2	1	5	64	**Mod**	6	2	1	5	48	**Mod**
Inundation as a result of construction of pipeline / watercourse crossings.	8	2	2	5	72	**Mod**	2	2	1	4	14	**Low**
Dust and sediment settling on the wetland as a result of construction of pipeline / watercourse crossings.	6	2	2	5	54	**Mod**	4	2	2	4	32	**Mod**
Compacting of soils as a result of construction of pipeline / watercourse crossings.	8	3	2	5	80	**High**	8	2	1	4	56	**Mod**
13. Visual aspects												
The primary sources of visual pollution will be due to construction activities, dust mobilisation, and construction vehicles traversing the proposed pipeline routes and WRP site. These activities will temporarily transform the physical landscape.	6	2	2	5	54	**Mod**	4	2	2	5	36	**Mod**
Presence of newly erected project infrastructure in the landscape, e.g. pump stations.	4	4	2	5	44	**Mod**	2	4	2	5	22	**Low**
14. Socio-economic												
Creation of employment opportunities.	4	2	2	2	24	**Low**	4	2	2	4	32	**Mod**
Access to land along the Kromdraai collection pipeline route will be restricted during construction.	4	2	2	4	32	**Mod**	4	2	2	3	28	**Low**
Access to land along the MS&S collection pipeline route will be restricted during construction.	4	2	2	5	36	**Mod**	2	2	2	5	18	**Low**

[2] General impact significance ratings have been provided here. For impact significance ratings for each wetland site, refer to APPENDIX K

POTENTIAL ENVIRONMENTAL IMPACT: CONSTRUCTION PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
Access to land along the Navigation collection pipeline route will be restricted during construction.	2	2	2	2	12	Low	2	2	2	1	10	Low
Access to land along the distribution pipeline route to KwaGuqa Reservoir will be restricted during construction.	8	2	2	5	72	Mod	8	2	2	5	72	Mod
Access to land along the distribution pipeline route to Reservoir B will be restricted during construction.	4	2	2	3	28	Low	4	2	2	2	24	Low
Access to land along the distribution pipeline route to Reservoir A will be restricted during construction.	6	2	2	4	48	Mod	4	2	2	2	24	Low
Environmentally intrusive impacts (i.e. health and safety, noise and dust) along the Kromdraai collection pipeline route.	4	2	2	3	28	Low	4	2	2	2	24	Low
Environmentally intrusive impacts along the MS&S collection pipeline route.	4	2	4	3	36	Mod	2	2	4	3	18	Low
Environmentally intrusive impacts along the Navigation collection pipeline route.	2	2	4	1	14	Low	-	-	-	-	-	None
Environmentally intrusive impacts along the distribution pipeline route to KwaGuqa Reservoir.	4	2	2	3	28	Low	4	2	2	2	24	Low
Environmentally intrusive impacts along the distribution pipeline route to Reservoir B.	2	2	2	1	10	Low	-	-	-	-	-	None
Environmentally intrusive impacts along the distribution pipeline route to Reservoir A.	6	2	2	4	48	Mod	4	2	2	2	24	Low
Environmentally intrusive impacts at the WRP site.	2	2	2	2	12	Low	2	2	2	1	10	Low
Increase in traffic along the Kromdraai collection pipeline route.	6	2	2	5	54	Mod	2	2	2	4	16	Low

POTENTIAL ENVIRONMENTAL IMPACT: CONSTRUCTION PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
Increase in traffic along the MS&S collection pipeline route.	4	2	2	3	28	**Low**	2	2	2	3	14	**Low**
Increase in traffic along the Navigation collection pipeline route.	4	2	2	2	24	**Low**	2	2	2	1	10	**Low**
Increase in traffic along the distribution pipeline route to KwaGuqa Reservoir.	4	2	2	3	28	**Low**	4	2	2	2	24	**Low**
Increase in traffic along the distribution pipeline route to Reservoir B.	4	2	2	3	28	**Low**	4	2	2	2	24	**Low**
Increase in traffic along the distribution pipeline route to Reservoir A.	6	2	2	3	42	**Mod**	4	2	2	2	24	**Low**
Increase in traffic at the WRP site.	4	2	2	4	32	**Mod**	2	2	2	4	16	**Low**
Influx of jobseekers along the proposed pipeline routes, resulting in social change and increased pressure on local services.	4	2	2	3	28	**Low**	2	2	2	1	10	**Low**
Influx of jobseekers at the WRP.	4	2	2	4	32	**Mod**	2	2	2	2	12	**Low**
Planned developments may be impacted by the proposed Kromdraai pipeline routes.	4	4	2	3	36	**Mod**	-	-	-	-	-	**None**
Planned developments may be impacted by the proposed MS&S pipeline route.	4	4	2	3	36	**Mod**	-	-	-	-	-	**None**

7.4.1 Geology

Impact assessment

Possible blasting of hard rock in sections of the proposed collection and distribution pipeline routes may impact on underlying geology. Blasting would displace sections of hard rock and impact on ambient noise levels, animal life in the study area and generate dust.

Mitigation measures

The permanent displacement of *in situ* rock cannot be mitigated; however, by using appropriate blasting techniques the impacts can be minimised.

Impact significance

It is anticipated that blasting activities will result in negligible impacts, and will be restricted to the site only. Impacts of **low** significance are therefore expected.

7.4.2 Topography

Impact assessment

In situ material will be excavated and placed on surface during the construction of the buried sections of the pipelines. The stockpiling of material on surface will only be a temporary measure for the construction of the pipelines, and the material will be replaced and rehabilitated within a relatively short period of time. Settling is expected to occur over the areas where the buried pipelines have been laid. Compaction is also expected in areas where vehicles and plant equipment travel regularly.

The temporary stockpiling, compaction of *in situ* material, excavation, mixing, and replacement of excavated material will affect surface topography and drainage. The construction of the storage/balancing sumps and/or pump stations, will further contribute to a permanent alternation of surface topography and drainage. No additional impacts on topography will result from the proposed upgrading activities within the WRP site.

Mitigation measures

Recommended mitigation measures include:

- Excavated material is to be stockpiled in windrows not exceeding 1.5 m in height adjacent to the excavation for the collection and distribution pipelines;
- Excavated material should be stockpiled in a manner where it can act as storm water control berms during the Construction Phase;
- Storm water cut-off drains should be located regularly along construction roads;
- Separate stripping of the material is required when constructing bulk earthworks to ensure that excavated clays, loams, and plinthic materials are not mixed, and can be returned to their former positions during rehabilitation;
- Ensure that rehabilitated areas are ripped to a suitable depth (minimum of 500 mm or to refusal);
- Ensure that the area is shaped to be free draining after rehabilitation is complete;
- Profile the area to be the same as the original topography;
- Harrow the area after seeding to ensure that the topography is re-established so that deep furrows are avoided; and
- A surface water drainage plan should be compiled prior to construction.

The impact of permanent infrastructure cannot be mitigated.

Impact significance

The negative impact on topography as a result of temporary stockpiling, compaction of in situ material, excavation, mixing, and replacement of excavated material will occur in the short to medium term, affect only the site, and be of a **low** significance. The impact of permanent infrastructure will be of **moderate** significance.

7.4.3 Soils

Context

Large sections of the pipeline routes are located on soils that have already been disturbed by mining related activities or various non-mining related activities such as loading zones, trenches, diggings, partly excavated areas, eroded areas and footprints of demolished infrastructure.

Impact assessment

The construction of the collection and distribution pipelines will impact on soils in the study area. The major activities that will result in impacts to soil will be as a result of vegetation clearing, stripping, and compaction of soils. This will cause the natural functioning of soils in terms of a growth medium and habitat for fauna and flora to cease as long as the trenches are open. If the trenches are deeper than 1.5 m, the subsoil or underlying rock material will be penetrated at shallow sections, which creates the possibility of topsoil and subsoil mixing. In that event, a reduction in soil fertility will occur.

The topsoil on rehabilitated sections (specifically along the Kromdraai collection pipeline) is shallow and trenches will definitely penetrate the low quality spoil (coaliferous) material. Mixing this material with the topsoil during backfilling of the trenches will cause coal related salt pollution of the topsoil.

Mitigation measures

Recommended mitigation measures include:

- Approximately 10 km of existing trenches occur within 10-30 m of the current proposed pipeline route. Most of these trenches currently serve the purpose of barricading mining areas, industrial areas and dangerous zones. If possible, it is recommended that these trenches be used to locate the pipelines; the trenches can be deepened and backfilled to the current level to maintain the current purpose of the trenches. This will result in negligible impacts on soils as a result of the proposed pipelines;
- Topsoil and excavated material is to be stockpiled in separate windrows not exceeding 1.5 m in height, adjacent to the excavation for the collection and distribution pipelines to ensure that the soils remain fertile;
- Separate stripping of the material is required to ensure that excavated black/yellow clays, loams, and plinthic/saprolitic materials are not mixed, and can be returned in their former position during rehabilitation;
- Ensure that rehabilitated areas are ripped to a suitable depth (minimum of 500 mm or to refusal);
- Topsoil stripping should include the vegetation seed bed to facilitate revegetation of the area;
- In mining areas that have been rehabilitated, mixing coaliferous spoil material with topsoil should be avoided at all costs. Spoil material should by no means be penetrated and trenches should be excavated only to the depth of the spoil material. After the trench is backfilled, soil can then be graded from both sides on top of the closed trench to create a berm of 300 to 500 mm high in order to provide more protection to the pipeline and which can simultaneously serve as a method to demarcate the pipeline;
- As part of the rehabilitation procedure, soil compaction by heavy mechanical equipment can be alleviated by ripping actions after the trenches have been backfilled;
- Excavated material should be stockpiled in a manner where it can act as storm water control berms during the Construction Phase;
- Storm water cut-off drains should be located regularly along construction servitudes and the pipeline routes to avoid erosion of stockpiled materials;
- Contamination due to oil and fuel spillages should be avoided; strict guidelines should be given to contractors in terms of the mechanical condition of equipment used, the maintenance of equipment as well as the reporting and cleaning up procedures of spillages, should they occur;
- The pipeline should be commissioned to check for leakages and repaired, if necessary, before backfilling of the trenches takes place. Inspections should take place on a daily basis;

- The trenches should be backfilled shortly after the pipeline has been declared leakage free. Rehabilitation of the closed trenches should take place in spring or early summer. Soils should be loosened and levelled with a ripping and disc action and seeded with 2 or 3 annual species. Only locally indigenous species should be used. The annual species will stabilise the soil in the first year while natural succession of species establish themselves. Intensive fertilising is not required because it is a narrow strip which can recover fairly rapidly. Lime can be applied at 1 ton per ha after the ripping action and can be worked into the upper 100-150 mm of soil with the disc action. A fertiliser mixture such as 2:3:2(22) can be applied directly after seeding, which should take place shortly after good rains. A second application of 100 kg 232(22) can be applied after 6 weeks (after good rains);

- All oil contaminated or otherwise polluted soil and wastes from the construction areas must be removed to licensed landfill sites using a registered waste disposal company;

- Erosion should be monitored and stabilised as soon as possible wherever it occurs;

- A soil stripping and erosion plan must be compiled prior to commencement of the Construction Phase; and

- All disturbed areas must be profiled and stabilised, and erosion control measures must be installed in places identified as being at risk of erosion.

Impact significance

The significance rating of the impacts resulting from excavating pipeline trenches is **moderate**, with limited mitigation potential. Impacts resulting from topsoil mixing with subsoil or spoil material is also **moderate**; the frequency of the impact is once off, although the duration of the impact will remain to some extent after rehabilitation takes place. This impact can, however, be fairly well mitigated (to **low** significance levels). Compaction can be remediated mechanically; the significance rating of the impact is therefore **low**. Soil pollution resulting from oil and fuel spillages is considered a higher magnitude impact, with a moderate significance rating. However, should the relevant mitigation measures be implemented, impact significance can be reduced to **low**.

7.4.4 Land capability

Context

In terms of land capability, the majority of the pipeline routes (47.4 %) are located on arable land with moderate to very deep red and yellow-brown soils with moderate to high agricultural potential. 36.8 % of the pipeline routes are located on mined areas, disturbed areas and areas occupied by semi-permanent infrastructure, classified as 'wilderness'. Remaining sections are located on grazing land (8.4 %) and temporary (3.2 %), seasonal (3.2 %); and permanent wetlands (1 %).

Impact assessment

During construction of the pipelines (roughly 95 km in length), a servitude (right of way) width of up to 20 m will be required. The total impact of pipeline construction is therefore expected to be ±88 ha of agricultural land and ±86 ha of wilderness/grazing land capability. The area over which the pipeline routes are located will, however, return to the pre-construction land capability subsequent to construction.

Mitigation measures

Recommended mitigation measures include:

- All mitigation measures proposed for soils above;

- The pipelines should be buried more than 1 m below the surface where possible to ensure that land capability can return to its pre-construction state, with the exception of some of the wetland areas (refer to Section 7.4.7); and

- A mutually acceptable agreement must be drawn up with landowners to compensate them in the event of crop loss and servitude rights.

Impact significance

The impact on land capability will be a **low** negative impact, acting in the short term, and affecting only the immediate site.

7.4.5 Ecology: terrestrial fauna and flora

Context

Most of the sections of the proposed pipeline routes run through areas that have already been impacted by mining activities or anthropogenic influences. As a result, large quantities of exotic species were found along the proposed pipeline routes.

Impact assessment

During the Construction Phase, the vegetation clearing and stripping of topsoil will be the primary mechanism impacting fauna and flora. In total ±190 ha of land will be impacted. This is mostly made up of 95 km of pipeline routes (with a construction servitude of 20 m in width). The disturbance of vegetation clearing will further contribute to the establishment of alien invasive species in the area.

Noise of machinery and human activities will also drive fauna away from the area. Since the proposed pipelines will be buried, impacts on burrowing mammals will be high. If the small mammals have young, they will not move away and will be harmed.

Mitigation measures

Recommended mitigation measures include:

- All mitigation measures described in Section 7.4.3 (Soil) need to be implemented;
- Areas where disturbance is permissible should be demarcated prior to construction activities taking place;
- Vegetation audits need to be conducted prior to commencement of construction activities. These audits need to be conducted in the construction demarcated areas located in areas of a high and moderate sensitivity (including secondary grasslands) (see Figure 3 of APPENDIX I). These areas may contain protected species, such as *Brunsvigia radulosa* and *Gladiolus ecklonii*;
- Daily audits need to be conducted ahead of construction to identify if any fauna need to be relocated, especially burrowing mammals;
- Should any protected species or burrowing mammals be found within an area demarcated for construction, no disturbance of this area should take place. If this is not possible, the protected species or mammals must be relocated;
- All exotic and invasive species should be removed within the 20 m construction servitude;
- Indigenous and currently occurring species, such as *Eragrostis* species, should be planted in rehabilitated areas and maintained;
- All replanting activities should be undertaken at the end of the dry season (middle to end September) to ensure optimal conditions for germination and rapid vegetation establishment;
- All areas that were planted pasture or that consisted of natural vegetation before construction must be reseeded;
- Inspect rehabilitated areas at three monthly intervals during the first and second growing season to determine the efficacy of rehabilitation measures;

- Remedial action is required where vegetation establishment has not been successful or erosion is evident;
- An ongoing alien invasive control programme should be implemented for the duration of the project; and
- Grazing livestock need to be kept away from rehabilitated areas, for two growing seasons.

Impact significance

Terrestrial fauna and flora along the entire length of the pipeline network will only be impacted in the short-term. Rehabilitation is expected to be successful over the pipeline route within a period of 2 years. Fauna will return to the area once construction activities have ceased. The impact on fauna and flora during the Construction Phase is expected to be **low**, should the appropriate mitigation measures be implemented.

7.4.6 Ecology: aquatics

Context

The water bodies associated with the proposed pipeline routes are already in an impacted state. No endangered or vulnerable aquatic taxa were found during the aquatic ecology survey (APPENDIX J).

Impact assessment

The proposed pipeline / watercourse crossings could result in the following impacts:

- Impacts on water quality

  If sediments and contaminants enter the in-stream environment, a decrease in water quality will occur, which will impact on the aquatic biota. Accidental spills, leaks and contamination with pollutants will also impact the water quality and the aquatic biota.

- Impacts on macro-channel and riparian habitat

  The removal of vegetation and changes to the channel banks and habitats will result in macro-channel instability and will impact the in-stream habitats around the pipeline crossing sites. Bank erosion, exotic vegetation encroachment and bank undercutting can occur.

- Impacts on in-stream habitat

  Increases or decreases in channel widths, removal or modification of substrates and changes in flow will impact the site and the aquatic biota. Increased sedimentation will also occur.

- Impacts on macroinvertebrates and ichthyofauna

  Aquatic biota will be impacted due to the amount of disturbance and activity at the pipeline / watercourse crossing sites. This is, however, temporary and conditions should recover during the Operational Phase.

Mitigation measures

In addition, the following mitigation measures are recommended:

- Place the relevant sections of the pipelines below the groundwater flow component of the streams and wetlands so as to not impede the flow and impact the sites once construction is completed;
- At sites 1, 3, 4 and 5, construct the proposed pipelines as close to the existing upstream road servitudes as possible;

- Construct pipeline / watercourse crossings during the dry season so as to limit impacts to the sites, particularly in terms of flow diversion;
- Construct pipeline / watercourse crossings in stages so as to limit the impact to the sites. As one stage is complete, rehabilitate the habitat before starting the next construction section;
- Implement low impact construction techniques so as to minimise the impact on the river system, especially during the diverting of any water during construction;
- Where possible, keep construction activities out of wetland areas. Limit movement of construction vehicles within wetlands. Restrict vehicles to service roads;
- Clean up and rehabilitate any accidental spillages or impacts to the aquatic and wetland ecosystems;
- Devise and implement a relocation plan if rare and sensitive species are identified during construction;
- Implement dust suppression on dirt roads during construction to avoid excessive dust formation;
- Implement suitable vegetation and habitat rehabilitation where construction site impacts occur. This should be done in consultation with the aquatic and wetland ecologist;
- Where wetland soils have been compacted, labourers should loosen soils with light weight tools; and
- Implement corrective mitigation measures should any significant decrease in ecological integrity occur (both aquatic and wetland) within any biomonitoring period as a result of impacts associated with the pipeline / watercourse crossings.

Impact significance

In terms of aquatic ecology, the significance of the impacts was mostly rated as **moderate**. Implementation of appropriate mitigation measures will, however, reduce the significance of the impacts.

7.4.7 Surface water

Context

Seven pipeline / watercourse crossings are proposed (see Figure 5); one of which occurs at an existing mine road crossing The 1 in 50- and 1 in 100 year floodlines for these crossings were determined (see Appendix B of APPENDIX G).

Impact assessment

The primary source of impacts during the Construction Phase of the project will be as a result of the alteration of stream beds and banks, temporary stream flow reduction and impedance due to pipeline construction across wetlands and streams. Further impacts to surface water resources may occur due to increased turbidity and sedimentation of water sources as a result of exposed soils due to vegetation clearing and soil stripping operations.

Once the pipeline / watercourse crossings have been buried, no further impacts on the flows in the rivers are expected.

Mitigation measures

Recommended mitigation measures include the following:

- All mitigation measures for soil, vegetation, wetlands, and sensitive landscapes should be implemented;

- During pipeline excavation, excavated soil should be protected from stormwater runoff so that the soil does not report to the river system. Storm water cut-off drains should be located regularly along construction servitudes and the pipeline routes to avoid erosion of stockpiled materials;
- Excavated material should be stockpiled in a manner where it can act as storm water control berms to prevent the ingress of runoff into trenches;
- During backfilling, soils should be well compacted and vegetation re-established as soon as possible to prevent erosion;
- Construction activities within the 1 in 50- and 1 in 100 year floodlines should be limited as far as possible. No construction sites/camps should be located within the 1 in 50- and 1 in 100 year floodlines;
- All soil, rock and gravel stockpiles should be located outside the 1:50 year floodline;
- Vehicle traffic in watercourses should be limited in frequency, and avoided during wet periods;
- Watercourse crossings should be constructed during the dry season;
- Strip wetland soils separately according to colour and replace in the same order as the former position in the soil profile to avoid significant mixing of soils;
- Only non-carbonaceous fill material should be used for watercourse crossing sites;
- Ensure that wetland soils are adequately ripped in areas of disturbance to ensure that regrowth of the vegetation and percolation of water is optimal;
- Soil and vegetation must be rehabilitated before the next rainy season;
- Riverbanks in the disturbed areas should be profiled to emulate the adjacent undisturbed slopes;
- Turbidity and sedimentation downstream of the pipeline / watercourse crossing sites should be monitored for at least two rainy seasons; and
- Construction roads should be planned prior to commencement of the Construction Phase to ensure that the minimum numbers of roads are located in wetland or natural vegetation areas.

Impact significance

The impact of excavating pipeline trenches across watercourses is anticipated to be **low**. Excavation activities in watercourses are expected to last for less than 1 month. This will only impact surface water resources for one growing season in which time it is predicted that vegetation cover will be adequate to prevent further impacts.

7.4.8 Groundwater

Impact assessment

Accidental spillage of oil or other hydrocarbons and pollutants along the proposed pipeline routes and within the construction sites/camps may result in groundwater contamination. During the excavation of the pipeline trenches, sub-surface flow may seep into the trenches and would need to be removed to enable construction to continue. The volumes of water reporting to the trenches would, however, be negligible. No further impacts on the groundwater environment are anticipated during the Construction Phase.

Mitigation measures

The following mitigation measures are recommended:

- Implement pollution prevention techniques on all construction equipment, e.g. drip trays on trucks; and
- Immediately remove soils contaminated with oils and other hydrocarbons or pollutants and dispose as hazardous waste.

Impact significance

Impacts on groundwater resulting from accidental oil or other hydrocarbons and pollutants will be minor, with a low probability of occurring; impact significance is therefore anticipated to be **low**.

7.4.9 Air quality

Context

The air quality in the study area is already impacted by pollutant sources such as power stations, petrochemical plants, small industries, domestic combustion, motor vehicles, smouldering coal-discard dumps and veld burning.

Impact assessment

Vehicle emissions and dust generated by vehicles traversing the construction sites (including the upgraded WRP site) and by excavating pipeline trenches are the only sources of air quality pollution expected during the Construction Phase.

Mitigation measures

Recommended mitigation measures include:

- Ensure that dust suppression measures are implemented on exposed soils and dust generating roads; and
- Ensure that vehicles are serviced regularly and that vehicles with emission problems are identified speedily and rectified.

Impact significance

Air quality impacts resulting from vehicle emissions and dust are considered to be **low** within context of existing pollution from industry and motorways in the area. Impacts will act over the short-term, and affect the local extent. Should the appropriate mitigation measures, such as dust suppression, be implemented, impact significance can be further reduced.

7.4.10 Noise

Impact assessment

Blasting in areas of hard rock along the proposed pipeline routes will increase ambient noise levels. Other construction related activities, such as movement of heavy machinery and vehicle traffic, will also result in temporary impacts on noise levels in the study area.

Mitigation measures

Recommended mitigation measures are as follows:

- Apply due diligence and all industry-accepted methods to limit factors contributing to the development of a shockwave and noise as a result of blasting;
- Ensure that sufficient consultation with all potentially affected landowners occurs prior to blasting;
- Control blasting operations to ensure sound pressure levels are kept below the generally accepted 'no damage' level of 140 dB, or any other levels that may apply to a specific area as determined by municipal ordinances, etc.;

- Limit construction working hours to between 6am and 6pm in areas where local residents may be affected, and to week days;
- Ensure efficient design and maintenance of silencers on diesel-powered vehicles and equipment; and
- Train personnel to adhere to operational procedures that reduce the occurrence and magnitude of individual noisy events.

Impact significance

Blasting impacts on noise levels will be moderate to high (depending on proximity to existing noise impacts, such as the N4/N12 Highway, the Greenside Colliery Rapid Load-out Terminal (RLT), mining operations, etc), but will take place immediately and on a local scale. Impact significance is therefore expected to be **moderate**.

Impacts on noise levels as a result of movement of heavy machinery and vehicle traffic will also be **moderate**, short-term, and will take place on a local scale. These impacts can, however, be mitigated to **low**.

7.4.11 Visual aspects

Impact assessment

The primary sources of visual pollution during the Construction Phase will be due to construction activities, dust mobilisation, and construction vehicles traversing the proposed pipeline routes and WRP site. These activities will temporarily transform the physical landscape, i.e. removal of natural vegetation and land cover, transformation of the site topography; presence of new infrastructure; and dust pollution.

The N12 highway is the major receiving feature of any visual impact in the study area (specifically during the construction of the distribution pipeline to KwaGuqa Reservoir). Along this route, however, vehicles are travelling at an average of 100 – 120 kilometres per hour and their occupants will be exposed to the visual impact for a short period of time only.

The proposed distribution pipeline route from Reservoir B to Reservoir A will be located adjacent to roads in urban residential areas, e.g. Woltemade Street, Christiaan de Wet Street, and Nicol Street. These roads will be major receiving features of visual impacts during pipeline construction.

Furthermore, visual aspects will be impacted by the presence of newly erected project infrastructure in the landscape, e.g. pump stations and water balancing/holding facilities.

Mitigation measures

Recommended mitigation measures include:

- Screen construction sites along the proposed pipeline routes, if possible;
- Subsequent to backfilling, profile the area to be the same as the original topography;
- Rehabilitate affected areas as soon as possible;
- Employ proper "housekeeping" at construction camps/sites;
- Implement effective dust suppression;
- Use selective and judicious lighting for the construction sites, if required;
- Apply colour variations on the outward surfaces of the pump stations. Use colours complementary to the colours in the surrounding landscape; and
- Where possible, structures should be partially sunken into the landscape.

Impact significance

With regard to construction activities, impacts will be **moderate**, short-term, and will take place on a local scale.

Regarding the presence of 'permanent' infrastructure, the magnitude of the visual impact will be low, mainly due to low receptor sensitivity (i.e. receptors do not occur in close proximity to the sites) and low visual quality of the receiving landscape. Impacts will, however, be long-term and local. Impact significance is therefore considered to be **moderate**.

7.4.12 Archaeological or cultural historical sites

The Phase 1 Heritage Impact Assessment (APPENDIX L) indicated that there will be no impacts on archaeological or cultural historical sites for any phases of the project.

Should, however, any heritage resources of significance be exposed during the construction of the project, the South African Heritage Resources Authority (SAHRA) should be notified immediately, all development activities should be stopped and an archaeologist accredited with the Association for Southern African Professional Archaeologist (ASAPA) should be notified in order to determine appropriate mitigation measures for the discovered finds. This may include obtaining the necessary authorisation (permits) from SAHRA to conduct the required mitigation measures.

7.4.13 Wetlands

Context

Sixteen sites were selected as part of the baseline assessment for the wetland study (Table 9). Impact assessments were, however, not conducted for the following sites:

- WC 7 – No active wetland was found at the pipeline crossing site. It is recommended that the pipeline be constructed as close to the conveyer belt as possible and that rehabilitation of the site be done after construction;
- WC 9 – The proposed pipeline will be located on the western side of the road and railway. This area has been extensively degraded through cultivation and thus no functional wetland is present. The pan is situated on the other side of the road and will not be impacted upon;
- BS seep – This seep zone is not affected by the reduction in water to the valley bottom channel; and
- WC 11 – This artificial furrow is already heavily impacted upon, and the channel is very narrow. Thus a pipeline would not have a significant impact on this artificial system.

Impact assessment

The construction of the pipeline / watercourse crossings will cause the following impacts:

- Bed disturbance, vegetation removal and habitat degradation;
- An area upstream of the construction site might become inundated, which in turn could result in habitat loss;
- Vehicles moving in the vicinity of the wetland are likely to contribute to dust and sediment entering the wetland. This is a negative impact that could cause vegetation degradation; and
- The movement of construction vehicles could result in compacting of soils in the wetland area. This is a negative impact that could cause vegetation degradation and the path of flow of water in the wetland to change.

Mitigation measures

Mitigation measures include:

- Ensure that the proposed pipelines are buried below the groundwater level;
- At Site WC12, install the pipeline to the southern side of pan, or on the southern side of the existing pipeline running through the pan, as this area has already been heavily impacted upon;
- Construct the pipeline / watercourse crossings above ground on existing road and railroad servitudes, and existing pipe bridges at sites WC 1, WC3, WC4, WC5, WC6 and WC8;
- If a road is to be built in future below the wastewater works at Site WC6 (RR1), then the proposed pipeline should be constructed along the road servitude;
- Construct pipeline / watercourse crossings in stages so as to limit the impact to the sites and during the dry season;
- Keep construction activities and heavy vehicles out of the wetland areas, where possible. Limit movement of construction vehicles within wetlands. Restrict vehicles to service roads;
- Allow for ample flow through of water should additional culverts be constructed;
- Avoid dumping of construction materials and spoils within the wetlands;
- Implement rehabilitation where negative habitat impacts have occurred and are likely to occur in future;
- Revegetate bare areas and remove exotic vegetation;
- Where wetland soils have been compacted, labourers should loosen soils with light weight tools;
- Clean up and rehabilitate any accidental spillages or impacts to the aquatic and wetland ecosystems;
- Devise and implement a relocation plan if rare and sensitive species are identified during construction;
- Implement dust suppression on dirt roads during construction to avoid excessive dust formation; and
- Maintain service roads to avoid erosion and excessive dust formation.

Impact significance

Negative impacts associated with the Construction Phase range from **moderate** to **high** for the various wetlands. For Site WC5, the impact resulting from the movement of construction vehicles could result in a **high** negative impact, as these activities could cause vegetation degradation and the flow of water in the wetland to change over the medium term. The significance of most of these impacts can, however, be reduced.

7.4.14 Socio-economic

Impact assessment

The Construction Phase is expected to create around 400 temporary jobs. These will span a period of around 18 months, and will have a positive impact on the area.

Due to servitude agreements, land access restrictions will be experienced temporarily during construction and permanently during operation. However, most sections of the pipelines fall within existing municipal servitudes, meaning additional restrictions will be minimal. Operational servitudes will still allow complete access to land, but will result in an agreement of restricted land use, preventing future infrastructure development and the planting of perennial crops. As the WRP will be upgraded within the existing site footprint, no land access restrictions are anticipated.

Regarding the proposed distribution pipeline to KwaGuqa Reservoir, an informal settlement lies in the original pipeline alignment near the reservoir. This community would potentially require resettlement should the original route be followed. However, Route Refinement 3 has been proposed to avoid this impact. Servitudes required by the original route alignment of the Kromdraai collection pipeline will also potentially negatively impact future planned residential development; however, Route Refinement 2 has been suggested to avoid this impact.

Environmentally intrusive impacts expected for all project components relate to the creation of noise and dust, and health and safety risks relating to construction activities. However, as a large proportion of pipeline lies on land owned by Anglo, impacts relating to construction activities will have a minimal impact on the general public. Construction/upgrading activities at the WRP are unlikely to create significant environmentally intrusive impacts, as any residential settlement is over 1 km away from the Plant.

During the Construction Phase there will likely be an increase in traffic volume due to an increase in construction vehicles, construction crews and rerouting of vehicles. This will potentially cause congestion, increase levels of noise and dust and increase health and safety risks on the roads. The majority of construction sites will not impact major routes; however, the distribution pipeline to Reservoir A lies within Witbank CBD and increased traffic volume will have a more significant impact as these are major routes.

As news regarding the proposed project spreads, expectations regarding possible employment opportunities may take root, leading to an influx of jobseekers.

As indicated by a representative from the municipality, residential development is currently being planned south of the N4 highway, directly west of the existing Schoongezicht residential area. Should the Kromdraai collection pipeline proceed as planned, this future development is likely to be restricted, as these pipelines will require new servitudes. Route Refinement 2 has therefore been proposed to re-align the pipeline to run between the N4 and the R104, so as not to restrict the planned residential development.

The originally proposed Middelburg Steam and Station collection pipeline route was routed along an existing power line servitude which currently traverses Portion 9 of the farm Driefontein 297IR. A stakeholder indicated that this route traverses the footprint of the planned tailings facility and requested the route to be refined/re-aligned. Route Refinement 4 has therefore been proposed to re-align the pipeline to run along the eastern boundary of the property and then run along the servitude across Portion 27 to join the original alignment.

Mitigation measures

It is recommended that Anglo make use of local labour as far as possible and that employment recruitment policies be put in place for the Construction Phase, in order to maximise employment opportunities.

The following mitigation measures are recommended:

- Details of servitudes required during the Construction Phase should be made available in a clear and transparent manner and arrangements made to compensate for the temporary loss of access to landowners. Where possible, pipelines should follow existing servitudes, so as to reduce the need for further land restrictions;
- Where access to businesses is affected, or parking lots made temporarily unavailable, alternative access and parking should be provided in order to avoid any reduction in business productivity. Where private residential property is affected, care should be taken over any residential infrastructure such as trees, fences and access routes;

- Compensation assessments should be undertaken by independent registered valuers together with a social scientist and relevant company representative. This team will determine the respective rates, oversee negotiations, and facilitate the distribution process. This should include compensation relating to the replacement of lost assets, lost income or production, and lost access to social services;
- It is considered unlikely that property values will be negatively affected by the pipeline after construction as the pipeline will be buried, but this should be assessed by the valuers where landowners may have this concern and compensation determined accordingly;
- In light of this, it is recommended that Route Refinement 1 along the Kromdraai collection pipeline route be followed, as this will follow the existing road servitude south of the Sewage Treatment Plant;
- It is recommended that Route Refinement 3 of the KwaGuqa Reservoir distribution pipeline be followed, as this will reduce negative impacts and potential resettlement for the KwaGuqa x16 informal settlement;
- Activities of construction vehicles should be ceased during the night to reduce noise and disruption, and vehicles should be re-routed to avoid schools and busy public centres as far as possible. Health and safety road awareness should be administered to schools along with community awareness campaigns of the associated risks of increased heavy duty traffic. Furthermore, all vehicles should be maintained to acceptable safety standards in order to reduce risks to the general public and drivers;
- The construction areas should be clearly demarcated with security tape and signage should be erected to illustrate the dangers of open trenches etc. Awareness campaigns on health and safety aspects should be conducted by distributing pamphlets to community members and land owners;
- The construction teams should wear reflective clothing with identification cards and should undergo training in terms of protocols in dealing with the public, especially in terms of the correct procedure for handling the public (adults and children) that may be inquisitive and may not adhere to the safety warnings;
- Employment procedures and policies should be made available in a clear and transparent manner in order to reduce and manage potential population influx, thereby reducing associated impacts of pressure on local services; and
- It is recommended that Route Refinements 2 and 4 be followed to re-align the pipeline routes, so as not to restrict the planned residential and mine infrastructure development.

Impact significance

The relatively small number of job opportunities, combined with their temporary nature will mean this impact will have **low positive** significance.

The additional pipeline route to Reservoir A is likely to have the most significant impact (**moderate** impact) in terms of land access restrictions. The pipeline runs from the reservoir, located behind Witbank Mall, across a crossroads and down a street lined with businesses. All of these businesses require access from the street, and a number offer off-road parking which may be disrupted. However, with effective construction planning and coordination, each property should be immediately affected for a maximum of 2-3 weeks by construction activities.

The most environmentally intrusive pipeline (**moderate** impact) will be the distribution pipeline from Reservoir B to Reservoir A. This is because this pipeline enters residential areas. Construction activities here will lie within 10 m of small businesses lining the street, including a veterinary surgery and guest houses as well as a range of public services that face potential disturbance.

The majority of construction sites will not impact major routes; however, the distribution pipeline to Reservoir A lies within Witbank CBD and increased traffic volume will have a more significant impact (**moderate** impact) as these are major routes.

The linear nature of the proposed pipelines will mean employment will follow the pipeline route rather than remain in a fixed location and the relatively low level of job opportunities will mean any influx of jobseekers will be limited. Furthermore, should a population influx occur, it will be short term, as construction teams move along the pipeline route. Impact significance is therefore **low**. Since the WRP is a fixed location, impact significance is **moderate**.

7.5 Operational Phase

Table 18 below summarises those impacts directly related to the Operational Phase of the proposed project, and provides a significance rating for each impact before and after mitigation.

Table 18: Environmental Impact Assessment Matrix for the proposed eMalahleni Mine Water Reclamation Expansion Project – Operational Phase

POTENTIAL ENVIRONMENTAL IMPACT: OPERATIONAL PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
1. Geology												
n/a	-	-	-	-	-	-	-	-	-	-	-	-
2. Topography												
Should sections of a pipeline need to be replaced, the temporary stockpiling, compaction of in situ material, excavation, mixing, and replacement of excavated material will affect surface topography.	2	3	1	3	14	Low	2	3	1	2	12	Low
3. Soil												
Leaks or spills from collection pipelines will result in soil contamination.	4	1	1	4	24	Low	4	1	1	2	16	Low
Leaks or spills from distribution pipelines will result in soil erosion.	4	1	1	4	24	Low	4	1	1	2	16	Low
Should 50 Mℓ/day of treated (potable) water be discharged into the Naauwpoortspruit, the additional volume of water could result in erosion if not controlled adequately.	8	4	2	4	80	High	6	4	2	3	54	Mod
4. Land capability												
n/a	-	-	-	-	-	-	-	-	-	-	-	-
5. Ecology: fauna and flora												
n/a	-	-	-	-	-	-	-	-	-	-	-	-

POTENTIAL ENVIRONMENTAL IMPACT: OPERATIONAL PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
6. Ecology: aquatics												
Removal of mine water discharges from the streams will result in improved water quality (in terms of salinity).	8	4	3	5	96	High	8	4	3	5	96	High
Removal of the discharged mine water from the streams will revert the streams to their natural flow regimes and is considered to be a positive impact on macro-channel, riparian and in-stream habitats.	6	4	3	5	72	Mod	6	4	3	5	72	Mod
Removal of the discharged mine water from the streams will revert the streams to their natural flow regimes and is considered to be a positive impact on macroinvertebrates and ichthyofauna biota.	6	4	2	4	60	Mod	6	4	2	4	60	Mod
Accidental spills and leaks (including during scouring processes) from the collection pipelines will impact negatively on the water quality and the aquatic biota.	6	4	2	4	60	Mod	6	3	2	3	48	Mod
Accidental spills and leaks (including during scouring processes) from the collection and distribution pipelines and resulting erosion will impact negatively on the macro-channel, riparian and in-stream habitats.	8	4	2	4	80	High	4	2	2	3	28	Low

POTENTIAL ENVIRONMENTAL IMPACT: OPERATIONAL PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
In the event of an accident or an emergency, untreated mine water may be released from the proposed pump stations and/or water balancing/holding dams (forming part of the mine water collection system as well as at the WRP) and enter the surrounding ecosystem, causing impacts on water quality and increased erosion of the receiving channel.	8	4	2	4	80	**High**	4	2	2	3	28	**Low**
7. Surface water												
Reduced discharge volumes to the Kromdraaispruit will reduce stream flow.	6	5	2	3	60	**Mod**	6	5	2	2	54	**Mod**
Reduced discharge volumes to the Kromdraaispruit will improve water quality in terms of salinity.	6	4	2	4	60	**Mod**	6	4	2	6	72	**Mod**
Reduced discharge volumes to the Kromdraaispruit will no longer mask the other sources and acid conditions will prevail in the Kromdraaispruit.	6	3	2	3	48	**Mod**	4	4	2	2	32	**Mod**
Removal of an average of 1.6 Mℓ/d from Middelburg Steam and Station Collieries decant from the Klipspruit/Brugspruit will reduce stream flow.	3	4	2	4	30	**Mod**	2	4	2	4	20	**Low**
Removal of an average of 1.6 Mℓ/d from Middelburg Steam and Station Collieries decant from the Klipspruit/Brugspruit will improve water quality.	4	4	2	4	40	**Mod**	6	4	2	4	60	**Mod**
Flooding of the WRP site may occur should 50 Mℓ/day of treated water be discharged into the Naauwpoortspruit during times when flow in the river is high, or if heavy rainfalls occur soon after the discharge.	8	1	2	2	40	**Mod**	6	1	2	1	24	**Low**

POTENTIAL ENVIRONMENTAL IMPACT: OPERATIONAL PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
Should 50 Mℓ/day of treated water be discharged into the Naauwpoortspruit, water quality will improve.	6	1	2	2	30	Low	6	1	2	2	30	Low
Should 50 Mℓ/day of treated water be discharged into the Naauwpoortspruit, erosion of the discharge point as well as the downstream channel would increase, particularly if this discharge were to occur during a time when large rainfall events had occurred or were to occur shortly thereafter.	6	1	1	2	24	Low	4	1	1	2	16	Low
Leaks along the collection pipelines will saturate the soil profiles around the pipeline. This will impact on the water quality of the soil profile and local streams in which the seepage will daylight.	4	1	1	2	16	Low	4	1	1	1	12	Low
Bursts along the collection pipelines will cause local erosion and impact on the water quality of the immediate environment and local streams if the burst occurs at a river crossing.	6	1	2	2	30	Mod	6	1	2	1	24	Low
Spills during the scouring process along the collection pipelines will impact on the water quality of the immediate environment.	6	1	1	3	30	Mod	2	1	1	1	6	Low

POTENTIAL ENVIRONMENTAL IMPACT: OPERATIONAL PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
8. Groundwater												
The polluted (excess) mine water being abstracted, treated and re-used will significantly reduce the volumes of polluted mine water in the region, contribute significantly to cost savings in terms of water provision to end users, and make a contribution to replace water lost to the Ecological Reserve due to wider mining impacts in the Upper-Olifants catchment.	8	4	3	4	88	**High**	8	4	3	4	88	**High**
If the water level in the underground void (associated with the rehabilitated Central Pit 1) is higher than the surrounding natural aquifer a hydraulic gradient away from the pit will develop and this may cause the groundwater quality to deteriorate.	8	4	2	4	80	**High**	8	1	1	2	40	**Mod**
If the water level in the underground void (associated with the rehabilitated Central Pit 1) is lower than the surrounding aquifer a hydraulic gradient towards the pit will develop, which may result in the formation of a dewatering cone in the natural aquifer.	10	4	2	3	90	**High**	1 0	1	1	2	40	**Mo(**
9. Air quality												
Particulate matter or dust pollution may occur as a result of limestone handling at the WRP site.	4	2	1	4	28	**Low**	2	2	1	4	14	**Low**
10. Noise												
Conveyance of water through proposed collection and distribution pipelines, operating valves and water off-take points.	2	4	2	2	16	**Low**	2	4	2	2	16	**Low**

POTENTIAL ENVIRONMENTAL IMPACT: OPERATIONAL PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
Operation of the new (or upgraded) pump stations at the Kromdraai Liming Plant, the Brugspruit WPCW, Navigation and WRP site.	4	4	1	2	28	Low	4	4	1	2	28	Low
11. Heritage												
n/a	-	-	-	-	-	-	-	-	-	-	-	-
12. Wetlands[3]												
Removal of mine water discharges is considered to be a positive impact on the water quality.	2	4	2	4	20	Low	2	4	2	4	20	Low
Removal of mine water discharges is considered to be an overall positive impact on the seasonal habitat zone (more natural state).	6	4	2	4	60	Mod	6	4	2	4	60	Mod
Removal of mine water discharges is considered to be an overall positive impact on the permanently inundated habitat zones (more natural state).	4	4	2	4	40	Mod	4	4	2	4	40	Mod
Inundation and flow obstruction due to pipeline location and spills.	8	5	1	4	80	High	2	2	1	4	14	Low
Eroding of wetlands due to releases from pipeline scour valves.	6	3	2	5	60	Mod	4	2	1	4	28	Low
Degradation of wetland integrity due to spill of untreated water from collection pipelines, including scour valves.	8	3	3	5	88	High	6	1	2	4	42	Mod
13. Visual aspects												
n/a	-	-	-	-	-	-	-	-	-	-	-	-
14. Socio-economic												
Creation of employment opportunities.	2	2	4	1	14	Low	2	2	4	2	16	Low
Augmentation of local potable water supply.	6	3	4	5	72	Mod	8	4	3	5	96	High
Impacts on health and safety of local communities / residents resulting from pipeline leaks or bursts.	2	1	2	2	10	Low	2	1	2	1	8	Low

[3] General impact significance ratings have been provided here. For impact significance ratings for each wetland site, refer to APPENDIX K

7.5.1 Geology

There will be no additional impacts to geology during the Operational Phase of the project.

7.5.2 Topography

No additional impacts are expected to occur on topography during the Operational Phase of the project. Should sections of the pipelines need to be replaced, the impacts described under the Construction Phase resulting from temporary stockpiling, compaction of in situ material, excavation, mixing, and replacement of excavated material will take place.

7.5.3 Soils

Impact assessment

Leaks or spills of mine affected water from the proposed collection pipelines will result in soil contamination and erosion. Similarly, leaks or spills of treated (potable) water from the proposed distribution pipeline will result in soil erosion.

Pipelines are prone to "washout" after heavy rains in areas where they run up and down slopes.

In the unforeseen event that the treated water cannot be distributed to the various end users, the water (50 Mℓ/day) will be discharged into the Naauwpoortspruit. This additional volume of water could result in erosion if not controlled adequately.

Should sections of the pipelines need to be replaced, the impacts described under the Construction Phase resulting from pipeline excavation will take place.

Mitigation measures

Recommended mitigation measures include:

- The collection and distribution pipelines should be commissioned to check for leakages and repaired, if necessary, before backfilling of the trenches (during the Construction Phase) takes place. Inspections should take place on a daily basis;
- Erosion should be monitored throughout the Operational Phase and stabilised as soon as possible, wherever it occurs. Regular checks along the pipeline routes should be conducted, especially during the rainy season;
- Pipelines should be monitored for leaks and spills on a regular basis during the Operational Phase,;
- Repair damaged pipes immediately to avoid excessive spills;
- Prevent pipeline spillages and, should any occur, contain, clean up and rehabilitate immediately;
- Ensure that any release or spills from scour valves are contained and not released into the environment. In the event that any release or spills from scour valves are released into the environment, erosion control measures should be implemented; and
- Gabions should be installed at the discharge point to the Naauwpoortspruit to ensure that stream flow velocities are not significantly increased to such an extent that erosion may occur.

Impact significance

The impact significance rating of soil contamination by poor quality mine water is **low**. The negative impact is immediate and site specific. The impact can, however, hardly be reversed or mitigated. Poor quality water which drains into the soil profile cannot be removed or reclaimed. **Low** impacts are also anticipated as a result of pipeline leaks or spills causing soil erosion. In term of discharge to the Naauwpoortspruit, high magnitude impacts extending over a local scale are expected; impact significance is therefore anticipated to be **high**, but could be reduced to **moderate**, should appropriate mitigation measures be implemented.

7.5.4 Land capability

Once the collection and distribution pipelines have been constructed, there are not expected to be any additional impacts to land capability during the Operational Phase of the project.

7.5.5 Ecology: terrestrial fauna and flora

No additional impacts on terrestrial fauna and flora are anticipated during the Operational Phase. An ongoing alien invasive control programme needs to be conducted during this phase of the project.

7.5.6 Ecology: aquatics

Impact assessment

The following impacts are anticipated during the Operational Phase:

- The removal of mine water discharges from the streams is considered to be a positive impact on the water quality of the streams. In addition, the streams will revert to their natural flow regimes, which is considered to be a positive impact on macro-channel, riparian and in-stream habitats. The improved water quality and natural habitats will result in a positive impact on the aquatic biota at the sites;
- Accidental spills and leaks (including scouring processes) from the collection pipelines will impact negatively on water quality and aquatic biota;
- Erosion caused by accidental spills and leaks (including scouring processes) from the collection and distribution pipelines will impact negatively on the macro-channel, riparian and in-stream habitats; and
- Negative impacts on water quality and in-stream habitat disturbances may impact on the aquatic biota; and
- In the event of an accident or an emergency, untreated mine water may be released from the proposed pump stations and/or water balancing/holding dams (forming part of the mine water collection system as well as at the WRP) and enter the surrounding ecosystem, causing impacts on water quality and increased erosion of the receiving channel.

Mitigation measures

The following mitigation measures are recommended:

- Maintain pipeline service roads to avoid erosion and excessive dust formation;
- Monitor the pipelines for leaks and spills on a regular basis;
- Repair damaged pipes immediately to avoid excessive spills;
- Contain spills to avoid degrading water quality downstream;
- Prevent pipeline spillages and, should any occur, clean up and rehabilitate immediately;
- Implement corrective mitigation measures should any significant decrease in ecological integrity occur (both aquatic and wetland) (as indicated through implementation of the biomonitoring programme) as a result of impacts associated with the pipeline / watercourse crossings;
- At pump station and water holding facility sites, a suitable storm water and emergency management plan should be in place. Should any accidents occur, rehabilitation of any impacted aquatic ecosystems should be implemented immediately;
- At the WRP, the existing storm water management plan and procedures for the storage and disposal of chemicals, wastes and effluents associated with the plant, should be updated to include the additional components associated with the upgraded implemented; and

- In the event of an emergency, no discharge of any contaminated water into the receiving water environment should take place. Contaminated water should be stored in the mine water storage dams at the WRP. All pumping of contaminated water should be stopped, until the emergency is rectified. Implementation of site rehabilitation should be initiated immediately should any site impacts occur.

Impact significance

The improved water quality and natural habitats will result in a **moderate** to **high** positive impacts on the aquatic biota at the sites.

Accidental spills and leaks from the mine water collection system and/or the WRP will result in **moderate** to **high** impacts on aquatic ecology, occurring over the long term. Impact significance will, however, reduce to **moderate** to **low**, should the appropriate mitigation measures be implemented.

7.5.7 Surface water

Impact assessment

The following potential impacts are associated with the Operational Phase:

- The base flow of the Kromdraaispruit is dominated by the liming plant discharge. The removal of the discharge will significantly reduce the flow in the river which could impact negatively on the wetland system in terms of water flow. The removal of the liming plant discharge will impact on the salinity related water quality of the spruit. There are other sources of acid water in the catchment which might aggravate the acid conditions in the river if the liming plant discharge is removed;
- The decant from Middelburg Steam and Station Collieries also reports to the Brugspruit / Klipspruit River System. These decants are to be collected as part of the proposed expansion project and pumped to the WRP for treatment. Removing the decants will therefore impact the flow regime of the Brugspruit / Klipspruit as well as the river system's water quality;
- The discharge of treated water from the WRP to the Naauwpoortspruit could result in flooding, improved water quality, and erosion;
- Any spills or leaks from the collection pipelines (including scour valve discharges) will impact on the water quality of the soils. Seepage from the soils will impact on the local streams; and
- Bursts in the distribution and collection pipelines will cause local erosion. The water quality of the water conveyed in the collection pipelines will impact on the water quality of the local streams and areas around the burst. The water conveyed in the distribution pipelines will be treated to potable quality it will not impact negatively on the water quality of the receiving streams.

Reducing the discharge volume to the Kromdraaispruit

Reducing the amount of pre-treated (neutralised) mine water discharged into the Kromdraaispruit from the current 8 Mℓ/day to zero was assessed. The approach adopted was to use the time series of measured monthly flows and sulphate concentrations at the weir. Sulphate was chosen as the water quality variable to assess as it is a good indicator of the input from mining. Two cases were investigated. Case 1 is the reduction of the 8 Mℓ/day discharge to 3 Mℓ/day, which represents the situation for the remaining life of the mine. Case 2 is the removal of the full discharge which represents the situation after closure of the mine. The monthly flows at the weir were reduced by 5 Mℓ/day for Case 1 and by 8 Mℓ/day for Case 2. The average monthly flow volumes were calculated for the two cases for comparison to the current situation. The sulphate load to the river was reduced and a revised set of sulphate concentrations was calculated for the two cases.

The modelled monthly flow rates for the two cases together with the current flow volumes are given in Table 19 of APPENDIX G. The percentage reduction in flow is also given in the table. The results show that the removal of the discharge will result in a 40 % to 70 % reduction in flow for Case 1 and a 60 % to 95 % reduction for Case 2. The analysis results indicate that the reduction in flow is likely to be significant due to the removal of the liming plant discharge.

The calculated sulphate concentrations for the two cases together with the measured sulphate concentrations at the weir are shown plotted in Figure 6 of APPENDIX G. The analysis results show that the removal of the discharge will reduce the sulphate concentrations and improve the water quality in the Kromdraaispruit from a salinity perspective. However, the available water quality data for the Kromdraaispruit shows that the conditions are acidic in the spruit for at least 50 % of the time while the liming plant discharge is acidic for only 5 % of the time. This implies that there are other sources of acid in the Kromdraaispruit which will no longer be masked by the discharge once it stops.

Reducing the discharge volume to the Klipspruit / Brugspruit

The collection of the decants from the defunct mines that are the responsibility of the DMR have not been included in this EIA, although provision has been made in the design to collect the decants. The impact of collecting the decant from MS&S only has been assessed. The current discharge from MS&S is estimated to be 1 600 m^3/d and the water quality profile is given in Table 21 of APPENDIX G. The water quality profile shows that the decant is acid, high in heavy metals and saline. The RWQO for the salinity related variables, pH and the heavy metals exceed the RWQO. The impact of removing this water stream from the river system would be positive on the water quality.

The predicted reduction in the flow is shown in Table 22 of APPENDIX G. The results show that the impact on the flow regime is low with a reduction in the low flows of about 13 % reducing to 2 % for the higher flows. The percentiles of the current and modelled sulphate concentrations at B1H004 (flow gauge which includes the decant from Middelburg Steam and Station Collieries) are shown in Table 23 of APPENDIX G. The results show that the removal of the discharge will result in a lowering of the sulphate concentration. The reduction is, however, still insufficient for the RWQO to be met. The decants from the other defunct mines will need to be removed in order for the RWQO to be met.

Discharging treated water to the Naauwpoortspruit

There is currently no pre-treated mine water being discharged into the Naauwpoortspruit. The discharges into this river system will only occur as an emergency discharge from the WRP to be made in the unforeseen event that downstream users cannot take the water. The emergency discharges will be water of a potable standard. During the emergency discharges, a large volume of water (50 Mℓ/d) will be discharged as a once-off release into the Naauwpoortspruit. Table 25 of APPENDIX G shows the minimum, maximum, 5th, 50th and 95th percentiles of the daily flows measured at the B1H019 weir on the Naauwpoortspruit as well as the emergency discharge of 50 Mℓ/d.

The emergency discharge of 50 Mℓ/d is less than the 95th percentile of the measured flow at B1H019 and the emergency discharge was exceeded on 418 occasions in the daily flow record at B1H019 which extends from March 1990 to April 2010. This is a large volume of water to add to a small stream such as the Naauwpoortspruit. This large volume of water would be considerably more harmful to the stream should the discharge take place in months with relatively high stream flows; or occur within the periods of heavy rainfall, such as was experienced in the last two years.

An operating rule is proposed so that releases are reduced as the flow in the river increases. The releases are based on the gauge plate reading and the associated discharge at the B1H019 weir on the Naauwpoortspruit. The rule is summarised in Table 19, which relates the various discharges in the stream to the allowed discharges from the WRP in m^3/s as well as Mℓ/d.

The impact of the discharge on the instream water quality will be positive as the water will be treated to potable standards before discharge.

Table 19: Operating rules for the emergency discharge releases from the WRP, gauge plate readings and their associated discharges for the Naauwpoortspruit at weir B1H019

Gauge plate depth (m)	Discharge at B1H019 (m^3/s)	Allowed discharge (m^3/s)	Total flow (m^3/s)	Allowed discharge (Mℓ/d)
0	0.000	0.579	0.579	50

Gauge plate depth (m)	Discharge at B1H019 (m^3/s)	Allowed discharge (m^3/s)	Total flow (m^3/s)	Allowed discharge (Mℓ/d)
0.05	0.066	0.579	0.645	50
0.1	0.189	0.579	0.768	50
0.15	0.349	0.579	0.928	50
0.2	0.539	0.579	1.118	50
0.25	0.757	0.579	1.336	50
0.3	0.999	0.579	1.578	50
0.35	1.260	0.579	1.839	50
0.4	1.550	0.579	2.129	50
0.41	1.610	0.521	2.131	45
0.42	1.670	0.463	2.133	40
0.43	1.730	0.405	2.135	35
0.44	1.790	0.347	2.137	30
0.45	1.850	0.289	2.139	25
0.46	1.920	0.231	2.151	20
0.47	1.970	0.174	2.144	15
0.48	2.030	0.116	2.146	10
0.49	2.080	0.058	2.138	5
0.5	2.130	0.000	2.130	0
0.55	2.340	0.000	2.340	0

Collection and distribution pipelines

The proposed collection pipelines will convey untreated mine water while the proposed distribution pipelines will be delivering potable water to the water supply reservoirs. The collection pipelines are routed through mining areas, within existing mining / powerline / railway line servitudes and along road reserves. The pipelines will be buried and will not be vulnerable to vandalism or tampering. However, there could still be leaks or bursts from the pipelines. Leaks would infiltrate into the soil and would be noticeable on surface as a wet patch or areas of lush vegetation. Any leaks from the collection pipelines will also pollute the local subsurface water quality. For the distribution pipelines the local water quality will not be impacted negatively.

A pipeline burst will be seen on surface as a fountain of water. Pipeline bursts will result in local erosion and increase in flow in the local streams draining the area where the burst occurs. These bursts can be quickly identified due to a drop in pressure in the system and a reduction in volume reporting to the destination. The water quality of the local streams will be significantly impacted by a burst. Given the length of time that the burst will continue, the impact will be restricted to the local streams.

Scour valves / bleed points will be located at low points along the proposed pipelines. The locations of the scour valves are shown in Figure 7 of APPENDIX G. The scour valves will be used to discharge the water contained in the pipeline at these low points during times of pipeline maintenance (routine and emergency). For the collection pipelines, should this water not be collected and contained during times of maintenance, but be discharged directly into the environment, the receiving surface water environment will be impacted on in terms of water quality. To avoid this impact, the water in the collection pipelines should not be discharged to the environment, but collected in tankers and transported to the WRP for treatment. The only impact will be spills of water during the scouring process due to mismanagement.

Once the pipeline / watercourse crossings have been buried, no further impacts on the flows in the rivers are expected.

Mitigation measures

Reducing the discharge volume to the Kromdraaispruit

If the impact of the reduction in flow is considered to be high on the wetland and the aquatic ecology of the Kromdraaispruit, a portion of the flow can be returned to the river after neutralisation as would occur during the Operational Phase when 3 Mℓ/day will be returned to the system. However, this should only be considered if the wetland system is considered to be of high importance.

As indicated in APPENDIX K, the the importance of the wetland system at the Kromdraaispruit downstream of the liming plant (site KS) can be summarised as follows:

- A present ecological score of “Very Low” was assigned to this wetland. This score is outside of the generally excepted range and suggests that this wetland is seriously modified with extensive loss of natural habitat;
- The wetland attained a “Moderate” score for Ecological Importance and Sensitivity. This wetland is thus important on a provincial or local scale with the present biodiversity not being sensitive to flow and habitat modifications. Wetlands in this category play a small role in the quality of waters flowing into major rivers;
- The habitat integrity of this wetland was calculated and a C class was assigned to it. A loss and change of natural habitat has occurred; and
- Site KS scored “Moderate” for natural services and “Low” for human services. The natural services score was due to the loss of natural habitat and subsequent loss of some of the natural functions provided by the wetland. The “Low” human services score can be ascribed to the locality of the wetland. There are not many people in the vicinity of the wetland that are reliant on this particular wetland. This wetland is mostly effective in phosphate- and nutrient trapping, erosion control and toxicant removal.

In terms of aquatic ecology, site KS is in a critically modified state (Ecological Class F). Homogeneous habitat and poor water quality resulted in the lack of Ichthyofaunal diversity. Refer to APPENDIX J for details.

Based on the above, it can be concluded that the wetland system located downstream of the discharge point from the liming plant is not considered to be of high importance. Hence, it will not be absolutely necessary to return 3 Mℓ/day to the system upon mine closure. Anglo, should, however, investigate measures to improve the current condition of the wetland.

The removal of the neutralised discharge may result in acid conditions occurring more frequently in the Kromdraaispruit. This can be mitigated in the short-term by liming the discharge at the Kromdraaispruit. This has been attempted in the past. A liming plant is still located at the weir. In the long-term, Anglo should support an investigation to locate, collect and neutralise the acid streams, or to incorporate the acid streams in the collection system for treatment at the eMalahleni Mine Water Reclamation Plant.

Reducing the discharge volume to the Klipspruit / Brugspruit

Mitigation is not required as the impacts on the river system are low for the reduction of flow and positive for the improvement in water quality.

Discharging treated water to the Naauwpoortspruit

The following mitigation measures are proposed:

- A flood protection berm should be built along the WRP site to prevent flood water inundating the plant site should a discharge take place when the flow in the Naauwpoortspruit is high or if heavy rainfalls occur soon after a discharge;
- Discharge from the WRP into the Naauwpoortspruit should not be directly into the stream, but routed through a velocity reduction mechanism, such as a temporary storage dam. The discharge point should also have erosion reduction structures such as gabion baskets;
- Discharge would need to follow the operating rules described in Table 19, including:
  - The WRP should not be allowed to make the full discharge of 50 Mℓ/d into the stream unless the flow downstream at weir B1H019 is less than 1.55 m^3/s; and
  - The total flow in the stream, which includes the natural flow and the discharge, should not exceed 2.16 m^3/s. This would protect the people, farms and industries downstream from flooding. The weir would therefore need to be monitored daily to facilitate the application of this rule.

Spills or leaks from the collection and distribution pipelines

The following mitigation measures are recommended:

- A leakage detection system and routine pipeline inspections should be undertaken;
- The pipeline will have a pressure and volume monitoring system which will detect bursts. The burst must be repaired immediately as part of the pipeline maintenance schedule. Sufficient valves should be in place along the pipeline to isolate the burst as quickly as possible;
- Remediation protocols should be developed to remediate the area after a burst or where extensive leaks have occurred; and
- Protocols for scouring the collection pipelines should be developed to prevent spills from entering the river systems. If spills do occur, the remediation protocols should be applied.

Impact significance

The removal of the 8 Mℓ/day discharge from the Kromdraaispruit will impact significantly on the low flow regime in the spruit. The reduction in the flow could impact on the wetland system and aquatic ecology. Impact significance is therefore **moderate**. Neutralised water could, however, be released post closure to maintain the wetland system if the importance of the wetland system is regarded as high. Impact significant could therefore be reduced.

The removal of the liming plant discharge will result in a **moderate positive** impact on the salinity related water quality of the spruit. However, there are other sources of acid water in the catchment which might aggravate the acid conditions in the river if the liming plant discharge is removed. This could result in **moderate** impacts occurring over the long term on a regional scale (i.e. the greater Olifants Catchment).

The negative impact on the flow regime of removing the 1.6 Mℓ/day Middelburg Steam and Station decant from the Klipspruit system is **low**. The removal of the decant will result in a **moderate positive** impact on the water quality in the Klipspruit/Brugspruit system.

The discharge of treated water from the WRP to the Naauwpoortspruit under emergency conditions will improve the water quality of the stream. However, the proposed release of 50 Mℓ/day is a significant flow when compared to the flows measured in the Naauwpoortspruit. An operating rule was developed so that the discharge can take place and not cause flooding of the Naauwpoortspruit.

Should flooding of the WRP site occur as a result of discharging treated water to the Naauwpoortspruit when flow in the river is high, or if heavy rainfalls occur soon after the discharge, **moderate** negative impacts will take place. Impacts will be of very high magnitude, but will be immediate and on a local scale. Should the appropriate mitigation measures be implemented, impact significance can be reduced to **low**.

Discharge from the WRP into the adjacent stream would have a **moderate positive** impact on the water quality, due to the water quality being considerably better than that of the Naauwpoortspruit. The negative impact of discharge on the erosion of the discharge point as well as the downstream channel would be **moderate**, particularly if this discharge were to occur during a time when large rainfall events had occurred or were to occur shortly thereafter. This impact could, however, be reduced to low, should the appropriate mitigation measures be implemented.

The impact of leaks along the collection pipelines will be **low**. Bursts from the collection pipelines will, however, result in a **moderate** impact, as the scale and magnitude of the impact would be larger. Impacts resulting from the mismanagement during the scouring process will be minor and site specific; the impact is therefore anticipated to be **low**.

7.5.8 Groundwater

Impact assessment

Mine water abstraction

It is expected that there will be no negative impact on the groundwater regime as a result of abstracting mine water from the Kromdraai and Excelsior and Navigation Sections of Landau Colliery, as well as from Middelburg Steam and Station Collieries. The water models (see Section 4.1) predict that the volumes of water that will be abstracted as part of the expansion scheme are available as excess water, which is either currently being discharged to surface water resources as neutralised or polluted water, is being evaporated, or is starting to flood new mine workings.

A **high** positive impact will, however, be incurred as the polluted (excess) mine water being abstracted, treated and re-used will significantly reduce the volumes of polluted mine water in the region, contribute significantly to cost savings in terms of water provision to end users, and make a contribution to replace water lost to the Ecological Reserve due to wider mining impacts in the Upper-Olifants catchment.

Waste disposal

Since the capacity of the WRP will increase from 25 Mℓ/day to 50 Mℓ/day, additional volumes of waste sludge gypsum and brine will be generated. As indicated in Section 2.1.5, it is proposed that these wastes be disposed at existing mine waste disposal facilities and/or at newly constructed facilities at Blaauwkrans Dump site at Navigation.

Since the quality of the mine (feed) water to the WRP will differ from that of the current feed water (see Table 11), the composition of the gypsum sludge may change. Since it is proposed that this gypsum sludge be disposed of into the Yellow Buoy Section of the Blaauwkrans Dump, the quality of future seepage from the Yellow Buoy Section to groundwater may change. *Note*: the brine will be disposed into the existing brine lagoon at the WRP site and/or newly constructed brine lagoons at Blaauwkrans, which are lined facilities. Therefore, seepage to groundwater should not occur.

Mass balance modelling results were used to indicate future gypsum sludge quality as a result of the WRP expansion and changes in feed water quality (i.e. Kromdraai, Excelsior and Navigation Sections of Landau Colliery, and Middelburg Steam and Station Collieries) (APPENDIX H).

The indicative composition and leachate quality of the gypsum sludge associated with the proposed WRP expansion suggests that the quality of future seepage from the Yellow Buoy Section will generally remain unchanged. It is, however, recommended that the modelled estimates of sludge composition and process water quality be replaced by laboratory results on sludge samples from the upgraded and expanded WRP when these become available. In particular, the leachability of trace elements, such as arsenic, from the material placed in the Yellow Buoy Section should be assessed.

It is therefore anticipated that no impacts on the groundwater environment will occur as a result of placing the gypsum sludge from the expanded and upgraded WRP into the Yellow Buoy Section of the Blaauwkrans Dump.

Storage of mine affected water in underground mine voids (associated with rehabilitated Central Pit 1)

In terms of the collection system at Kromdraai, subsequent to mine closure, and the decommissioning of the Liming Plant, the abstracted water will be conveyed via pipelines to an underground mine void (associated with a rehabilitated opencast pit, namely Central Pit 1), prior to being pumped to the WRP.

It is expected that the water table in the rehabilitated pit will be hydraulically connected with the adjacent natural Karoo aquifer. The groundwater risks associated with using the rehabilitated pit as a water storage facility can be as follows:

- The water stored in the rehabilitated pit will come in contact with material that may cause a deterioration in the water quality. Of particular concern is the presence of pyrite that will oxidise and produce Acid Mine Drainage (AMD). If the water level in the pit is higher than the surrounding natural aquifer a hydraulic gradient away from the pit will develop and this may cause the groundwater quality to deteriorate.
- If the water level in the pit is lower than the surrounding aquifer a hydraulic gradient towards the pit will develop, which may result in the formation of a dewatering cone in the natural aquifer.

Interaction between the two water bodies will be governed by the following:

- The aquifer parameters such as the transmissivity and hydraulic conductivity of the aquifer material; and
- The hydraulic gradient between the pit and the surrounding aquifer.

The aquifer parameters will govern the inflow rate into or out of the pit dependent on the hydraulic gradient and direction of flow. Low aquifer parameters in either the pit material or the natural aquifer will reduce the potential impact as well as the extent of the impact. This means that groundwater contamination or the development of a dewatering cone will be restricted to the immediate vicinity of the pit.

To minimise the interaction between the aquifers and the extent of the impact, it is recommended that the water level in the pit be maintained at a similar level than that of the natural aquifer. This will reduce flow between the two aquifers.

7.5.9 Air quality

Impact assessment

The upgraded WRP will make use of membrane-based treatment technology. No odour generation is expected when using this treatment technology. Particulate matter or dust pollution may, however, occur as a result of limestone handling at the WRP site.

Mitigation measures

The following mitigation measures are recommended:

- If possible, undertake handling activities in covered areas; and
- Implement adequate dust suppression measures.

Impact significance

The impact associated with the release of particulate matter during the handling of limestone is regarded as minor, highly probable, short term, and restricted to the site only. Impact significance is therefore **low**.

7.5.10 Noise

Impact assessment

During the Operational Phase, ambient noise levels may increase due to the following:

- Conveyance of water through the proposed pipelines, operating valves and water off-take points; and
- Operation of the new (or upgraded) pump stations at the Kromdraai Liming Plant, the Brugspruit WPCW, Navigation and at WRP site.

Mitigation measures

Recommended mitigation measures include:

- Pipelines need to be operated within their design and safety limits;
- Conduct standardised noise measurements on equipment, pump stations, etc; and
- Ensure systematic maintenance of all equipment, including pump stations.

Impact significance

Noise generated as a result of conveyance of water through the proposed pipelines will be an insignificant contributor to background noise levels, especially since the pipelines will be buried. Impact significance is therefore **low**. Similarly, noise impacts resulting from the pump stations are also considered to be **low**. Impacts are unlikely to extend beyond the pump station site.

7.5.11 Archaeological or cultural historical sites

The Phase 1 Heritage Impact Assessment (APPENDIX L) indicated that there will be no impacts on archaeological or cultural historical sites for any of the phases of the project.

7.5.12 Wetlands

Impact assessment

The operational pipelines may result in the following impacts:

- If the pipeline is not buried deep enough below ground, water flow will be impeded and inundation could occur. This will further result in habitat loss in the wetland and possible decrease in water downstream of the pipeline;
- If the release from the scour valves is not contained it could cause erosion in the wetland channel and subsequent habitat degradation and loss; and
- If the spill from the damaged scour valves or pipelines is not addressed immediately it could cause erosion in the wetland channel and subsequent habitat degradation and loss due to decreased water quality.

At Site KS, the reduction/removal of mine water discharges:

- Is considered to be a positive impact on the water quality of the entire project area, as the water currently flowing down the Kromdraaispruit is very acidic;
- Will revert the seasonal wetland zones size to a more natural state. Although the seasonal wetland area will then be smaller than usual, the overall impact will be positive; and
- Will change the permanently inundated zones to seasonally inundated zones, which is a more natural state. The overall impact will be positive.

At Site BS, the reduction/removal of mine water discharges:

- Is considered to be a positive impact on the water quality of the entire project area, as the water currently flowing down the Blesbokspruit is very acidic;
- Will revert the seasonal wetland zones size to a more natural state. Although the seasonal wetland area will then be smaller than usual the overall impact will be positive; and
- Will change the permanently inundated zones to seasonally inundated zones, which is a more natural state. Vegetation diversity will increase as the quality of the water now entering the system from adjacent seeps will improve. The overall impact will be positive. Due to the seep feeding into the Blesbokspruit, the valley bottom will be replenished.

Mitigation measures

Mitigation measures include:

- Prevent pipeline and scour valve spillages;
- Should any pipeline and scour valve spillages occur, clean up and rehabilitate immediately;
- Monitor the pipelines for leaks and spills on a regular basis;
- Repair damaged scour valves and pipes immediately to avoid excessive spills;
- Contain any spills to avoid degrading downstream water quality; and
- Implement rehabilitation where negative habitat impacts have occurred and are likely to occur in the future.

Impact significance

In general, negative impacts associated with inundation are **moderate**. There are instances, such as at Site WC4, where impacts will be **high**.

Spills of untreated mine water from the mine water collection system could result in impacts of **high** significance. This activity will result in high magnitude impacts as it could cause erosion in the wetland channel and subsequent habitat degradation and loss due to poor water quality. Impacts will also be regional and over the medium term. These impacts can, however, be reduced to **low**, should appropriate mitigation measures, such as prevention and containing of spills, be implemented.

Impacts associated with the reduction/removal of mine water discharges from river systems are considered to be **low** to **moderate positive** impacts.

7.5.13 Visual aspects

No additional impacts are anticipated during the Operational Phase, provided that limestone handling at the WRP site is managed sufficiently to avoid excessive dust pollution (see Section 7.5.9 above).

7.5.14 Socio-economic

Impact assessment

The Operational Phase of the proposed project will result in the creation of around 10-20 permanent job opportunities; employment creation is positive. The major benefit of the proposed project is the impact on potable water, as the project will augment the country's supply of water, producing an additional 25 Mℓ of treated water per day, which is critical given the fact that South Africa is a water scarce country.

Impacts on the health and safety of local communities / residents may result from pipeline leaks or bursts.

Mitigation measures

It is recommended Anglo make use of local labour as far as possible and employment recruitment policies be put in place for the Operational Phase, in order to maximise employment opportunities.

Regular monitoring of the treated water and the WRP should be undertaken in order to ensure the quality of the treated water supply to communities and address the current problems of water standards, thereby maximising the potential benefits of the expansion scheme.

It is recommended that Anglo implements a community awareness campaign throughout the Operational Phase. The purpose of this campaign should be to create awareness among the local communities / residents / affected landowners of the potential risks associated with the pipelines. The campaign could include the distribution of pamphlets, talks at local schools, etc. Signage could also be erected at various points along the pipelines to illustrate the dangers of the contents of the pipelines (particularly the collection pipelines). Implementation of the community awareness campaign will also reduce the risks of theft or vandalism to the pipelines.

Impact significance

Although employment creation is **positive**, the limited number of opportunities available means this impact will be of **low** significance.

The impact on potable water supply is a **highly positive** impact, as it will occur on a regional scale over the long term.

The impact of pipeline bursts or leaks on community health and safety is likely to be **low**.

7.6 Decommissioning Phase

Table 20 below summarises those impacts directly related to the Decommissioning Phase of the proposed project, and provides a significance rating for each impact before and after mitigation.

Table 20: Environmental Impact Assessment Matrix for the proposed eMalahleni Mine Water Reclamation Expansion Project – Decommissioning Phase

POTENTIAL ENVIRONMENTAL IMPACT: DECOMMISSIONING PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
1. Geology												
n/a	-	-	-	-	-	-	-	-	-	-	-	-
2. Topography												
Should the pipelines be removed, the temporary stockpiling, compaction of in situ material, excavation, mixing, and replacement of excavated material will affect surface topography	2	3	1	3	14	**Low**	2	3	1	2	12	**Low**

POTENTIAL ENVIRONMENTAL IMPACT: DECOMMISSIONING PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
3. Soil												
Should the pipelines be reclaimed, the natural soil profile and horizon sequences will be disturbed which will cause the natural functioning of soils in terms of a growth medium and habitat for fauna and flora to cease; and potential soil erosion.	8	2	1	5	64	**Mod**	6	2	1	5	48	**Mod**
During backfilling of pipeline trenches, topsoil may be mixed with subsoil or rocky material, reducing soil fertility.	6	4	1	4	54	**Mod**	4	4	1	1	24	**Low**
During the backfilling of pipeline trenches on rehabilitated land (along the Kromdraai collection pipeline route), topsoil may be mixed with low quality spoil material, resulting in soil pollution.	8	4	1	4	72	**Mod**	4	4	1	1	24	**Low**
Soil compaction will result from mechanical equipment.	2	2	1	4	14	**Low**	2	2	1	2	10	**Low**
Soil may be polluted with oil and fuel spillages from mechanical equipment.	6	2	1	2	30	**Mod**	4	2	1	1	16	**Low**
4. Land capability												
±88 ha of agricultural land and ±86 ha of wilderness/grazing land capability will be affected during pipeline reclamation.	2	2	1	5	16	**Low**	2	2	1	5	16	**Low**
5. Ecology: terrestrial fauna and flora												
Vegetation clearing and stripping of topsoil during pipeline reclamation.	6	4	1	4	54	**Mod**	4	2	1	3	24	**Low**
Noise of machinery and human activities will drive fauna from the area.	6	2	1	3	36	**Mod**	4	2	1	3	24	**Low**
The disturbance of vegetation clearing will further contribute to the establishment of alien invasive species in the area.	8	4	1	5	80	**High**	4	1	1	2	16	**Low**

POTENTIAL ENVIRONMENTAL IMPACT: DECOMMISSIONING PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
6. Ecology: aquatics												
Removal of pipeline/watercourse crossings will impact on water quality and aquatic biota.	6	2	2	4	48	**Mod**	4	2	1	2	20	**Low**
Removal of pipeline/watercourse crossings will impact on macro-channel and riparian habitats.	8	3	2	4	72	**Mod**	6	2	2	4	48	**Mod**
Removal of pipeline/watercourse crossings will impact on in-stream habitats.	6	2	2	4	48	**Mod**	4	2	2	4	32	**Mod**
Removal of pipeline/watercourse crossings will impact on macroinvertebrates and ichthyofauna biota.	6	2	2	4	48	**Mod**	4	2	2	4	32	**Mod**
7. Surface water												
Alteration of stream beds and banks, temporary stream flow reduction and impedance due to pipeline reclamation across watercourses. Further impacts to surface water resources may occur due to increased sedimentation of water sources as a result of exposed soils due to vegetation clearing and soil stripping operations.	4	2	1	2	20	**Low**	2	2	1	1	8	**Low**
8. Groundwater												
Accidental spillage of oil or other hydrocarbons and pollutants along the proposed pipeline routes and within the decommissioning sites/camps may result in groundwater contamination.	2	2	1	2	10	**Low**	2	2	1	1	8	**Low**

POTENTIAL ENVIRONMENTAL IMPACT: DECOMMISSIONING PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
9. Air quality												
Vehicle emissions, and dust generated by vehicles traversing the decommissioning sites and by excavating pipeline trenches.	2	2	2	4	16	Low	2	2	1	4	14	Low
10. Noise												
Decommissioning related activities, such as movement of heavy machinery and vehicle traffic, will also result in temporary impacts on noise levels in the study area.	6	2	2	3	42	Mod	4	2	2	3	28	Low
11. Heritage												
n/a	-	-	-	-	-	-	-	-	-	-	-	-
12. Wetlands[4]												
Bed disturbance, vegetation removal and habitat degradation as a result of construction of pipeline / watercourse crossings.	8	2	1	5	64	Mod	6	2	1	5	48	Mod
Inundation as a result of construction of pipeline / watercourse crossings.	8	2	2	5	72	Mod	2	2	1	4	14	Low
Dust and sediment settling on the wetland as a result of construction of pipeline / watercourse crossings.	6	2	2	5	54	Mod	4	2	2	4	32	Mod
Compacting of soils as a result of construction of pipeline / watercourse crossings.	8	3	2	5	80	High	8	2	1	4	56	Mod
13. Visual aspects												
Reclamation of the collection and distribution pipelines will temporarily transform the physical landscape, i.e. removal of natural vegetation and land cover, transformation of the site topography; presence of new infrastructure; and dust pollution.	6	2	2	5	54	Mod	4	2	2	5	36	Mod

[4] General impact significance ratings have been provided here. For impact significance ratings for each wetland site, refer to APPENDIX K

POTENTIAL ENVIRONMENTAL IMPACT: DECOMMISSIONING PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	Total	SP	M	D	S	P	Total	SP
Removal of project infrastructure, such as pump stations and water/balancing holding facilities will transform the landscape.	4	5	2	5	48	Mod	4	5	2	5	48	Mod
14. Socio-economic												
A temporary increase in employment opportunities followed by a decrease.	4	2	2	2	24	Low	4	2	2	4	32	Mod
Noise and dust impacts associated with decommissioning activities.	See 9 and 10 above											
Health and safety impacts associated with decommissioning activities.	4	2	2	3	28	Low	4	2	2	2	24	Low
Should the WRP be decommissioned, potential impacts may occur on the availability and quality of potable water for local communities and the wider population.	10	4	2	4	100	High	6	4	2	2	48	Mod

7.6.1 Geology

No additional impacts on geology are expected during the Decommissioning Phase.

7.6.2 Topography

Should the pipelines be removed during decommissioning, the impacts described under the Construction Phase as a result of the temporary stockpiling, compaction of in situ material, excavation, mixing, and replacement of excavated material will take place. All relevant mitigation measures provided for the Construction Phase should therefore be implemented.

7.6.3 Soils

Should the collection and distribution pipelines be removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated. All relevant mitigation measures provided for the Construction Phase should therefore be implemented. Should the aim be to reclaim the collection pipelines upon decommissioning, possible soil pollution along the pipeline routes may also occur, should poor quality mine water remaining in the system leak into the environment.

7.6.4 Land capability

Should the collection and distribution pipelines be reclaimed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated. All relevant mitigation measures provided for the Construction Phase should therefore be implemented.

7.6.5 Ecology: terrestrial fauna and flora

Should the proposed collection and distribution pipelines, etc be reclaimed/removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated. All relevant mitigation measures provided for the Construction Phase should therefore be implemented.

7.6.6 Ecology: aquatics

Should the proposed collection and distribution pipelines, etc be reclaimed/removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated. All relevant mitigation measures provided for the Construction Phase should therefore be implemented.

7.6.7 Surface water

Any impacts incurred due to maintenance or decommissioning are expected to be the same as described for the Construction Phase. All relevant mitigation measures provided for the Construction Phase should therefore be implemented.

7.6.8 Groundwater

Should the proposed collection and distribution pipelines, etc be reclaimed/removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated. All relevant mitigation measures provided for the Construction Phase should therefore be implemented.

7.6.9 Air quality

Should the proposed collection and distribution pipelines, etc be reclaimed/removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated. All relevant mitigation measures provided for the Construction Phase should therefore be implemented.

7.6.10 Noise

Should the collection and distribution pipelines, etc be reclaimed/removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated, with the exception of those related to blasting. All relevant mitigation measures provided for the Construction Phase should therefore be implemented.

7.6.11 Archaeological or cultural historical sites

The Phase 1 Heritage Impact Assessment (APPENDIX L) indicated that there will be no impacts on archaeological or cultural historical sites for any of the phases of the project.

7.6.12 Wetlands

Should the collection and distribution pipelines, etc be reclaimed/removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated. All relevant mitigation measures provided for the Construction Phase should therefore be implemented.

7.6.13 Visual aspects

Should the collection and distribution pipelines be reclaimed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated, with the exception of those related to blasting. All relevant mitigation measures provided for the Construction Phase should therefore be implemented.

Should project infrastructure, such as the pump stations and water balancing/holding facilities, be removed during this phase, a **moderate positive** impact on visual aspects will occur, provided that affected sites are rehabilitated (re-vegetated) and become stabilised and self-sustaining.

7.6.14 Socio-economic

Impact assessment

Decommissioning Phase can only be approximated and may be subject to significant change. It is recommended that:

- A detailed Closure Plan is developed during the Operational Phase prior to closure;
- Linkages are made with government for handover of the pipelines / sections;
- Sections of the pipeline are reused or recycled where feasible; and
- Alternative uses for the pipeline are fully investigated.

Potential impacts associated with the Decommissioning Phase may include the following:

- A temporary increase in employment opportunities followed by a decrease;
- Noise and dust impacts associated with decommissioning activities;
- Health and safety impacts associated with decommissioning activities; and
- Potential impacts on the availability and quality of potable water for local communities and the wider population.

These impacts should be fully assessed and options explored to mitigate these impacts during the Closure Plan.

Mitigation measures

Potential mitigation measures may include:

- Undertake a programme of retrenchment and re-training during the Operational Phase, providing employees with clear, transparent information on planned activities and closure dates, offering employment at similar sites where possible and full retrenchment packages;
- Conduct an analysis of possible sustainable community development programmes to be put in place;
- Support an investigation into alternative sources of water during the Operational Phase to ensure a continuous, safe supply of water to communities;
- Support an assessment to determine the complete removal of acid mine drainage, meaning local communities will not experience impacts related to continued pollution and health and safety issues; and
- Conduct an analysis of alternative uses for the pipeline to assess future employment opportunities.

Impact significance

Health and safety impacts are anticipated to be **low**. Impacts on the availability and quality of potable water for local communities and the wider population will be very **high**. It will not be easy to mitigate these impacts and appropriate measures would need to be detailed in the Closure Plan. There will, however, be a temporary increase in employment opportunities, resulting in a **low positive** impact. This impact could be enhanced to **moderate**, should labour be sourced from local communities.

7.7 Cumulative impacts

Soil, land capability and land use

Due to the already highly disturbed nature of the soils in the study area, the proposed project will probably result in low cumulative negative impact to soils acting over the long-term, and affecting the immediate *site*.

Fauna and flora

Due to the already highly disturbed nature of the flora and fauna within the study area, the total cumulative negative impact during all phases of the project will probably only be of a low significance, affecting the local extent, and acting in the medium-term.

Surface water

As part of the feasibility study for the proposed project, a water resources impact assessment was conducted (APPENDIX Q). The key aim of this study was to determine the impact of removing the discharges of Kromdraai, Middelburg Steam and Station Collieries, and other defunct mines (namely Old Douglas 1 and Transvaal and Delagoa Bay Collieries) on the water quality (salt load specifically) and water quantity of the Klipspruit, Wilge and Loskop Dam catchments.

The assessment required the assembling and calibrating of a catchment scale salt load model. Ten monitoring stations throughout the study area were used to calibrate the model. The modelling results indicated that by removing the discharges from the river system:

- Sulphate concentrations would reduce significantly (Table 21) The removal of the discharges will improve adherence to the RWQO set for these river systems; and
- A small negative impact on water quantity will result (Table 22). The proposed project will have a low impact on the yield of the Loskop Dam.

Table 21: Summary of the impact on sulphate concentration

Sulphate concentration impacts	Klipspruit % Reduction	Wilge % Reduction	Loskop Dam % Reduction	Impact
Kromdraai and Middelburg Steam and Station discharges excluded	11.8	47.4	6.3	Large positive
Kromdraai and Middelburg Steam and Station, Old Douglas 1 and Transvaal and Delagoa Bay discharges excluded	66.2	47.4	13.2	Large positive

Table 22: Summary of the impact on quantity (yield)

Water quantity impacts	Klipspruit % Reduction	Wilge % Reduction	Loskop Dam % Reduction	Impact
Kromdraai and Middelburg Steam and Station discharges excluded	3.2	1.5	1.9	Small negative
Kromdraai and Middelburg Steam and Station, Old Douglas 1 and Transvaal and Delagoa Bay discharges excluded	8.5	1.5	3.1	Small negative

The cumulative negative impact for all phases of the development will be outweighed by the positive impact of eliminating decant from the contributing mines, and supplementing the Ecological Reserve.

Wetlands

The cumulative negative impact of the pipeline / watercourse crossings on wetlands will probably be high and act in the medium-term, affecting the local extent. Cumulative positive impacts are, however, expected as a result of removing/reducing mine water discharges/decants to the river systems.

Air quality

Impacts on air quality resulting from the proposed project are considered to be low within context of existing pollution from industry and motorways in the area. The contributions to cumulative impacts are therefore considered to be insignificant.

Noise

Since the proposed project components are situated in close proximity to existing noise impacts, such as the N4/N12 Highway, the Greenside Colliery Rapid Load-out Terminal (RLT), mining operations, major roads in urban residential areas, etc., the contributions of the proposed project to cumulative impacts are considered to be insignificant.

7.8 Assumptions and knowledge gaps / limitations

General

The proposed collection pipelines for Kromdraai and Excelsior and Middelburg Steam and Station, the distribution pipeline leading to KwaGuqa Reservoir and the additional pipeline leading to Reservoir A from Witbank Reservoir will be new pipelines. The Navigation collection pipeline and the majority of the Witbank Reservoir distribution pipeline will preferably make use of existing pipelines, or new ones will be constructed in existing servitudes, reducing land restriction and construction related impacts.

The Water Reclamation Plant (WRP) expansion will take place within the existing plant footprint, meaning no further land will be affected, and impacts will relate solely to construction activities. Proposed new waste disposal sites have already been permitted, thus impacts relating to their construction have not been addressed in this EIA and specialist studies.

Soil, land use and land capability

A 100 m buffer zone could not be surveyed in the tight timeframes for the project. The pipeline route was surveyed and an approximate 30 m buffer zone was covered. Numerous route refinements were made after the fieldwork had been completed. Some of these changes fall outside the surveyed 30 m buffer zone and information had to be interpolated.

Terrestrial ecology

This assessment was based on information collected during a single site visit conducted during January 2010 and a survey for the route refinements in April 2010. No detailed soil, geological or geotechnical information was available at the time of the survey. In order to obtain a comprehensive understanding of the dynamics of communities and the status of endemic, rare or threatened species in any area, vegetation and faunal assessments should consider investigations at different time scales (across seasons/years) and through repetition. In such a scenario, the precautionary principle should be applied and all natural portions of grassland should be regarded as sensitive.

Furthermore, due to the vast expanse of the study area in relation to the time available for the completion of this study, most conclusions have been based on single sampling events for both the original pipeline and the route refinements. Limitations of this method of sampling include the following:

- Temporal changes in biodiversity are not taken into account during single sampling events;
- Variations in biodiversity due to temporal animal movements, such as migrations, are not taken into account; and

- Unusual environmental conditions (such as unusually high or unusually low rainfall) may cause temporary states of biodiversity during the period of study, which may differ from the norm.

Aquatic ecology

The following was assumed for the purposes of the aquatic ecosystem study:

- The maps supplied were correct and that all the major aquatic and wetland pipeline crossings were identified and listed; and
- The information supplied by Anglo was correct at the time that fieldwork commenced.

The following limitations were placed on the aquatic and wetland ecosystem study of this project:

- A single wet season baseline assessment was conducted;
- Accuracy of the maps, aquatic and wetland pipeline crossings, routes and desktop assessments were made using the current 1:50 000 topographical map series of South Africa;
- Accuracy of Global Positioning System (GPS) coordinates were limited to ±15 m in the field;
- Local security issues in and around many of the sites and locations reduced the length of time spent in the field by specialists; and
- Many of the sites were impacted and degraded as a result of surrounding human activities. This limited the existing functioning and condition of the aquatic and wetland habitats.

Heritage

It is possible that the Phase 1 HIA may have missed heritage resources in the project area, as some heritage sites may occur in thick clumps of vegetation while others may lie below the surface of the earth and may only be exposed once development commences.

Human health

Conclusions regarding the potential risks associated with microbiological contamination subsequent to the proposed expansion of the WRP and with the substances that were not modelled cannot be reached with confidence. However, it is understood that the concentrations of substances and microorganisms in potable water delivered by the expanded WRP will not be higher than those currently delivered.

Ammonia concentrations in the potable water delivered by the expanded WRP were not modelled. If the dedicated NH_3 stripper proposed for the expanded WRP does not result in lower NH_3 concentrations than those measured in the current product, ammonia may have a detrimental effect on consumer acceptability of the product delivered by the expanded WRP. It must be noted, however, that the presence of ammonia at concentrations measured in the current water product is unlikely to affect consumer health.

The Human Health Risk Assessment was based on analytical results presented to INFOTOX. The assessment was a valid interpretation of the potential human health risks associated with domestic use of reclaimed water only in so far as the analysis results are representative of the quality of water that will be produced by the WRP. Daily, and in some cases weekly water quality results, were made available for the period June 2008 to September 2009.

The high frequency of sampling and the extended sampling period (16 consecutive months) ensured a high degree of confidence in the validity of the samples as being representative of the water quality to be expected from the WRP. Comparison of the mean values with the 99^{th} percentiles indicated that excessive variations in water quality parameter values and in concentrations of non-radioactive substances are not likely. The human health risk assessment is therefore a valid interpretation of the health risks potentially associated with the ingestion of potable water produced by the WRP over the long term.

The human health risk assessment based on the results of the microbiology investigation is a valid interpretation of the health risks potentially related to the ingestion of potable water produced by the WTP over the long term.

INFOTOX assessed the modelled results (Keyplan (Pty) Ltd 2010(a)) as basis for the risk assessment of the potential future water quality subsequent to the proposed expansions, but cannot judge the quality or the validity of the model or the accuracy of the results.

The database available for assessment of potential human health risks subsequent to the proposed expansion of the WRP is limited and therefore the conclusions regarding the future potable water product are tentative.

Socio-economic

The primary assumption underpinning this study is that all information received from Anglo, other specialist studies and Interested and Affected Parties (I&APs) was correct and valid at the time of the study. In this regard, the study team is confident that the social and socio-economic environment has been adequately assessed and that the findings presented in this report provide an accurate reflection of the *status quo* and future projections of the potential socio-economic impacts associated with the construction and operation of the proposed project.

The social profile of the community is largely based on data from secondary sources, which has been supplemented by stakeholder and affected landowner interviews. For the purposes of this assessment, this data is sufficient; however, extrapolations from this data may not be completely accurate in reflecting individual communities and households.

Figures quoted in the estimates of certain impacts (e.g. numbers of employment opportunities that will be created) may be subject to change, should the project design alter. In such cases, conservative estimates were employed.

It is assumed that the Construction Phase will require a servitude of up to 20 m and the Operational Phase will require a servitude of up to 10 m; potential impacts of the proposed project have been rated accordingly.

Assessment has been made on the basis that all pipelines will be buried. Operational impacts have therefore assumed a concept of land restrictions to areas affected, rather than a policy of land lost. Should the pipeline design alter, further assessment would need to be undertaken in order to determine the social significance of overland pipelines.

It is not anticipated that any relocation will be required for any of the project components. Should relocation be necessary, a separate survey and analysis would be required.

Water balance model

- Confidence in the calculated recharge of Middelburg Steam and Station Collieries could be increased through the use of rainfall data for the same period as decant flow measurements;
- The coal floor contours and decant elevations need to be confirmed by the Kromdraai survey department as these could have a major implication for pumping rates at various in-pit pond areas; and
- Model calibration for Kromdraai was largely based on metered dewatering, but did not account for pit storage changes. Model calibration for Kromdraai may be improved depending on the availability of metered pumping and water level data.

8.0 ENVIRONMENTAL MANAGEMENT PLAN

8.1 Purpose of this EMP

This Environmental Management Plan (EMP) is based on the results of the Environmental Impact Assessment as outlined in Chapter 7 of this document, and addresses the management and mitigation of the environmental impacts resulting from the proposed activities associated with the eMalahleni Mine Water Reclamation Expansion Project. Both the EIA Report and this EMP have been prepared in accordance with the requirements of the Regulations GN R 385 under the National Environmental Management Act, 1998 (Act 107 of 1998).

8.2 Implementation of the EMP

A number of activities must take place before commencement of construction. Certain of these activities are not directly related to physical work on site, but are presented below, as they should be addressed before commencement of, or during the early phases of construction.

8.2.1 Anglo's responsibility for EMP implementation

Primary responsibility for implementation of the EMP rests with Anglo, who must ensure that all contracting companies tendering for work receive a copy of the EMP and understand their responsibility to operate within the framework of the measures defined in the EMP. When adjudicating tenders, Anglo will ensure that contractors have made appropriate allowance for the management of environmental matters. Anglo will appoint an Environmental Control Officer (ECO) who will be present on site as often as possible, but who will, as a minimum, undertake EMP audits every month during the Construction Phase. ECO audit intervals during the Operational Phase should be confirmed and agreed with the ECO before commencement with this phase.

8.2.2 Responsibility of contractors

All contracting companies will receive a copy of the EMP at time of tender. Each contractor is to familiarise himself with the environmental management measures for the site and ensure that contracting prices allow for environmental costs.

At appointment each contractor must have his copy of the EMP on site. It is the responsibility of the contractors to ensure that all of their staff are aware of the measures applicable to their area of work on site. It is the responsibility of the contractor to bring to the attention of the Anglo ECO any environmental incident or breach of the conditions of the EMP, within 24 hours of occurrence of such event, through the company's Incident Reporting System.

8.2.3 Environmental incidents and breaches of EMP conditions

The ECO will bring to the attention of the Anglo site manager major environmental incidents or breaches of the conditions of the EMP, within 24 hours of occurrence of such event. The site manager will notify the controlling authority within 48 hours of such an incident, if the environmental incident constitutes a breach of any permit or licence condition.

The ECO will continuously monitor the contractor's adherence to the EMP and will issue the contractor with a notice of non-compliance whenever transgressions are observed. The ECO will record the nature and magnitude of the non-compliance in a register, the action taken to discontinue the non-compliance, the action taken to mitigate its effects and the results of the actions. The contractor should act immediately when a notice of non-compliance is received and implement the agreed corrective action.

Any avoidable non-compliance with the EMP will be considered sufficient grounds for the imposition of a penalty. The value of the penalty will be equal to the cost of corrective action, i.e. the cost to the contractor equals twice the cost of corrective action. Any non-compliance with the agreed procedures of the EMP is a transgression of the various statutes and laws that define the manner in which the environment is managed. Set penalties should be enforced. Penalties shall be specified in the contract with the Contractor.

8.2.4 Complaints management

Complaints received regarding activities on the construction site pertaining to the environment should be recorded in a register and the response noted with the date and action taken. This record should be submitted with the monthly reports and a verbal report should be given at regular site meetings.

8.3 Construction Phase EMP

The following mitigation measures have been identified for the Construction Phase of the proposed project (Table 23).

8.4 Operational Phase EMP

The following mitigation measures have been identified for the Operational Phase of the proposed project (Table 24).

8.5 Decommissioning Phase EMP

The following mitigation measures have been identified for the Decommissioning Phase of the proposed project (Table 25).

Table 23: Environmental Management Plan for the eMalahleni Mine Water Reclamation Expansion Project – Construction Phase

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
1. Geology				
1.1	**Project activity:**	Possible blasting of hard rock in sections of the pipeline route	-	-
	Impact:	Blasting would displace sections of hard rock	-	-
	Mitigation measure(s):	Implement appropriate blasting techniques which keep blast shock to a minimum	As appropriate, throughout construction	Contractor
2. Topography				
2.1	**Project activity:**	During pipeline construction, the temporary stockpiling, compaction of in situ material, excavation, mixing, and replacement of excavated material.	-	-
	Impact:	The stockpiling of material on surface will alter surface topography. Settling is expected to occur over the areas where the buried pipelines have been laid. Compaction is also expected over areas where vehicles and plant equipment travel regularly.	-	-
	Mitigation measure(s):	Excavated material is to be stockpiled in windrows not exceeding 1.5 m in height adjacent to the excavation for the collection and distribution pipelines.	As necessary, throughout excavation	Contractor
		Excavated material should be stockpiled in a manner where it can act as storm water control berms.	As necessary, throughout excavation	Contractor
		Storm water cut-off drains should be located regularly along construction servitudes.	As necessary, throughout construction	Contractor
		Separate stripping of the material is required when constructing bulk earthworks to ensure that excavated clays, loams, and plinthic materials are not mixed, and can be returned in the former position during rehabilitation.	As necessary, throughout excavation	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
		Ensure that rehabilitation areas are ripped to a suitable depth (minimum of 500 mm).	As necessary, during rehabilitation	Contractor
		Ensure that the area is shaped to be free draining after rehabilitation is complete.	As necessary, during rehabilitation	Contractor
		Profile the area to be the same as the original topography.	As necessary, during rehabilitation	Contractor
		Harrow the area after seeding to ensure that the topography is re-established so that deep furrows are avoided.	As necessary, during rehabilitation	Contractor
		A surface water drainage plan should be compiled prior to construction.	Once, prior to construction	Contractor
2.2	**Project activity:**	The construction of the storage/balancing sumps and/or pumps stations.	-	-
	Impact:	Permanent alternation of surface topography.	-	-
	Mitigation measure(s):	Cannot be mitigated	-	-
3. Soil				
3.1	**Project activity:**	Excavating pipeline trenches	-	-
	Impact:	Disturbance of natural soil profile and horizon sequences which will cause the natural functioning of soils in terms of a growth medium and habitat for fauna and flora to cease, and potential soil erosion.	-	-
	Mitigation measure(s):	Where possible, locate pipelines in existing mine trenches positioned within 10-30 m of the proposed pipeline routes.	Where relevant, throughout excavation	Contractor
		Topsoil stripping should include the vegetation seed bed to facilitate in revegetation of the area.	As necessary, throughout excavation	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
		Excavated material should be stockpiled in a manner where it can act as storm water control berms.	As necessary, throughout construction	Contractor
		Storm water cut-off drains should be located regularly along construction servitudes and the pipeline routes to avoid erosion of stockpiled materials.	As necessary, throughout construction	Contractor
		Pipeline trenches should be backfilled shortly after the pipeline has been declared leakage free.	Once, after the pipeline has been declared leakage free	Contractor
		Conserve the stockpiled topsoil by protecting it against erosion; do not stockpile topsoil long enough to lose function.		
		Rehabilitate backfilled pipeline trenches. Loosen and level soils with a ripping and disc action and seed with 2 or 3 annual local species. Lime should be applied at 1 ton per ha after the ripping action and can be worked into the upper 100-150 mm of soil with the disc action.	As necessary, in spring or early summer	Contractor
		A fertiliser mixture such as 2:3:2(22) should be applied directly after seeding.	Once, immediately after seeding (shortly after good rains)	Contractor
		A second application of 100 kg 2:3:2(22) fertiliser mixture should be applied.	Once, after 6 weeks of initial application (after good rains)	Contractor
		Erosion should be monitored and stabilised as soon as possible wherever it occurs.	As necessary, throughout construction	Contractor
		A soil stripping and erosion plan must be compiled.	Once, prior to commencement of construction	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
		All disturbed areas must be profiled and stabilised, and erosion control measures must be installed in places identified as being at risk of erosion.	As necessary, throughout construction	Contractor
3.2	**Project activity:**	Backfilling pipeline trenches	-	-
	Impact:	Topsoil may be mixed with subsoil or rocky material reducing soil fertility.	-	-
	Mitigation measure(s):	Topsoil and excavated material is to be stockpiled in separate windrows not exceeding 1.5 m in height, adjacent to the excavation for the collection and distribution pipelines.	As necessary, throughout excavation	Contractor
		Separate stripping of the material is required to ensure that excavated black/yellow clays, loams, and plinthic/saprolitic materials are not mixed, and can be returned in their former position during rehabilitation.	As necessary, throughout excavation	Contractor
3.3	**Project activity:**	Backfilling pipeline trenches on rehabilitated land (along the Kromdraai collection pipeline route specifically)	-	-
	Impact:	Topsoil may be mixed with low quality spoil material, resulting in soil pollution	-	-
	Mitigation measure(s):	In mining areas that have been rehabilitated, mixing coaliferous spoil material with topsoil should be avoided at all costs. Spoil material should by no means be penetrated and trenches should be excavated only to the depth of the spoil material. After the trench is backfilled, soil should then be graded from both sides on top of the closed trench to create a berm of 300 to 500 mm high in order to provide more protection to the pipeline and which can simultaneously serve as a method to demarcate the pipeline.	As necessary, throughout construction	Contractor
3.4	**Project activity:**	Use of mechanical equipment		
	Impact:	Soil compaction		
	Mitigation measure(s):	Ensure that rehabilitated areas are ripped to a suitable depth (minimum of 500 mm or to refusal).	As necessary, throughout rehabilitation	Contractor
3.5	**Project activity:**	Oil and fuel spillages from mechanical equipment	-	-
	Impact:	Soil pollution	-	-
	Mitigation measure(s):	Contamination due to oil and fuel spillages should be avoided.	As necessary, throughout	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
			construction	
		Strict guidelines should be given to contractors in terms of the mechanical condition of equipment used, the maintenance of equipment as well as the reporting and cleaning up procedures of spillages, should they occur.	Once, prior to construction	Anglo
		All oil contaminated or otherwise polluted soil and wastes from the construction areas is to be removed to licensed landfill sites using a registered waste disposal company.	As necessary, throughout construction	Contractor
4. Land capability				
4.1	**Project activity:**	Excavating pipeline trenches.	-	-
	Impact:	±88 ha of agricultural land and ±86 ha of wilderness/grazing land capability will be impacted upon during pipeline construction.	-	-
	Mitigation measure(s):	The pipelines should be buried more than 1 m below the surface where possible to ensure that land capability can return to its pre-construction state.	As necessary, throughout construction	Contractor
		A mutually acceptable agreement must be drawn up with landowners to compensate them in the event of crop loss and servitude rights.	Once, prior to construction	Anglo
		See 3.1-3.5 above.		
5. Ecology: terrestrial flora and fauna				
5.1	**Project activity:**	Vegetation clearing and stripping of topsoil during pipeline, etc construction.	-	-
	Impact:	Loss of vegetation communities and animal habitat; loss of biodiversity	-	-
	Mitigation measure(s):	Areas where disturbance is permissible should be demarcated prior to construction activities taking place.	Once, prior to construction	Contractor
		Vegetation audits need to be conducted prior to commencement of construction activities. These audits need to be conducted in the construction demarcated areas located in areas of a high and moderate sensitivity (including secondary grasslands) (see Figure 3 of APPENDIX I). These areas may contain protected species, such as *Brunsvigia radulosa* and *Gladiolus ecklonii.*	As necessary, prior to construction	ECO
		Daily audits need to be conducted ahead of construction to identify if any fauna need to be relocated, especially burrowing mammals.	As necessary, prior to	ECO

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
			construction	
		Should any protected species or burrowing mammals be found within an area demarcated for construction, no disturbance to this area should take place. If this is not possible, the protected species or mammal must be relocated.	As necessary, prior to construction	ECO
		All exotic and invasive species should be removed within the 20 m construction servitude.	As necessary, throughout construction	Contractor
		Indigenous and currently occurring species, such as *Eragrostis* species, should be planted in rehabilitated areas and maintained.	As necessary, during rehabilitation	Contractor
		All replanting activities should be undertaken at the end of the dry season (middle to end September) to ensure optimal conditions for germination and rapid vegetation establishment	As necessary, during rehabilitation	Contractor
		All areas that were planted pasture or natural vegetation before construction must be reseeded.	As necessary, during rehabilitation	Contractor
		Inspect rehabilitated areas at three monthly intervals during the first and second growing season to determine the efficacy of rehabilitation measures.	As necessary, during rehabilitation	Contractor
		Remedial action is required where vegetation establishment has not been successful or erosion is evident.	As necessary, during rehabilitation	Contractor
		Grazing livestock need to be kept away from rehabilitated areas, for two growing seasons.	As necessary, during rehabilitation	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
5.2	**Project activity:**	Presence of machinery and human activities.	-	-
	Impact:	Drives fauna away from the area.	-	-
	Mitigation measure(s):	See Section 10 below.		
5.3	**Project activity:**	Vegetation clearing and stripping of topsoil during pipeline, etc construction.	-	-
	Impact:	Disturbance created by vegetation clearing will further contribute to the establishment of alien invasive species in the area.	-	-
	Mitigation measure(s):	An ongoing alien invasive control programme should be implemented for the duration of the project. All exotic and invasive species should be removed within the 20 m servitude.	As necessary, throughout Construction and Operational Phases	ECO
6. Ecology: aquatics				
6.1	**Project activity:**	Construction of pipeline/watercourse crossings.	-	-
	Impacts:	Impact on water quality, aquatic biota, and macro-channel, riparian and in-stream habitats.	-	-
	Mitigation measure(s):	Clean up and rehabilitate any accidental spillages.	As necessary, throughout construction	Contractor
		Devise and implement a relocation plan if rare and sensitive species are identified during construction.	Once, plan to be in place prior to construction. Implement as necessary throughout construction	ECO
		Implement dust suppression on dirt roads.	As necessary, throughout construction	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
		At sites 1, 3, 4 and 5, construct the proposed pipelines as close to the existing upstream road servitudes as possible.	As necessary, throughout construction	Contractor
		Place the relevant sections of the pipelines below the groundwater flow component of the streams and wetlands so as to not impede the flow and impact the sites once construction is completed.	As necessary, throughout construction	Contractor
		Construct pipeline / watercourse crossings during the dry season.	As necessary, throughout construction	Contractor
		Construct pipeline / watercourse crossings in stages so as to limit the impact to the sites. As one stage is complete, rehabilitate the habitat before starting the next construction section.	As necessary, throughout construction	Contractor
		Implement low impact construction techniques so as to minimise the impact on the river system, especially during the diverting of any water during construction.	As necessary, throughout construction	Contractor
		Where possible, keep construction activities out of wetland areas. Limit movement of construction vehicles within wetlands. Restrict vehicles to service roads.	As necessary, throughout construction	Contractor
		Implement suitable vegetation and habitat rehabilitation where construction site impacts occur. This should be done in consultation with a suitably qualified person.	As necessary, throughout rehabilitation	Contractor / suitably qualified person / ECO
		Where wetland soils have been compacted, labourers should loosen soils with light weight tools.	As necessary, throughout construction	Contractor
		Implement corrective mitigation measures should any significant decrease in ecological integrity occur (both aquatic and wetland) within any biomonitoring period as a result of impacts associated with the pipeline / watercourse crossings.	As necessary, throughout construction	ECO

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
7. Surface water				
7.1	**Project activity:**	Pipeline construction across watercourses.	-	-
	Impact:	Alteration of stream bed and banks, temporary stream flow reduction and impedance, increased sedimentation and turbidity of water sources.	-	-
	Mitigation measure(s):	All mitigation measures for soil, vegetation, wetlands, and sensitive landscapes should be implemented.	As necessary, throughout construction	Contractor
		Construction roads should be planned prior to commencement of the Construction Phase to ensure that the minimum numbers of roads are located in wetland or natural vegetation areas.	Once, prior to commencement of the Construction Phase	Contractor
		During backfilling, soils should be well compacted and vegetation re-established as soon as possible to prevent erosion.	As necessary, throughout construction	Contractor
		Construction activities within the 1 in 50- and 1 in 100 year floodlines should be limited as far as possible. No construction sites/camps should be located within the 1 in 50- and 1 in 100 year floodlines.	As necessary, throughout construction	Contractor
		All soil and rock and gravel stockpiles should be located outside the 1:50 year floodline.	As necessary, throughout construction	Contractor
		Vehicle traffic in watercourses should be limited in frequency, and avoided during wet periods.	As necessary, throughout construction	Contractor
		Watercourse crossings should be constructed during the dry season.	As necessary, throughout construction	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
		Strip wetland soils separately according to colour and replace in the same order according to the former position in the soil profile to avoid significant mixing of soils.	As necessary, throughout excavation	Contractor
		Only non-carbonaceous fill material should be used for pipeline / watercourse crossing sites.	As necessary, throughout backfilling	Contractor
		Ensure that wetland soils are adequately ripped in areas of disturbance to ensure regrowth of the vegetation and percolation of water is optimal.	As necessary, throughout rehabilitation	Contractor
		Riverbanks over the disturbed areas should be profiled to emulate the adjacent undisturbed slopes.	As necessary, throughout rehabilitation	Contractor
		Soil and vegetation must be rehabilitated before the next rainy season.	As necessary, throughout rehabilitation	Contractor
8. Groundwater				
8.1	**Project activity:**	Accidental spillage of oil or other hydrocarbons and pollutants along the proposed pipeline routes and within the construction sites/camps.	-	-
	Impact:	Groundwater contamination	-	-
	Mitigation measure(s):	Implement pollution prevention techniques on all construction equipment, e.g. drip trays on trucks	As necessary, throughout construction	Contractor
		Immediately remove soils contaminated with oils and other hydrocarbons or pollutants and dispose as hazardous waste.	As necessary, throughout construction	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
9. Air quality				
9.1	**Project activity:**	Vehicles traversing the construction sites; excavating pipeline trenches.	-	-
	Impact:	Vehicle emissions, and dust generation.	-	-
	Mitigation measure(s):	Ensure that dust suppression measures are implemented on exposed soils and dust generating roads.	As necessary, throughout construction	Contractor
		Ensure that vehicles are serviced regularly and that vehicles with emission problems are identified speedily and rectified.	As necessary, throughout construction	Contractor
10. Noise				
10.1	**Project activity:**	Blasting in areas of hard rock along the proposed pipeline routes.	-	-
	Impact:	Increased ambient noise levels.	-	-
	Mitigation measure(s):	Apply due diligence and all industry-accepted methods to limit factors contributing to the development of a shockwave and noise as a result of blasting.	As necessary, during blasting	Contractor
		Ensure that sufficient consultation with all potentially affected landowners occurs prior to blasting.	As necessary, prior to blasting	Contractor
		Control blasting operations to ensure sound pressure levels are kept below the generally accepted 'no damage' level of 140 dB, or any other levels that may apply to a specific area as determined by municipal ordinances, etc.	As necessary, during blasting	Contractor
10.2	**Project activity:**	Other construction related activities, such as movement of heavy machinery and vehicle traffic.	-	-
	Impact:	Increased ambient noise levels.	-	-
	Mitigation measure(s):	Limit construction working hours to between 6am and 6pm in areas where local residents may be affected, and to week days.	As necessary, throughout construction	Contractor
		Ensure efficient design and maintenance of silencers on diesel-powered vehicles and equipment.	As necessary, throughout construction	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
		Train personnel to adhere to operational procedures that reduce the occurrence and magnitude of individual noisy events.	As necessary, throughout construction	Anglo / Contractor
11. Heritage				
11.1	**Project activity:**	Pipeline, pump station construction and related activities	-	-
	Impact:	Impacts on heritage resources / archaeological or cultural historical sites.	-	-
	Mitigation measure(s):	Should, any heritage resources of significance be exposed during the construction of the project, the South African Heritage Resources Authority (SAHRA) should be notified immediately, all development activities should be stopped and an archaeologist accredited with the Association for Southern African Professional Archaeologist (ASAPA) should be notified in order to determine appropriate mitigation measures for the discovered finds. This may include obtaining the necessary authorisation (permits) from SAHRA to conduct the required mitigation measures.	If required, throughout construction	Anglo / Contractor
12. Visual				
12.1	**Project activity:**	Construction activities, dust mobilisation, and construction vehicles traversing the proposed pipeline routes and WRP site.	-	-
	Impact:	These activities will temporarily transform the physical landscape, i.e. removal of natural vegetation and land cover, transformation of the site topography; presence of new infrastructure; and dust pollution.	-	-
	Mitigation measure(s):	Screen construction sites along the proposed pipeline routes, if possible	As necessary, throughout construction	Contractor
		Subsequent to backfilling, profile the area to be the same as the original topography.	As necessary, throughout rehabilitation	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
		Rehabilitate affected areas as soon as possible.	As necessary, throughout rehabilitation	Contractor
		Employ proper "housekeeping" at construction camps/sites.	As necessary, throughout construction	Contractor
		Implement effective dust suppression.	As necessary, throughout construction	Contractor
		Use selective and judicious lighting for the construction sites, if required.	As necessary, throughout construction	Contractor
12.2	**Project activity:**	Installation of new infrastructure, e.g. pump stations and water balancing/holding facilities.	-	-
	Impact:	Presence of new infrastructure in the landscape.	-	-
	Mitigation measure(s):	Apply colour variations on the outward surfaces of the infrastructure. Use colours complementary to the colours in the surrounding landscape.	Once, during construction	Contractor
		Where possible, structures should be partially sunken into the landscape.	Once, during construction	Contractor
13. Wetlands				
13.1	**Project activity:**	Pipeline / watercourse crossings.	-	-
	Impact:	Bed disturbance, vegetation removal and habitat degradation	-	-
	Mitigation measure(s):	At Site WC12, install the pipeline to the southern side of pan, or on the southern side of the existing pipeline running through the pan, as this area has already been heavily impacted upon.	Once, during construction	Contractor
		Construct the pipeline / watercourse crossings above ground on existing road and railroad servitudes, and existing pipe bridges at sites WC 1, WC3, WC4, WC5, WC6 and WC8.	As necessary, during construction	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
		If a road is to be built in future below the wastewater works at Site WC6 (RR1), then the proposed pipeline should be constructed along the road servitude.	As necessary, during construction	Contractor
		Construct pipeline / watercourse crossings in stages so as to limit the impact to the sites and during the dry season.	As necessary, during construction	Contractor
		Avoid dumping of construction materials and spoils within the wetlands.	As necessary, throughout construction	Contractor
		Implement rehabilitation where negative habitat impacts have occurred and are likely to occur in future.	As necessary, throughout construction	Contractor
		Revegetate bare areas and remove exotic vegetation.	As necessary, throughout construction	Contractor
		Clean up and rehabilitate any accidental spillages or impacts to the aquatic and wetland ecosystems.	As necessary, throughout construction	Contractor
		Devise and implement a relocation plan if rare and sensitive species are identified during construction.	Devise plan prior to construction. Implement throughout construction	ECO

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
13.2	**Project activity:**	Pipeline / watercourse crossings.	-	-
	Impact:	Inundation.	-	-
	Mitigation measure(s):	Ensure that the proposed pipelines are buried below the groundwater level.	As necessary, throughout construction	Contractor
		Allow for ample flow through of water should additional culverts be constructed.	As necessary, throughout construction	Contractor
13.3	**Project activity:**	Pipeline / watercourse crossings.	-	-
	Impact:	Dust and sediment settling on the wetland.	-	-
	Mitigation measure(s):	Keep construction activities and heavy vehicles out of the wetland areas, where possible. Limit movement of construction vehicles within wetlands. Restrict vehicles to service roads.	As necessary, throughout construction	Contractor
		Implement dust suppression on dirt roads during construction to avoid excessive dust formation.	As necessary, throughout construction	Contractor
		Maintain service roads to avoid erosion and excessive dust formation.	As necessary, throughout construction	Contractor
13.4	**Project activity:**	Pipeline / watercourse crossings.	-	-
	Impact:	Compacting of soils	-	-
	Mitigation measure(s):	Where wetland soils have been compacted, labourers should loosen soils with light weight tools.	As necessary, throughout construction	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
14. Socio-economic				
14.1	**Project activity:**	Pipeline construction and WRP upgrade.		
	Impact:	Creation of employment opportunities.		
	Mitigation measure(s):	Make use of local labour as far as possible and employment recruitment policies should be put in place, in order to maximise employment opportunities.	As necessary, throughout construction	Anglo
14.2	**Project activity:**	Pipeline construction.	-	-
	Impact:	Access to land along the proposed collection and distribution pipeline routes will be restricted during construction.	-	-
	Mitigation measure(s):	Details of servitudes required should be made available in a clear and transparent manner and arrangements made to compensate landowners for the temporary loss of access. Where possible, pipelines should follow existing servitudes, so as to reduce the need for further land restrictions.	As necessary, prior to construction	Anglo
		Where access to businesses is affected, or parking lots made temporarily unavailable, alternative access and parking should be provided in order to avoid any reduction to business productivity. Where private residential property is affected, care should be taken over any residential infrastructure such as trees, fences and access routes.	As necessary, throughout construction	Contractor
		Compensation assessments should be undertaken by independent registered valuers together with a social scientist and relevant company representative. This team will determine the respective rates, oversee negotiations, and facilitate the distribution process. This should include compensation relating to the replacement of lost assets, lost income or production, and lost access to social services.	As necessary, prior to construction	Anglo
		It is considered unlikely that property values will be negatively affected by the pipelines after construction as the pipeline will be buried, but this should be assessed by the valuers where landowners may have this concern and compensation determined accordingly.	As necessary, prior to construction	Anglo

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
		Route Refinement 1 along the Kromdraai collection pipeline route should be implemented, as this will follow the existing road servitude south of the Sewage Treatment Plant.	As necessary, during construction	Contractor
		Route Refinement 3 of the KwaGuqa Reservoir distribution pipeline should be implemented, as this will reduce negative impacts and potential resettlement for the KwaGuqa x16 informal settlement.	As necessary, during construction	Contractor
14.3	**Project activity:**	Increase in construction vehicles accessing the pipeline routes and WRP.	-	-
	Impact:	Increase in traffic.	-	-
	Mitigation measure(s):	Activities of construction vehicles should be re-routed to avoid schools and busy public centres as far as possible. Activities of construction vehicles should be ceased during the night to reduce noise and disruption. Health and road safety awareness should be administered to schools along with community awareness campaigns of the associated risks of increased heavy duty traffic. All vehicles should be maintained to acceptable safety standards in order to reduce risks to the general public and drivers.	As necessary, throughout construction	Contractor
14.4	**Project activity:**	Pipeline construction and WRP upgrade.	-	-
	Impact:	Environmentally intrusive impacts along the pipeline routes and at the WRP, e.g. health and safety, dust and noise.	-	-
	Mitigation measure(s):	The construction areas should be clearly demarcated with security tape and signage should be erected to illustrate the dangers of open trenches etc. Awareness campaigns should be conducted by distributing pamphlets on the health and safety aspects to all community members and land owners.	As necessary, throughout construction	Contractor
		The construction teams should wear reflective clothing with identification cards and should undergo training in terms of protocols in dealing with the public, especially in terms of the correct procedure for handling the public (adults and children) that may be inquisitive and may not adhere to the safety warnings.	As necessary, throughout construction	Contractor

Construction Phase Environmental Management Plan			Timeline and frequency	Responsible party
14.5	**Project activity:**	Influx of jobseekers along the proposed pipeline routes and at the WRP.	-	-
	Impact:	Social change and increased pressure on local services.	-	-
	Mitigation measure(s):	Employment procedures and policies should be made available in a clear and transparent manner.	As necessary, prior to and throughout construction	Anglo / Contractor
14.6	**Project activity:**	Pipeline construction and operation.	-	-
	Impact:	Planned developments may be impacted by the proposed pipeline routes.	-	-
	Mitigation measure(s):	Route Refinements 2 and 4 should be implemented to re-align the pipeline routes, so as not to restrict the planned residential and mine infrastructure development.	As necessary, during construction	Contractor

Table 24: Environmental Management Plan for the eMalahleni Mine Water Reclamation Expansion Project – Operational Phase

Operational Phase Environmental Management Plan			Frequency and Timeline	Responsible party
1. Geology				
1.1	**Project activity:**	n/a	-	-
	Impact:	n/a	-	-
	Mitigation measure(s):	n/a	-	-
2. Topography				
2.1	**Project activity:**	The temporary stockpiling, compaction of in situ material, excavation, mixing, and replacement of excavated material, should sections of the pipelines need to be replaced.	-	-
	Impact:	The stockpiling of material on surface will alter surface topography. Settling is expected to occur over the areas where the buried pipelines have been laid. Compaction is also expected over areas where vehicles and plant equipment travel regularly.	-	-
	Mitigation measure(s):	See 2.1 Construction Phase EMP		
3. Soil				
3.1	**Project activity:**	Spillages and leaks of mine affected water from collection pipelines.		
	Impact:	Soil contamination and erosion.		
	Mitigation measure(s):	The collection pipelines should be commissioned to check for leakages and repaired, if necessary, before backfilling of the trenches takes place.	Once, prior to backfilling during Construction Phase	Contractor
		Erosion should be monitored and stabilised as soon as possible, wherever it occurs.	As necessary, throughout the Operational Phase	Anglo

Operational Phase Environmental Management Plan			Frequency and Timeline	Responsible party
		Pipelines should be monitored for leaks and spills.	Regularly, throughout the Operational Phase	Anglo
		Repair damaged pipes immediately to avoid excessive spills.	When necessary, throughout the Operational Phase	Anglo
		Should pipeline spillages occur, contain, clean up and rehabilitate immediately.	When necessary, immediately after spill	Anglo
		Ensure that any release or spills from scour valves are contained and not released into the environment.	As necessary, throughout the Operational Phase	Anglo
3.2	**Project activity:**	Spillages of treated potable water from distribution pipelines.	-	-
	Impact:	Soil erosion.	-	-
	Mitigation measure(s):	The distribution pipelines should be commissioned to check for leakages and repaired, if necessary, before backfilling of the trenches takes place.	Once, prior to backfilling during Construction Phase	Contractor
		Erosion should be monitored and stabilised as soon as possible, wherever it occurs.	As necessary, throughout the Operational Phase	Anglo

Operational Phase Environmental Management Plan			Frequency and Timeline	Responsible party
		Pipelines should be monitored for leaks and spills.	Regularly, throughout the Operational Phase	Anglo
		Repair damaged pipes immediately to avoid excessive spills.	When necessary, throughout the Operational Phase	Anglo
		In the event that any release or spills from scour valves are released into the environment, erosion control measures should be implemented.	As necessary, throughout the Operational Phase	Anglo
		Inspect areas where pipelines go up/down a slope for washout after a heavy rain event.	As necessary, after heavy rain events	Anglo
3.3	**Project activity:**	Discharge of 50 Mℓ/day of treated (potable) water into the Naauwpoortspruit, in the unforeseen event that the treated water cannot be distributed to the various end users.	-	-
	Impact:	The additional volume of water could result in erosion if not controlled adequately.	-	-
	Mitigation measure(s):	Gabions should be installed at the discharge point to the Naauwpoortspruit to ensure that stream flow velocities are not significantly increased to such an extent that erosion may occur.	Once, prior to discharge	Anglo
4. Land capability				
4.1	**Project activity:**	n/a	-	-
	Impact:	n/a	-	-
	Mitigation measure(s):	n/a	-	-

Operational Phase Environmental Management Plan			Frequency and Timeline	Responsible party
5. Ecology: flora and fauna				
5.1	**Project activity:**	n/a	-	-
	Impact:	n/a	-	-
	Mitigation measure(s):	n/a	-	-
6. Ecology: aquatics				
6.1	**Project activity:**	Accidental spills and leaks (including during scouring processes) from pipelines, pump stations, water holding facilities, etc.	-	-
	Impact:	Impacts on water quality, aquatic biota and macro-channel, riparian and in-stream habitats.	-	-
	Mitigation measure(s):	Monitor the pipelines for leaks and spills on a regular basis.	As necessary, throughout Operational Phase	Anglo / Contractor
		Repair damaged pipes immediately to avoid excessive spills.	As necessary, throughout Operational Phase	Anglo / Contractor
		Should pipeline spillages occur, contain spills, clean up and rehabilitate immediately.	As necessary, throughout Operational Phase	Anglo / Contractor
		Implement corrective mitigation measures should any significant decrease in ecological integrity occur (both aquatic and wetland) (as indicated through implementation of the biomonitoring programme) as a result of impacts associated with the proposed project.	As necessary, throughout Operational Phase	Anglo
		At pump station and water holding facility sites, a suitable storm water and emergency management plan should be in place.	Plan to be developed prior to commissioning	Anglo

Operational Phase Environmental Management Plan			Frequency and Timeline	Responsible party
		At the upgraded WRP, a suitable storm water management plan should be in place.	Plan to be developed prior to commissioning	Anglo
		At the upgraded WRP, ensure correct storage and disposal of chemicals, wastes and effluents associated with the plant, as per current practice.	As necessary, throughout Operational Phase	Anglo
		At the upgraded WRP, in the event of an emergency, no discharge of any contaminated water into the receiving water environment should take place. Contaminated water should be stored in the mine water storage dams at the WRP during such an event. If necessary, all pumping of contaminated water should be stopped, until the emergency is rectified. Implementation of site rehabilitation should be initiated immediately should any impacts on the Naauwpoortspruit occur.	As necessary, throughout Operational Phase	Anglo
7. Surface water				
7.1	**Project activity:**	Reduce discharge volumes to the Kromdraaispruit.	-	-
	Impact:	Reduction in stream flow.	-	-
	Mitigation measure(s):	Return a portion (3 Mℓ/day) of the flow to the river after neutralisation.	Once per day, prior to and post closure	Anglo
7.2	**Project activity:**	Reduce discharge volumes to the Kromdraaispruit.	-	-
	Impact:	Improve water quality in terms of salinity.	-	-
	Mitigation measure(s):	n/a	-	-
7.3	**Project activity:**	Reduce discharge volumes to the Kromdraaispruit.	-	-
	Impact:	Aggravate existing acid conditions in the Kromdraaispruit.	-	-
	Mitigation measure(s):	Continue to lime the water prior to discharge into the Kromdraaispruit.	As necessary until mine closure (2017)	Anglo

Operational Phase Environmental Management Plan			Frequency and Timeline	Responsible party
		Support an investigation to locate, collect and neutralise the acid streams, or to incorporate the acid streams in the collection system for treatment at the eMalahleni Mine Water Reclamation Plant.	As necessary prior to mine closure (2017)	Anglo
7.4	**Project activity:**	Remove the Middelburg Steam and Station Collieries decant from the Klipspruit/Brugspruit.		
	Impact:	Reduction in stream flow.		
	Mitigation measure(s):	n/a	-	-
7.5	**Project activity:**	Remove the Middelburg Steam and Station Collieries decant from the Klipspruit/Brugspruit.	-	-
	Impact:	Improve water quality.	-	-
	Mitigation measure(s):	Support an investigation to remove the decants into the Klipspruit/Brugspruit from other defunct mines in order for the RWQO to be met.	As necessary	Anglo
7.6	**Project activity:**	Discharge 50 Mℓ/day of treated water into the Naauwpoortspruit during times when flow in the river is high, or if heavy rainfalls occur soon after the discharge.	-	-
	Impact:	Flooding of the WRP site.	-	-
	Mitigation measure(s):	A flood protection berm should be built along the WRP site to prevent flood water inundating the plant site.	Once, prior to commissioning of upgraded WRP	Contractor
7.7	**Project activity:**	Discharge 50 Mℓ/day of treated water into the Naauwpoortspruit.	-	-
	Impact:	Improve water quality.	-	-
	Mitigation measure(s):	n/a	-	-

Operational Phase Environmental Management Plan			Frequency and Timeline	Responsible party
7.8	**Project activity:**	Discharge 50 Mℓ/day of treated water into the Naauwpoortspruit.	-	-
	Impact:	Erosion of discharge point as well as the downstream channel would increase.	-	-
	Mitigation measure(s):	Discharge from the WRP into the Naauwpoortspruit should not be directly into the stream, but routed through a velocity reduction mechanism, such as a temporary storage dam. The discharge point should also have erosion reduction structures such as gabion baskets.	Installation of necessary infrastructure should occur prior to commissioning of upgraded WRP	Contractor
		The WRP should not make the full discharge of 50 Mℓ/d into the stream unless the flow downstream at weir B1H019 is less than 1.55 m^3/s.	As necessary, throughout operations	Anglo
		The total flow in the stream, which includes the natural flow and the discharge, should not exceed 2.16 m^3/s.	As necessary, throughout operations	Anglo
7.9	**Project activity:**	Leaks along the collection pipelines will saturate the soil profiles around the pipeline.	-	-
	Impact:	This will impact on the water quality of soil profile and local streams in which the seepage will daylight.	-	-
	Mitigation measure(s):	A leakage detection system and routine pipeline inspections should be undertaken.	As necessary, throughout operations	Anglo

Operational Phase Environmental Management Plan			Frequency and Timeline	Responsible party
7.10	**Project activity:**	Bursts along the collection pipelines at a watercourse crossing.	-	-
	Impact:	This will cause local erosion and impact on the water quality of the immediate environment and local streams.	-	-
	Mitigation measure(s):	Bursts should be repaired immediately as part of the pipeline maintenance schedule.	As necessary, throughout operations	Anglo
		Sufficient valves should be in place along the pipeline to isolate the burst as quickly as possible.	Once, during pipeline construction	Contractor
		Remediation protocols should be developed to remediate an area after a burst or where extensive leaks or scour spills have occurred.	Once, prior to pipeline commissioning	Anglo
7.11	**Project activity:**	Spills during the scouring process along the collection pipelines.	-	-
	Impact:	This will impact on the water quality of the immediate environment.	-	-
	Mitigation measure(s):	Protocols for scouring the collection pipelines should be developed to prevent spills from entering the river systems.	Once, prior to pipeline commissioning	Anglo
8. Groundwater				
8.1	**Project activity:**	Storage of mine affected water in underground mine voids associated with the rehabilitated Central Pit 1.	-	-
	Impact:	Groundwater quality deterioration and formation of a dewatering cone in the natural aquifer.	-	-
	Mitigation measure(s):	Maintain water levels in the pit at a similar level than that of the natural aquifer.	As necessary, throughout operations	Anglo
9. Air quality				
9.1	**Project activity:**	Limestone handling at the WRP site.	-	-
	Impact:	Particulate matter or dust pollution.	-	-

Operational Phase Environmental Management Plan			Frequency and Timeline	Responsible party
	Mitigation measure(s):	If possible, undertake handling activities in covered areas.	As necessary, throughout Operational Phase	Anglo / Contractor
		Implement adequate dust suppression measures.	As necessary, throughout Operational Phase	Anglo / Contractor
10. Noise				
10.1	**Project activity:**	Conveyance of water through the proposed pipelines, operating valves and water off-take points.	-	-
	Impact:	Increased ambient noise levels.	-	-
	Mitigation measure(s):	Pipelines must be operated within their design and safety limits.	As necessary, throughout Operational Phase	Anglo
10.2	**Project activity:**	Operation of the new (or upgraded) pump stations at the Kromdraai Liming Plant, the Brugspruit WPCW, Navigation and at WRP site.	-	-
	Impact:	Increased ambient noise levels.	-	-
	Mitigation measure(s):	Ensure systematic maintenance of all equipment, including pump stations.	As necessary, throughout Operational Phase	Anglo / Contractor
11. Heritage				
11.1	**Project activity:**	n/a	-	-
	Impact:	n/a	-	-
	Mitigation measure(s):	n/a	-	-

Operational Phase Environmental Management Plan			Frequency and Timeline	Responsible party
12. Visual				
12.1	**Project activity:**	n/a	-	-
	Impact:	n/a	-	-
	Mitigation measure(s):	See 10.1 above		
13. Wetlands				
13.1	**Project activity:**	Pipeline location and spills.	-	-
	Impact:	Inundation and flow obstruction.	-	-
	Mitigation measure(s):	Repair damaged scour valves and pipes immediately to avoid excessive spills.	As necessary, throughout Operational Phase	Anglo / Contractor
		Monitor the pipelines for leaks and spills on a regular basis.	As necessary, throughout Operational Phase	Anglo / Contractor
13.2	**Project activity:**	Releases from pipeline scour valves.	-	-
	Impact:	Eroding of wetlands.	-	-
	Mitigation measure(s):	Repair damaged scour valves and pipes immediately to avoid excessive spills.	As necessary, throughout Operational Phase	Anglo / Contractor
13.3	**Project activity:**	Spill of untreated water from collection pipelines, including scour valves,	-	-
	Impact:	Degradation of wetland integrity.	-	-
	Mitigation measure(s):	Prevent pipeline and scour valve spillages.	As necessary, throughout Operational Phase	Anglo / Contractor

Operational Phase Environmental Management Plan			Frequency and Timeline	Responsible party
		Should any pipeline and scour valve spillages occur, clean up and rehabilitate immediately.	As necessary, throughout Operational Phase	Anglo / Contractor
		Contain any spills to avoid degrading downstream water quality.	As necessary, throughout Operational Phase	Anglo / Contractor
14. Socio-economic				
14.1	**Project activity:**	Operation of upgraded of WRP commissioning, pipeline maintenance, etc.	-	-
	Impact:	Creation of employment opportunities.	-	-
	Mitigation measure(s):	Where possible, use local labour.	As necessary, throughout operations	Anglo
		Employment recruitment policies should be put in place, in order to maximise employment opportunities.	As necessary, throughout operations	Anglo
14.2	**Project activity:**	Operation of upgraded of WRP commissioning	-	-
	Impact:	Augmentation of local potable water supply.	-	-
	Mitigation measure(s):	Regular monitoring of the treated water and the WRP should be undertaken in order to ensure the quality of the treated water supply to communities and to address the current problems of water standards, thereby maximising the potential benefits of the expansion scheme.	As necessary, throughout operations	Anglo

Operational Phase Environmental Management Plan			Frequency and Timeline	Responsible party
14.3	**Project activity:**	Pipeline leaks or bursts	-	-
	Impact:	Impacts on health and safety of local communities / residents / affected landowners	-	-
	Mitigation measure(s):	Implement a community awareness campaign. The purpose of this campaign should be to create awareness among the local communities / residents / affected landowners of the potential risks associated with the pipelines. The campaign could include the distribution of pamphlets, talks at local schools, road shows, etc. Signage could also be erected at various points along the pipelines to illustrate the dangers of the contents of the pipelines (particularly the collection pipelines).	Regularly, throughout operations	Anglo

Table 25: Environmental Management Plan for the eMalahleni Mine Water Reclamation Expansion Project – Decommissioning Phase

Decommissioning Phase Environmental Management Plan			Frequency and Timeline	Responsible party
1. Geology				
1.1	**Project activity:**	n/a	-	-
	Impact:	n/a	-	-
	Mitigation measure(s):	n/a	-	-
2. Topography				
2.1	**Project activity:**	The temporary stockpiling, compaction of in situ material, excavation, mixing, and replacement of excavated material during pipeline removal.		
	Impact:	The stockpiling of material on surface will alter surface topography. Settling is expected to occur over the areas where the buried pipelines have been laid. Compaction is also expected over areas where vehicles and plant equipment travel regularly.		
	Mitigation measure(s):	See 2.1 Construction Phase EMP.		
3. Soil				
3.1	**Project activity:**	Reclamation of the collection and distribution pipelines.	-	-
	Impact:	Possible soil pollution along the pipeline route may occur, should poor quality mine water remaining in the system leak into the environment.	-	-
	Mitigation measure(s):	The collection pipeline system should be flushed with clean water before reclamation commences.	Once, before reclamation commences	Contractor

Decommissioning Phase Environmental Management Plan			Frequency and Timeline	Responsible party
3.2	**Project activity:**	Reclamation of the collection and distribution pipelines.	-	-
	Impact:	Disturbance of the soil profile; possible mixing of topsoil, subsoil and spoil material; possible spillage of oil and fuel; and compaction of soils, could take place.	-	-
	Mitigation measure(s):	Should the aim be to reclaim the collection pipelines upon decommissioning, the pipelines should be constructed above ground.	Decision to be made and authorisation acquired (from MDEDET) prior to construction	Anglo
		See 3.1-3.5 Construction Phase EMP.		
4. Land capability				
4.1	**Project activity:**	Excavating pipeline trenches, should the aim be to reclaim the collection and distribution pipelines upon decommissioning.	-	-
	Impact:	±88 ha of agricultural land and ±86 ha of wilderness/grazing land capability will be impacted upon during pipeline reclamation.	-	-
	Mitigation measure(s):	A mutually acceptable agreement must be drawn up with landowners to compensate them in the event of crop loss and servitude rights.	Once, prior to construction	Anglo
		See 3.1-3.2 above.		
5. Ecology: terrestrial flora and fauna				
5.1	**Project activity:**	Vegetation clearing and stripping of topsoil during pipeline, etc decommissioning/reclamation.		
	Impact:	Loss of vegetation communities and animal habitat; loss of biodiversity		
	Mitigation measure(s):	See 5.1 Construction EMP		
5.2	**Project activity:**	Presence of machinery and human activities.		
	Impact:	Drives fauna away from the area.		
	Mitigation measure(s):	See 5.2 Construction EMP		
5.3	**Project activity:**	Vegetation clearing and stripping of topsoil during pipeline, etc decommissioning/reclamation.		

Decommissioning Phase Environmental Management Plan			Frequency and Timeline	Responsible party
	Impact:	Disturbance created by vegetation clearing will further contribute to the establishment of alien invasive species in the area.		
	Mitigation measure(s):	See 5.3 Construction EMP		
6. Ecology: aquatics				
6.1	**Project activity:**	Reclamation of pipeline/watercourse crossings.		
	Impact:	Impact on water quality, aquatic biota, and macro-channel, riparian and in-stream habitats.		
	Mitigation measure(s):	See 6.1 Construction EMP		
7. Surface water				
7.1	**Project activity:**	Reclamation of the collection and distribution pipelines.	-	-
	Impact:	Alternation of stream bed and banks, temporary stream flow reduction and impedance, an increased sedimentation and turbidity of water sources.	-	-
	Mitigation measure(s):	See 7.1 Construction Phase EMP		
8. Groundwater				
8.1	**Project activity:**	Accidental spillage of oil or other hydrocarbons and pollutants along the proposed pipeline routes and within the decommissioning sites/camps.	-	-
	Impact:	Groundwater contamination	-	-
	Mitigation measure(s):	See 8.1 Construction Phase EMP		
9. Air quality				
9.1	**Project activity:**	Vehicles traversing the decommissioning sites; excavating pipeline trenches, should pipelines be reclaimed.	-	-
	Impact:	Vehicle emissions, and dust generation.	-	-
	Mitigation measure(s):	See 9.1 Construction Phase EMP		
10. Noise				
10.1	**Project activity:**	Movement of heavy machinery and vehicle traffic during pipeline and other infrastructure reclamation.	-	-
	Impact:	Increased ambient noise levels.	-	-
	Mitigation measure(s):	See 10.2 Construction Phase EMP		

Decommissioning Phase Environmental Management Plan			Frequency and Timeline	Responsible party
11. Heritage				
11.1	**Project activity:**	n/a	-	-
	Impact:	n/a	-	-
	Mitigation measure(s):	n/a	-	-
12. Visual				
12.1	**Project activity:**	Reclamation of the collection and distribution pipelines.	-	-
	Impact:	These activities will temporarily transform the physical landscape, i.e. removal of natural vegetation and land cover, transformation of the site topography; presence of new infrastructure; and dust pollution.	-	-
	Mitigation measure(s):	See 12.1 Construction Phase EMP		
12.2	**Project activity:**	Removal of project infrastructure, such as the pump stations and water balancing/holding facilities.	-	-
	Impact:	Positive impact on physical landscape.	-	-
	Mitigation measure(s):	Rehabilitate affected sites to ensure that they become stabilised and self-sustaining.	As necessary, during rehabilitation	Anglo / Contractor
13. Wetlands				
13.1	**Project activity:**	Pipeline / watercourse crossings.		
	Impact:	Bed disturbance vegetation removal and habitat degradation		
	Mitigation measure(s):	See 13.1 Construction Phase EMP		
13.2	**Project activity:**	Pipeline / watercourse crossings.		
	Impact:	Inundation.		
	Mitigation measure(s):	See 13.2 Construction Phase EMP		
13.3	**Project activity:**	Pipeline / watercourse crossings.		
	Impact:	Dust and sediment settling on the wetland.		

Decommissioning Phase Environmental Management Plan			Frequency and Timeline	Responsible party
	Mitigation measure(s):	See 13.3 Construction Phase EMP		
13.4	**Project activity:**	Pipeline / watercourse crossings.		
	Impact:	Compacting of soils		
	Mitigation measure(s):	See 13.4 Construction Phase EMP		
14. Socio-economy				
14.1	**Project activity:**	Decommissioning of the WRP, pipelines and other infrastructure.	-	-
	Impact:	A temporary increase in employment opportunities followed by a decrease.	-	-
	Mitigation measure(s):	A programme of retrenchment and re-training should be implemented, providing employees with clear, transparent information on planned activities and closure dates, offering employment at similar sites where possible and full retrenchment packages.	As necessary, during the Operational Phase	Anglo
		Conduct an analysis of alternative uses for the pipelines to assess future employment opportunities.	As necessary, during the Operational Phase	Anglo
14.2	**Project activity:**	Decommissioning of the WRP, pipelines and other infrastructure.	-	-
	Impact:	Noise and dust impacts associated with decommissioning activities	-	-
	Mitigation measure(s):	See 9 and 10 above		
14.3	**Project activity:**	Decommissioning of the WRP, pipelines and other infrastructure.	-	-
	Impact:	Health and safety impacts associated with decommissioning the scheme.	-	-
	Mitigation measure(s):	Support an assessment to determine the complete management of acid mine drainage in the area, meaning local communities will not experience impacts related to continued pollution and health and safety issues.	As necessary, during the Operational Phase	Anglo
14.4	**Project activity:**	Decommissioning of the WRP, pipelines and other infrastructure.	-	-
	Impact:	Should the WRP be decommissioned, potential impacts on the availability and quality of potable water for local communities and the wider population	-	-

Decommissioning Phase Environmental Management Plan			Frequency and Timeline	Responsible party
	Mitigation measure(s):	Conduct an analysis of possible sustainable community development programmes to be put in place, should the scheme need to be decommissioned.	As necessary, during the Operational Phase	Anglo
		Support an investigation into alternative sources of water to ensure a continuous, safe supply of water to communities.	As necessary, during the Operational Phase	Anglo

8.6 Monitoring programme

The monitoring programme is summarised in below and discussed in the sections to follow.

Table 26: Monitoring programme

Aspect to be monitored	Parameter(s)	Timeline	Frequency	Responsible party
Emergency discharge to the Naauwpoortspruit	Flow	Throughout the Operational Phase	Daily	Anglo
	Quality (Table 27).	Prior to discharge	As necessary	Anglo
Treated (product) water	Conductivity, turbidity, pH, temperature, and chlorine residual.	Throughout the Operational Phase	Continuous	Anglo
	Standard range of physical, chemical and microbiological parameters.	Throughout the Operational Phase	Weekly	Anglo
	Extensive range of physical, chemical and microbiological parameters.	Throughout the Operational Phase	Monthly	Anglo / appropriately accredited laboratory
	Modelled concentrations and the concentrations of substances not modelled, including microbiological parameters (see Section 4.3.3).	Upon commissioning of upgraded WRP	To be tested once to confirm accuracy of predictions; thereafter, incorporate into overall monitoring programme	Anglo / appropriately accredited laboratory
Biomonitoring	Water quality, habitat and biological integrity both upstream and downstream of the pipeline / watercourse crossing sites.	Throughout the Construction Phase	Quarterly	Suitably qualified person
	Water quality, habitat and biotic upstream and downstream of the pipeline / watercourse crossing sites.	Throughout the Operational Phase	Bi-annually; one in the low flow season (May – September) and one in the high flow season (October – April).	Suitably qualified person
Wetlands associated with pipeline / watercourse crossing sites.	The ecological status of the wetlands (through Wetland-IHI and PES method), floral species composition (through community analysis) and water quality.	Throughout the Construction Phase	Quarterly	Suitably qualified person

Aspect to be monitored	Parameter(s)	Timeline	Frequency	Responsible party
Wetlands associated with pipeline / watercourse crossing sites.	The ecological status of the wetlands (through Wetland-IHI and PES method), floral species composition (through community analysis) and water quality.	For one year after construction	Biannually	Suitably qualified person
Wetlands at points located downstream of the current discharge/decant points along the Blesbokspruit and Kromdraaispruit.		Subsequent to reduction / removal of mine water discharges, i.e. after abstraction commences – Operational Phase	Biannually	Suitably qualified person

8.6.1 Naauwpoortspruit emergency discharge

A monitoring programme will need to be implemented in relation to the emergency discharge to the Naauwpoortspruit:

- Flow

  The total flow in the Naauwpoortspruit, which includes the natural flow and the emergency discharge, should not exceed 2.16 m^3/s. This would protect the people, farms and industries downstream from flooding. The weir would therefore need to be monitored daily to facilitate the application of this rule.

- Quality

  This will include sampling of the typical water quality parameters as necessary, prior to discharge. Recommended water quality sampling parameters are indicated in Table 27.

Table 27: Recommended Water Quality Sampling Parameters for the Water Quality Monitoring Programme

Recommended Water Quality Sampling Parameters	Units
Conductivity at 25˚C	mS/m
Total Dissolved Solids	mg/L
pH at 25°C	
Turbidity	NTU
Alkalinity as $CaCO_3$	mg/L
Ammonia as N	mg/L
Calcium as Ca	mg/L
Chloride as Cl	mg/L
Fluoride as F	mg/L
Magnesium as Mg	mg/L
Nitrate and Nitrite as N	mg/L
Potassium as K	mg/L

Recommended Water Quality Sampling Parameters	Units
Sodium as Na	mg/L
Sulphate as SO4	mg/L
Aluminium as Al	mg/L
Boron as B	mg/L
Iron as Fe	mg/L
Manganese as Mn	mg/L

8.6.2 Treated (product) water quality

The current monitoring programme at the WRP needs to continue:

- Continuous on-line water quality monitoring of the following key parameters:
  - Conductivity;
  - Turbidity;
  - pH;
  - Temperature; and
  - Chlorine residual.

  This allows for immediate action should any of the key parameters indicate an unacceptable water quality.

- Two grab samples per day (to reflect the water quality transferred to each of the potable water reservoirs) are analysed for a standard range of physical, chemical and microbiological parameters; and

- An additional monthly sample is tested for an extensive range of physical, chemical and microbiological parameters. All analyses are done by an appropriately accredited laboratory.

As indicated previously, the future concentrations of various constituents in the final product water were estimated (modelled) based on weighted flows for the additional feed water sources. The estimated concentrations are presented in Table 15. A number of heavy metals were not included in the model; these are indicated as "not modelled" in the table. Microbiological and radiological parameters were also not modelled.

It is therefore recommended that modelled concentrations and the concentrations of substances not modelled be confirmed by sampling and analysis of substances in the potable water delivered after the commissioning of the expanded WRP. This is also applicable to potential microbiological contamination of the future potable water product.

8.6.3 Biomonitoring (aquatic ecology)

During the Construction Phase, the water quality, habitat and biological responses both upstream and downstream of the pipeline / watercourse crossing sites need to be monitored on a quarterly basis. The information generated from this monitoring can be used to quickly implement management actions should a significant decrease in ecological integrity upstream or downstream of the crossings occur.

An ongoing monitoring programme for the aquatic ecosystem (including water quality, habitat and biotic integrity) is recommended for the Operational Phase. The monitoring programme should consist of two aquatic biomonitoring surveys per year; one in the low flow season (May – September) and one in the high flow season (October – April). The monitoring programme should include the same indicators as used during the baseline survey (APPENDIX J).

8.6.4 Wetlands

The ecological status of the wetlands (through Wetland-IHI and PES method), floral species composition (through community analysis) and water quality should be monitored at pipeline / watercourse crossing sites, and at points located downstream of the current discharge/decant points along the Blesbokspruit and Kromdraaispruit. The pipeline / watercourse crossing sites should be monitored quarterly during construction and bi-annually for a year thereafter. At points located downstream of discharge points, monitoring should be conducted bi-annually after commencement of abstraction. Monitoring should be conducted by a suitably qualified person. Findings from the monitoring cycle in comparison to findings of the baseline study will indicate whether further management action is required or not.

9.0 ENVIRONMENTAL IMPACT STATEMENT

Introduction and project description

Anglo Operations Limited (Pty) Ltd (Anglo) proposes to expand the capacity of the existing Mine Water Reclamation Scheme in eMalahleni, Mpumalanga Province. The proposed expansion will involve expanding the capacity of the existing Water Reclamation Plant (WRP) at Greenside Colliery to treat approximately 50 Mℓ of mine water per day.

The project components associated with the proposed project include the following:

- Collection of excess mine water from Landau Colliery (Kromdraai, Excelsior and Navigation Sections), and the defunct Middelburg Steam and Station Collieries, for which Greenside Colliery has environmental responsibility;
- Installation of conveyance systems to transfer excess mine water to the existing WRP;
- Upgrading of the existing WRP where mine water is treated to potable water standards;
- Distribution of treated water to an existing municipal water reservoir; and
- The disposal of waste generated during the mine water treatment process at existing mine waste disposal facilities and/or at newly constructed facilities at Blaauwkrans Dump site at Navigation. In terms of integrated waste management, downstream uses of the waste will also be assessed.

Approximately 400 additional employment opportunities will be created for skilled and unskilled workers during the Construction Phase. This will be over an 18-month period. Ten (10) to twenty (20) permanent jobs will be created for the routine operation and maintenance of the new pipeline and pump system. Focus will be on employing labour from the local community where possible.

It is anticipated that the Construction Phase will commence in April 2011. It is proposed that commissioning of the upgraded WRP will commence in January 2013. This proposed project will be operated and maintained over the long term. For the purposes of the financial model, the expansion project has been allocated a life cycle of 20 years.

Overview of the existing environment, impacts and mitigation measures

Geology

Baseline

The geology of the study area is dominated by near horizontally bedded successions of shales, sandstones and coal layers. This succession of sedimentary rocks overlies the well-consolidated conglomerates / diamictites of the Dwyka Formation, but in places rests directly on felsites and granites of the pre-Karoo Basement. A north south striking normal fault cuts across the site and divides the coal resource into distinct western and eastern parts. The fault cuts through the eastern limb of an anticline. A number of northeast-southwest trending, near-vertical dolerite dykes have intruded the coal.

Impact assessment and mitigation

Possible blasting of hard rock in sections of the proposed collection and distribution pipeline routes may impact on underlying geology during the Construction Phase. The permanent displacement of *in situ* rock cannot be mitigated; however, by using appropriate blasting techniques the impacts can be minimised. It is anticipated that blasting activities will result in negligible impacts, and will be restricted to the site only. Impacts of **low** significance are therefore expected. There will be no additional impacts to geology during the Operational and Decommissioning Phases of the project.

Topography

Baseline

The study area is situated in the eastern region of Mpumalanga, which is characterised by a gently undulating plateau with fairly broad to narrowly incised valleys such as the Olifants River valley. The general elevation of the area lies between 1 400 m and 1 600 m above mean sea level (mamsl). To the west of Witbank lies a high point of 1650 m, although the town lies at an average altitude of approximately 1 560 m.

Impact assessment and mitigation

The negative impact on topography as a result of temporary stockpiling, compaction of in situ material, excavation, mixing, and replacement of excavated material will be of a **low** significance. The impact of permanent infrastructure will be of **moderate** significance. No additional impacts are expected to occur on topography during the Operational Phase of the project. Should the pipelines be removed during decommissioning, the impacts described under the Construction Phase will take place.

Soils, land capability and land use

Baseline

The majority of the pipeline routes (47.4 %) are located on arable land with moderate to very deep red and yellow-brown soils with moderate to high agricultural potential. 36.8 % of the pipeline routes are located on mined areas, disturbed areas and areas occupied by semi-permanent infrastructure. Remaining sections are located on grazing land (8.4 %) and temporary (3.2 %), seasonal (3.2 %); and permanent wetlands (1 %).

Impact assessment and mitigation

The major activities that will result in impacts to soil will be as a result of vegetation clearing, stripping, and compaction of soils. The significance rating of the impacts resulting from excavating pipeline trenches is **moderate**, with limited mitigation potential. The topsoil on rehabilitated sections (specifically along the Kromdraai collection pipeline) is shallow and trenches will definitely penetrate the low quality spoil (coaliferous) material. Mixing this material with the topsoil during backfilling of the trenches will cause coal related salt pollution of the topsoil. Soil pollution could also result from oil and fuel spillages from construction equipment and vehicles. Impacts related to soil pollution are considered to be **moderate**; however, should the relevant mitigation measures be implemented, impact significance can be reduced to **low**.

During construction of the pipelines (roughly 95 km in length), a servitude (right of way) width of up to 20 m will be required. The total impact of pipeline construction is therefore expected to be ±88 ha of agricultural land and ±86 ha of wilderness/grazing land capability. The area over which the pipeline routes are located will, however, return to the pre-construction land capability subsequent to construction. Impact significance is therefore anticipated to be **low**.

During the Operational Phase, the activity that will result in high impacts to soils will be as a result of the discharge of 50 Mℓ/day of treated (potable) water from the WRP into the Naauwpoortspruit, in the unforeseen event that the treated water cannot be distributed to the various end users. This additional volume of water could result in erosion if not controlled adequately. This impact could be reduced to **moderate**, should appropriate mitigation measures be implemented, such as the installation of gabions at the discharge point.

Should the collection and distribution pipelines be removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated.

Terrestrial fauna and flora

Baseline

The study area is situated in the Grassland biome, which is characterised as land that is dominated by grass species rather than trees or large shrubs. A large percentage of exotic species are found in the study area and most areas are already highly impacted by mining or anthropogenic activities. However, sensitive areas, such as wetlands, are present as well as protected species within the secondary grasslands or riparian zones. No Red Data floral species were found during the survey.

During the field surveys conducted, mammals, such as Black-backed jackal, Warthog, Yellow Mongoose and Hare, were found. Bird species encountered during the survey include the Crowned, Yellow-eyed Canary and Cape Sparrow. No Herpetofauna species (reptiles) were encountered; however, trails of *Serpentes* (snake) species were found. Arthropods identified during the site surveys include Meadow Katydid, Cucurbit ladybird and Milkweed bug. No Red Data faunal species were recorded during the surveys.

Impact assessment and mitigation

During the Construction Phase, the vegetation clearing and stripping of topsoil will be the primary mechanism impacting fauna and flora. In total ±190 ha of land will be impacted. This is mostly made up of 95 km of pipeline routes (with a construction servitude of 20 m in width). The disturbance of vegetation clearing will further contribute to the establishment of alien invasive species in the area. These impacts are considered to be **moderate** to **high** impacts, but can be reduced to **low** impacts, should appropriate mitigation measures be implemented. These include conducting ecological audits prior to excavation, and implementing an ongoing alien invasive species control programme.

No additional impacts on terrestrial fauna and flora are anticipated during the Operational Phase. Should the proposed collection and distribution pipelines, etc be reclaimed/removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated.

Aquatic ecology

Baseline

The water bodies associated with the proposed pipeline routes are already in an impacted state. The water bodies within the study area have poor habitat availability. Poor habitat availability is a limiting factor for aquatic macroinvertebrate diversity at all sites. Biotic integrity of the water bodies range from moderately impaired to very seriously impaired. No endangered or vulnerable aquatic species were found at any of the water bodies.

Impact assessment and mitigation

The construction of the proposed pipeline / watercourse crossings could result in impacts on water quality, on macro-channel, riparian and in-stream habitats, and on macroinvertebrates and ichthyofauna. In terms of aquatic ecology, the significance of the impacts was mostly rated as **moderate**. Implementation of appropriate mitigation measures will, however, reduce the significance of the impacts.

During the Operational Phase, the removal of mine water discharges from the streams is considered to be **moderate** to **high** positive impacts on the aquatic biota due to improved water quality and natural habitats.

Accidental spills and leaks (including scouring processes) from the mine water collection system will, however, result in **high** negative impacts on water quality and aquatic biota. Impact significance will, however, reduce to **moderate** to **low**, should the appropriate mitigation measures be implemented. Should the proposed collection and distribution pipelines, etc be reclaimed/removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated.

Surface water

Baseline

The study area falls in the upper Olifants catchment in the Kromdraaispruit, Klipspruit and Naauwpoortspruit catchments. The Kromdraaispruit has a history of acid conditions due to seeps and decants from other defunct mines in the catchment and discharges from the liming plant at the Kromdraai Section of Landau Colliery (about 5% of the time). The Klipspruit is a highly impacted catchment with a long history of water quality problems. The current water quality in the catchment is impacted by acid seeps and decants from defunct mines. The WRP is located on the banks of the Naauwpoortspruit, which flows into the Witbank Dam. The river does not have a high base flow as there are limited point source discharges in the catchment. The water quality of the Naauwpoortspruit is highly impacted by local collieries as well as runoff from the urban areas.

Impact assessment and mitigation

The primary source of impacts during the Construction Phase of the project will be as a result of the alteration of stream beds and banks, temporary stream flow reduction and impedance due to pipeline construction across wetlands and streams. Further impacts to surface water resources may occur due to increased turbidity and sedimentation of water sources as a result of exposed soils due to vegetation clearing and soil stripping operations. These impacts are anticipated to be **low**.

During the Operational Phase, the most significant impact would result from the removal of the discharge from the Kromdraaispruit, which will significantly reduce the flow in the river, which in turn could result in **moderate** negative impacts on the wetland system in terms of water flow. Neutralised water could, however, be released post closure to maintain the wetland system. Impact significant could therefore be reduced. The removal of the liming plant discharge from the Kromdraaispruit, and decant from Middelburg Steam and Station into the Klipspruit/Brugspruit, will result in **moderate positive** impacts on the salinity related water quality of the river systems. However, there are other sources of acid water in the Kromdraaispruit Catchment, which might aggravate the acid conditions in the river if the liming plant discharge is removed. This will result in a negative **moderate** impact.

Other negative impacts of **moderate** significance include those resulting from the discharge of treated water from the WRP to the Naauwpoortspruit during times of high flow, and from spills, leaks or bursts from the collection pipelines (including scour valve discharges). Should, however, the appropriate mitigation measures be implemented, impact significance can be reduced to **low**. Discharge from the WRP into the adjacent stream would, however, have a **moderate positive** impact on the water quality. Should the proposed collection and distribution pipelines, etc be reclaimed/removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated.

Groundwater

Context

Since the quality of the mine (feed) water to the WRP will differ from that of the current feed water, the composition of the gypsum sludge may change. Since it is proposed that this gypsum sludge be disposed of into the Yellow Buoy Section of the Blaauwkrans Dump, the quality of future seepage from the Yellow Buoy Section to groundwater may change. *Note*: the brine will be disposed into the existing brine lagoon at the WRP site and/or newly constructed brine lagoons at Blaauwkrans, which are lined facilities. Therefore, seepage to groundwater should not occur.

Impact assessment and mitigation

During the Construction Phase, accidental spillage of oil or other hydrocarbons and pollutants along the proposed pipeline routes and within the construction sites/camps may result in **low** negative impacts on the groundwater regime.

During the Operational Phase, no impacts on the groundwater environment will occur as a result of placing the gypsum sludge from the expanded and upgraded WRP into the Yellow Buoy Section of the Blaauwkrans Dump. It is expected that there will be no negative impact on the groundwater regime as a result of abstracting mine water from the Kromdraai and Excelsior and Navigation Sections of Landau Colliery, as well as from Middelburg Steam and Station Collieries. A **high positive** impact will, however, be incurred as the polluted (excess) mine water being abstracted, treated and re-used will significantly reduce the volumes of polluted mine water in the region, contribute significantly to cost savings in terms of water provision to end users, and make a contribution to replace water lost to the Ecological Reserve due to wider mining impacts in the Upper-Olifants catchment.

If the water level in the underground void (associated with the rehabilitated Central Pit 1) is higher than the surrounding natural aquifer a hydraulic gradient away from the pit will develop and this may cause the groundwater quality to deteriorate. If the water level in the underground void (associated with the rehabilitated Central Pit 1) is lower than the surrounding aquifer a hydraulic gradient towards the pit will develop, which may result in the formation of a dewatering cone in the natural aquifer. These are both considered to impacts of high significance. Should, however, the water level in the pit be maintained at a similar level than that of the natural aquifer, it will reduce flow between the two aquifers, and impacts can mitigated to moderate.

Should the proposed collection and distribution pipelines, etc be reclaimed/removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated.

Air quality

Baseline

The air quality in the study area is already impacted by pollutant sources such as power stations, petrochemical plants, small industries, domestic combustion, motor vehicles, smouldering coal-discard dumps and veld burning.

Impact assessment and mitigation

Vehicle emissions and dust generated by vehicles traversing the construction sites (including the upgraded WRP site) and by excavating pipeline trenches are the only sources of air quality pollution expected during the Construction Phase. Air quality impacts resulting from vehicle emissions and dust are considered to be **low** within context of existing pollution from industry and motorways in the area. Should the appropriate mitigation measures, such as dust suppression, be implemented, impact significance can be further reduced.

The upgraded WRP will make use of membrane-based treatment technology. No odour generation is expected when using this treatment technology. Particulate matter or dust pollution may, however, occur as a result of limestone handling at the WRP site. The impact associated with the release of particulate matter during the handling of limestone is regarded **low**. Should the proposed collection and distribution pipelines, etc be reclaimed/removed during the Decommissioning Phase, all impacts which took place during the Construction Phase will be repeated.

Environmental Noise

Baseline

Ambient noise levels within the study area are fairly low. The proposed distribution pipeline route to KwaGuqa Reservoir is, however, located adjacent to the N4/N12 Highway and is therefore surrounded by the existing noise impacts from the highway. The proposed distribution pipeline route to Reservoir B is predominately located in rural areas; ambient noise levels are therefore low. The section of the distribution pipeline between Reservoir B to Reservoir A is however, located adjacent to roads in urban residential areas where ambient noise levels have already been impacted.

Impact assessment and mitigation

Blasting in areas of hard rock along the proposed pipeline routes will result in impacts on noise levels which will be **moderate** to **high** (depending on proximity to existing noise impacts, such as the N4/N12 Highway, the Greenside Colliery Rapid Load-out Terminal (RLT), mining operations, etc), but will take place immediately and on a local scale. Impact significance is therefore expected to be **moderate**. Impacts on noise levels as a result of movement of heavy machinery and vehicle traffic will also be **moderate**. These impacts can, however, be mitigated to **low**. During the Operational Phase, **low** impacts may result from the conveyance of water through the proposed pipelines, and from the proposed pump stations.

Visual aspects

Baseline

The study area is characterised by mining activities from Greenside Colliery, Kleinkopje and Landau Colliery. Industries in the area, such as Highveld Steel, further contribute to the background industrial visual environment. The discard dumps, mine infrastructure, and Rapid Load-out Terminal are particularly prominent visual features in the study area, especially to commuters travelling along the N12 and N4 highways into eMalahleni.

Impact assessment and mitigation

The primary sources of visual pollution during the Construction Phase will be due to construction activities, dust mobilisation, and construction vehicles traversing the proposed pipeline routes and WRP site. These impacts are considered to be **moderate**. Regarding the presence of 'permanent' infrastructure, the magnitude of the visual impact will be low, mainly due to low receptor sensitivity (i.e. receptors do not occur in close proximity to the sites) and low visual quality of the receiving landscape. Impacts will, however, be long-term and local. Impact significance is therefore considered to be **moderate**.

Should project infrastructure, such as the pump stations and water balancing/holding facilities, be removed during the Decommissioning Phase, a **moderate positive** impact on visual aspects will occur, provided that affected sites are rehabilitated (re-vegetated) and become stabilised and self-sustaining.

Archaeological or cultural historical sites

Baseline

Heritage resources such as Stone Age sites, rock paintings and engravings; stone tools; small, inconspicuous stone walled sites from the Late Iron Age farming communities; formal and informal graveyards, etc may occur in the study area.

Impact assessment and mitigation

The Phase 1 Heritage Impact Assessment revealed that no heritage resources of significance occur within the study area or stand to be affected by the proposed project. There will therefore be no impacts on archaeological or cultural historical sites for any phases of the project. Should, however, any heritage resources of significance be exposed during the construction of the project, the South African Heritage Resources Authority (SAHRA) should be notified immediately, all development activities should be stopped and an archaeologist accredited with the Association for Southern African Professional Archaeologist (ASAPA) should be notified in order to determine appropriate mitigation measures for the discovered finds. This may include obtaining the necessary authorisation (permits) from SAHRA to conduct the required mitigation measures.

Wetlands

Baseline

Sixteen wetland sites were selected to be investigated during the baseline assessment. These sites are either associated with proposed pipeline/watercourse crossings or stand to be impacted as a result of reduced discharges. The findings of the wetland baseline assessment indicated that most of the wetlands have been moderately to seriously modified with extensive loss of natural habitat. The only wetland with natural conditions remaining is the hillslope seep at the Blesbokspruit; this wetland will, however, not be affected by the proposed project.

Impact assessment and mitigation

The construction of the pipeline / watercourse crossings will cause impact negatively on the wetlands in the study area. Negative impacts range from **moderate** to **high** for the various wetlands. For specific sites, the impact resulting from the movement of construction vehicles could result in a **high** negative impact, as this activity could cause vegetation degradation and the flow of water in the wetland to change over the medium term. The significance of most of these impacts can, however, be reduced.

During the Operational Phase, inundation and flow obstruction due to pipeline location and spills, and spills of untreated water from the collection pipelines, including scour valves, will result in high negative impacts. These impacts can, however, be reduced to **low**, should appropriate mitigation measures, such as prevention and containing of spills, be implemented. Impacts associated with the reduction/removal of mine water discharges from river systems are considered to be **low** to **moderate positive** impacts.

Socio-economy

Baseline

The study area for the proposed project is located in the eMalahleni Local Municipality (ELM), situated in the Nkangala District Municipality. The ELM can be described as an urban and rural area, consisting of large farms, dispersed urban settlements, coal mines and power stations. The project area spans a large part of the municipality, encompassing eMalahleni City, Lynville, Clewer, KwaGuqa and Paxton, as well as more rural areas to the north.

Affected landowners

The majority of land affected by the proposed project is owned by Anglo, with other portions belonging to the eMalahleni Local Municipality, the Republic of South Africa, SANRAL, Transnet and Samancor Ltd. A total of four private landowners have been identified as potentially affected by the proposed project, and interviews revealed a generally positive response to the project. However, concerns were raised over the level of disruption pipeline construction activities may have in urban residential areas, particularly along the proposed distribution pipeline to Reservoir A.

Impact assessment and mitigation

The Construction Phase is expected to create around 400 temporary jobs. These will span a period of around 18 months. The relatively small number of job opportunities, combined with their temporary nature will mean this impact will have **low positive** significance. Should Anglo make use of local labour as far as possible, and liaise with local community structures and government structures to assist in identifying a local labour pool, this impact can be enhanced to **moderate**.

The additional pipeline route to Reservoir A is likely to have the most significant impacts (**moderate** impacts) in terms of land access restrictions, environmental intrusiveness (health and safety, dust and noise), and increased traffic. The pipeline runs from the reservoir, located behind Witbank Mall, across a crossroads and down a street lined with businesses. All of these businesses require access from the street, and a number offer off-road parking which may be disrupted. However, with effective construction planning and coordination, each property should be immediately affected for a maximum of 2-3 weeks by construction activities.

The linear nature of the proposed pipelines will mean employment will follow the pipeline route rather than remain in a fixed location and the relatively low level of job opportunities will mean any influx of jobseekers will be limited. Furthermore, should a population influx occur, it will be short term, as construction teams move along the pipeline route. Impact significance is therefore **low**. Since the WRP is a fixed location, impact significance is **moderate**.

The Operational Phase will result in the creation of around 10-20 permanent job opportunities; employment creation is a **positive** impact. Although employment creation is positive, the limited number of opportunities available means this impact will be of low significance. The major benefit of the proposed project is the impact on potable water, as the project will augment the country's supply of water, producing an additional 25 Mℓ of treated water per day, which is critical given the fact that South Africa is a water scarce country. The impact on potable water supply is a highly **positive** impact, as it will occur on a regional scale over the long term.

A potential **high** negative impact associated with the Decommissioning Phase may result from the unavailability and poor quality of potable water for local communities and the wider population. It will not be easy to mitigate this impact and appropriate measures would need to be detailed in the Closure Plan.

Cumulative impacts

Soil, land capability and land use

Due to the already highly disturbed nature of the soils in the study area, the proposed project will probably result in low cumulative negative impact to soils acting over the long-term, and affecting the immediate site.

Fauna and flora

Due to the already highly disturbed nature of the flora and fauna within the study area, the total cumulative negative impact during all phases of the project will probably only be of a low significance, affecting the local extent, and acting in the medium-term.

Surface water

Removing the discharges from the river system (Klipspruit, Wilge and Loskop Dam catchments) will result in the following:

- Sulphate concentrations would reduce significantly. The removal of the discharges will improve adherence to the RWQO set for these river systems; and
- A small negative impact on water quantity will result. The proposed project will have a low impact on the yield of the Loskop Dam.

The cumulative negative impact for all phases of the development will be outweighed by the positive impact of eliminating decant from the contributing mines, and supplementing the Ecological Reserve.

Wetlands

The cumulative negative impact of the pipeline / watercourse crossings on wetlands will probably be **high**. Cumulative **positive** impacts are, however, expected as a result of removing/reducing mine water discharges/decants to the river systems.

Air quality

Impacts on air quality resulting from the proposed project are considered to be **low** within context of existing pollution from industry and motorways in the area. The contributions to cumulative impacts are therefore considered to be insignificant.

Noise

Since the proposed project components are situated in close proximity to existing noise impacts, such as the N4/N12 Highway, the Greenside Colliery Rapid Load-out Terminal (RLT), mining operations, major roads in urban residential areas, etc., the contributions of the proposed project to cumulative impacts are considered to be insignificant.

Need and desirability of the proposed project

In summary, the proposed eMalahleni Mine Water Reclamation Expansion Project will:

- Reduce negative environmental impacts associated with excess mine water from contributing mines;
- Provide a solution in terms of excess water management for contributing mines;
- Provide supplemental water supply to satisfy the requirements for domestic, industrial and commercial users in the eMalahleni Local Municipality;
- The expansion of the scheme will deliver additional potable water to the municipality, without any capital expenditure to the existing municipal water infrastructure;
- The potable water cost will be more affordable compared to the interbasin transfer from Vaal River water;
- The municipality and contributing mines can partner to maximise the local benefits of the project in terms of job creation, investment in infrastructure and capacity building in water technology;
- A potential pollution threat in the form of decant mine water to the local water resources can be converted into a long-term sustainable water supply; and

- There is scope for additional modules to supply the long-term water shortfall to the Municipality.

Assessment of alternatives

Pipeline routes

Subsequent to the route selection process, a number of stakeholders suggested refinements to the proposed pipeline routes. These refinements are described in Section 5.1.7.3 and were assessed as part of the EIA. See Figure 18 for an indication of the potential pipeline route refinements. Based on the findings of the various physical and biological specialist studies (flora, fauna, soil, wetlands, surface water, etc), there are no significant differences between the route refinements and the original alignments, mostly due to the close proximity of the route refinements to the original alignments. However, the social impact assessment revealed the following:

- Kromdraai Collection Pipeline Route Refinement 1 vs. original alignment
  - Route Refinement 1 reduces the need for new servitude agreements and the impact of land restrictions by making use of an existing road servitude south of the Sewage Treatment Plant;
- Kromdraai Collection Pipeline Route Refinement 2 vs. original alignment
  - Route Refinement 2 will not restrict the planned residential development near the R104;
- Middelburg Steam and Station Collieries Route Refinement 4 vs. original alignment
  - Route Refinement 4 will not restrict the planned tailings facility development;
- Distribution Pipeline to KwaGuqa Reservoir Route Refinement 3 vs. original alignment
  - Route Refinement 3 will prevent the need to resettle residents of the KwaGuqa x16 informal settlement;

Based on the above, it is recommended that Pipeline Route Refinements 1 to 4 be proposed for permitting. See Figure 21.

Treated water distribution

To date, the eMalahleni Local Municipality has indicated that water is needed to supply growing development areas at both KwaGuqa and north of the Witbank Reservoir. Two alternatives for the distribution of treated water are therefore proposed, namely the distribution of treated water from the WRP to the KwaGuqa Reservoir and to Reservoir B, and the distribution of treated water from the WRP to Reservoir A via Reservoir B. Both of these routes were assessed during the EIA. The findings of the EIA revealed that[5]:

- Treated water distribution to from Reservoir B to Reservoir A
  - The construction of the distribution pipeline will result in **moderate** impacts on traffic, land access restrictions and environmentally intrusive impacts, such as health and safety, noise and dust. This is due to the proposed pipeline being located within the Witbank CBD crossing major road routes and entering residential areas with small businesses lining the street, including a veterinary surgery and guest houses as well as a range of public services that face potential disturbance. From an ecological perspective, relatively **low** impacts are expected along this route, as the pipeline occurs along existing roads, i.e. within already distributed areas.
- Treated water distribution from the WRP to KwaGuqa Reservoir
  - The construction of the distribution pipeline will result in **low** impacts on traffic, land access restrictions and environmentally intrusive impacts, such as health and safety, noise and dust

[5] Since both options include the distribution of water to Reservoir B, focus is made on the remaining pipeline sections.

(should Route Refinement 3 be implemented). However, three wetland crossings are associated with the proposed pipeline (WC4, 5 and 6), which could result in **moderate** impacts, which can be mitigated.

No fatal flaws were therefore identified for either of the proposed pipeline routes.

Taking all of the above into consideration, it is recommended that both pipeline routes be proposed for permitting. Once the decision has been made by the eMalahleni Local Municipality and Anglo in terms of which reservoir the treated water will be distributed to, the relevant pipeline will be constructed. *Note*: only one of the distribution pipelines will be constructed, for now, as part of the expansion project.

Conclusion

The positive value of treating mine affected water in the area to reduce pollution levels, as well as increasing the supply of potable water in the area far outweighs the negative impacts identified, all of which can be managed and mitigated to low to moderate levels of impact. It is recommended that the proposed Route Refinements 1, 2, 3 and 4 be followed as these significantly reduce impacts relating to potential resettlement, land restrictions and temporary loss of access to land.

The proposed solution to treating acid mine drainage should leave a positive legacy in the project area, and Anglo should be committed to maintaining this legacy, during construction, operation and after closure of the project.

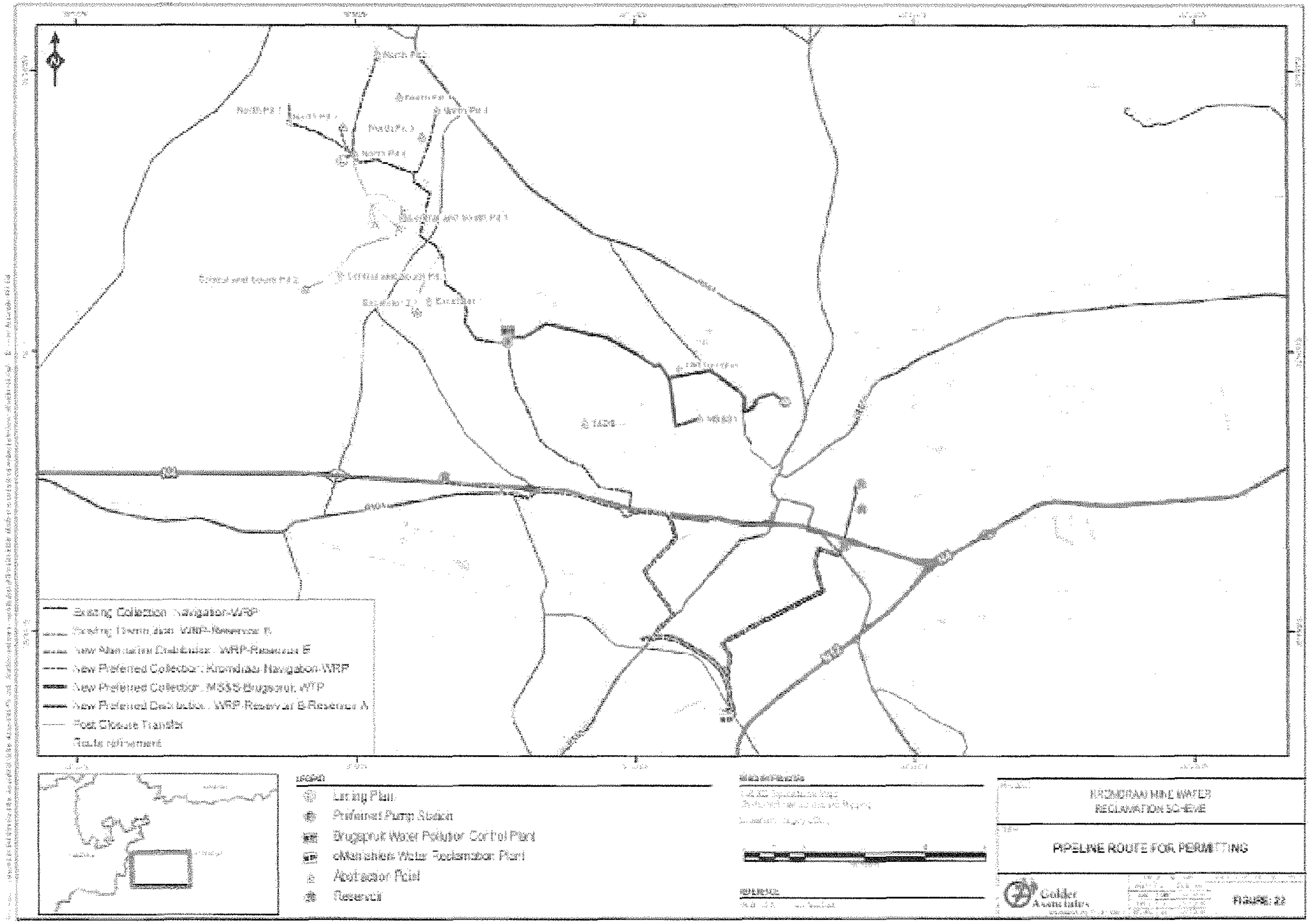


Figure 21: Pipeline routes for permitting

10.0 OPINION OF THE ENVIRONMENTAL ASSESSMENT PRACTITIONER (EAP)

From an environmental perspective, there is no reason why the proposed eMalahleni Mine Water Reclamation Expansion Project should not be implemented, provided that the mitigation measures and monitoring programmes recommended within this report are implemented diligently.

10.1 Final conclusion

The positive value of treating mine affected water in the area to reduce pollution levels, as well as increasing the supply of potable water in the area far outweighs the negative impacts identified, most of which can be managed and mitigated to low levels of impact. It is recommended that the proposed Route Refinements 1, 2, 3 and 4 be followed as these significantly reduce impacts relating to potential resettlement, land restrictions and temporary loss of access to land.

The proposed solution to treating acid mine drainage should leave a positive legacy in the project area, and Anglo should be committed to maintaining this legacy, during construction, operation and after closure of the project.

11.0 REFERENCES

Anglo Operations Limited. Landau Colliery, 2009. *Integrated Water Use Technical Supporting Document.*

Barnes, K. N. 2000. *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland.* Johannesburg: Birdlife South Africa.

Department of Water Affairs and Forestry, 2009. *Integrated Water Resources Management Strategy for the Upper and Middle Olifants Catchments – Interim IWRMP Report.* Report No. P WMA 04/000/00/7007.

Dr. J.C.C. Pistorius. 2010. *A Phase 1 Heritage Impact Assessment (HA) Study for the Expansion of the eMalahleni Mine Water Reclamation Scheme near eMalahleni (Witbank) in the Mpumalanga Province of South Africa.*

eMalahleni Local Municipality, 2006. *Water Services Master Plan for eMalahleni Local Municipality.*

eMalahleni Local Municipality, 2009. *eMalahleni Local Municipality Strategic Development Framework* .

Golder Associates Africa, 2005. *Final Scoping Report and Environmental Impact Assessment Report. Proposed eMalahleni Water Reclamation Project, Mpumalanga Province.*

Golder Associates Africa. 2009. *Anglo: Landau Colliery, Kromdraai Section: Water Market Assessment.*

Golder Associates Africa, 2010. *Kromdraai and Excelsior Sections of Landau Colliery and Middelburg Steam and Station Collieries. Water Make and Pumping and Analysis.*

Golder Associates Africa. 2010. *eMalahleni Mine Water Reclamation Project Terrestrial Ecology Report.*

Golder Associates Africa. 2010. *Specialist Aquatic Study for the proposed eMalahleni Mine Water Reclamation Project.*

Golder Associates Africa. 2010. *Specialist Wetland Study for the proposed eMalahleni Mine Water Reclamation Project.*

Golder Associates Africa. 2010. *Groundwater Risk Assessment of Gypsum Sludge Placement in the Yellow Buoy Section at Blaauwkraans.*

Golder Associates Africa. 2010. *eMalahleni Mine Water Reclamation Expansion Project Social Impact Assessment.*

Golder Associates Africa. 2010. *Surface Water Specialist Study. eMalahleni Mine Water Reclamation Expansion EIA.*

Golder Associates Africa. 2010. *Surface Water Specialist Study. eMalahleni Water Reclamation Plant: Treated Water Discharge Impact Assessment.*

Hodgson, F. 2009a. *Presentation on Kromdraai – Water Balance Modelling.*

Hodgson, F. 2009b. *Presentation on 2010 LOM Water Balance for SACE and some other that may feed water to the eMalahleni Water Treatment Plant.*

Hodgson, F. 2010. *Mine-water balance for Kromdraai Colliery.* Report Number: 2010/15/FDIH.

Infotox, 2010. *Baseline Human Health Risk Assessment for the Domestic Use of Reclaimed Water from the eMalahleni Water Purification Project.*

Keyplan, 2010. *Feasibility Study Mass Balance Report for the Kromdraai / Brugspruit Water Reclamation Project.* Report No. C09/613. Revision 0

Mucina, L, Ruterford, M.C. and Powrie, L.W. 2006. *Vegetation of South Africa, Lesotho and Swaziland.* South African National Biodiversity Institute. Pretoria.

Nkangala District Municipality, 2007. *Nkangala Water Master Plan.*

Rehab Green. 2010. *eMalahleni Mine Water Reclamation Expansion Project Soil, Land Capability and Land Use Assessment.*

Rehab Green. 2010. *Soil, Land Capability and Land Use Assessment of the Proposed Extension Route of the Existing Distribution Pipeline. Addendum to the eMalahleni Mine Water Reclamation Expansion Project Report.*

GOLDER ASSOCIATES AFRICA (PTY) LTD

Olivia Chapman	Brent Baxter
Project Manager	EAP

OC

g:\projects\12485 - kromdraai mine water reclamation scheme eia\reports\eia report\final eir\12485-emalahleni mwr expansion final eia report(oct10).docx

APPENDIX A

Specialist Report: Water Balance - Kromdraai and Excelsior Sections of Landau Colliery, and Middelburg Steam and Station Collieries

July 2010

CELEBRATING 50 YEARS in 2010

KROMDRAAI AND EXCELSIOR SECTIONS OF LANDAU COLLIERY, AND MIDDELBURG STEAM AND STATION COLLIERY

Water Make and Pumping Analysis

REPORT

Report Number. 12278-9533-7

ANGLO COAL

Golder Associates

A world of capabilities delivered locally

Executive Summary

Golder Associates Africa (Pty) Ltd (GAA) has been appointed by Anglo Coal to undertake a feasibility study for the long term management of water from the Kromdraai Section of Landau Colliery. There are currently 3 operational opencast pits at Kromdraai. These are the Central Pit, South Pit and the Excelsior Pit. Mining in the North Pit has been completed and is being rehabilitated whereas South Pit has recently started mining opencast.

A collection scheme for the water of Kromdraai, together with water from Middelburg Steam & Station Colliery (MSSC) is being investigated. MSSC is a defunct colliery that was mined using Bord and Pillar methods in the 1970s. MSSC is currently decanting. A good estimate of the volume of mine water from Kromdraai and Middelburg Steam & Station Colliery is required to serve as a basis of design for a treatment facility.

GAA have carried out supplemental monitoring at MSSC to determine the volume of water decanting from MSSC. This data have been used to determine the mine water make of MSSC.

The rainfall recharge for MSSC is determined from measurements of the decant water volumes, calculated evaporation from the decant evaporation ponds and rainfall onto the mine. A recharge factor of 20 % was calculated giving an expected yearly water make of 1 940 m^3/d. A peak pumping rate of 3 800 m^3/d may be expected.

A water balance modelling tool for Kromdraai was developed in Goldsim software to simulate the current and future (post closure) water system. The water management model includes water flows associated with the mining operations and the surface water reticulation. The model predicts recharge of rainfall to the workings allowing prediction of pumping rates.

Areas within the pits with large storage capacity are referred to as in-pit pond areas. When these areas are full of water they spill over to the adjacent in-pit areas or decant to the environment. Pumping rates are specified for in-pit pond areas from which water may decant to the environment. Three control levels with different pumping rates are specified in the model. Different pumping rates are used in order keep the carbonaceous backfill discard material covered with water as much as possible without allowing decant or seep to the environment.

The modelling results indicate that the model is capable of simulating:

- runoff and recharge based on current soil and land cover data;
- impact of life of mine progression on mine water make; and
- storage and pumping options associated with the water levels in the in-pit pond areas.

Using the available measured pumping information, an average recharge rate of 30% of rainfall was determined. This recharge rate was applied to the pits for the closure situation. The following average pumping rates from the pits were determined using the model:

- 4 700 m^3/d from the 3 in-pit ponds in North Pit;
- 1 850 m^3/d from the 2 in-pit pond areas in South Pit;
- 600 m^3/d from the 1 in-pit pond area in Excelsior; and
- The water from North, South and Excelsior in-pit ponds will be pumped to the in-pit pond in Central Pit which has a storage capacity of 8.3 million m^3. The average volume pumped from Central Pit for treatment was captured to be 9 850 m^3/d. This pump rate is the total which includes the pumping from other pits.

Table of Contents

APPENDICES

1.0 INTRODUCTION

Golder Associates Africa (Pty) Ltd (GAA) has been appointed by Anglo Coal to undertake a feasibility study for the long term management of water from the Kromdraai Section of Landau Colliery. Water management on Kromdraai is an important aspect of the mine's operations from both an environmental and operational perspective. Kromdraai is mining opencast the coal that has remained after previously being mined underground by Coronation Colliery using the bord-and-pillar method.

The option of treating water from Kromdraai, together with water from Middelburg Steam & Station Colliery (MSSC) is being investigated. Water from MSSC may be included in the collection scheme. MSSC is a defunct colliery that was mined using Bord and Pillar methods in the 1970s. Decant flows from MSSC are currently discharging into the Brugspruit.

A good estimate of the volume of mine water from MSSC is required to serve as a basis of design for a treatment facility. GAA have carried out supplemental monitoring at MSSC to determine the volume of water decanting from MSSC. This data have been used to determine the mine water make of MSSC.

Kromdraai needs to develop a water management plan and needs a water balance modeling tool to support reporting and management decisions. A mine water management model was developed in Goldsim software to simulate the current and future (post closure) water system. The water management model includes water flows associated with the mining operations and the surface water reticulation. The model predicts recharge of rainfall to the workings allowing prediction of pumping rates and balancing water around the onsite liming plant.

The report divided into two parts. The first part discusses the water make analysis for MSSC and the second discusses water balance modelling for Kromdraai. The report is structured in the following way:

- mine water system description, which provides an overview of the various water contributions, basic assumptions and methodology;
- available data and methodology;
- results and interpretation; and
- conclusions, recommendations and future work.

The results of the volumetric, recharge and decant calculations are provided to such a level of accuracy that they can be used for planning of mine water management during and after closure.

The study constitutes a first order basis of design and is based on the estimated average water production and water requirements, but recognises the following factors:

- variable rainfall;
- shortcomings in survey data;
- lack of measured water level and pumping data.

2.0 MIDDELBURG STEAM AND STATION COLLIERY WATER MAKE DETERMINATION

2.1 Description of water system

Figure 1 shows the location of Middelburg Steam & Station Colliery (MSSC) pit area and decant. A series of evaporation ponds were built to capture and evaporate the decant water. These dams are only evaporating a portion of the decant water with the remaining water flowing into the Brugspruit. Figure 2 shows the extents of the MSSC decant.

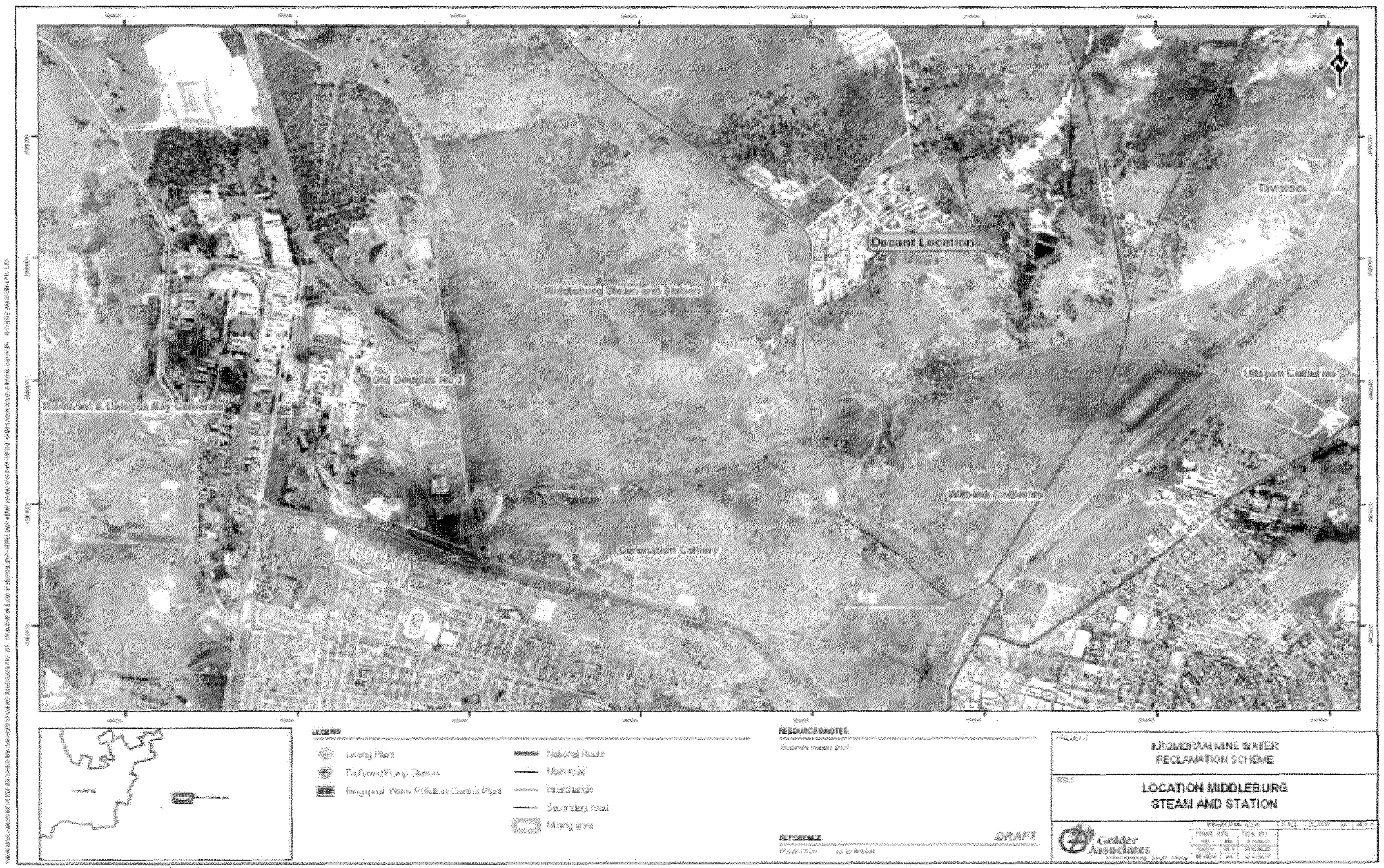


Figure 1: Locality map of Middelburg Steam & Station Colliery

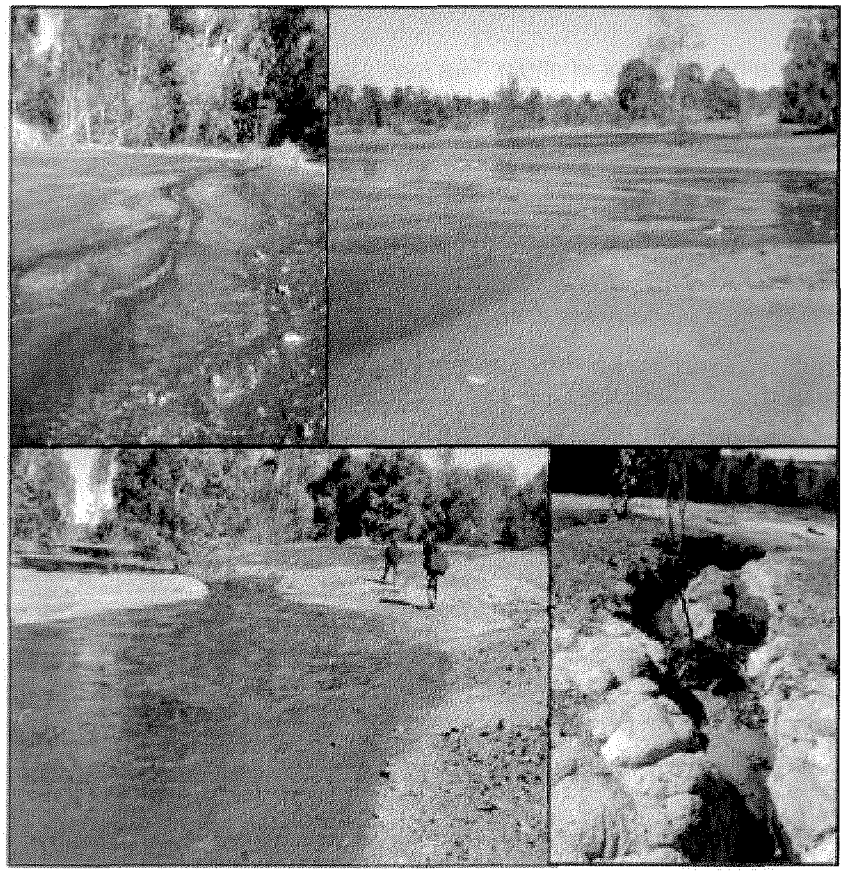


Figure 2: Decant flow at the Middelburg Steam and Station Colliery

2.2 Monitoring of decant

The decant from Middelburg Steam & Station Colliery water collects in a well defined channel downhill of the decant area which bypasses the evaporation dams. This area indicated in Figure 3 was selected for the flow measurement due to ease of access and flow measurement in the channel. The coordinates for this sampling area is 25.8478 S and 29.2106 E. The measured discharge is given in Table 1.

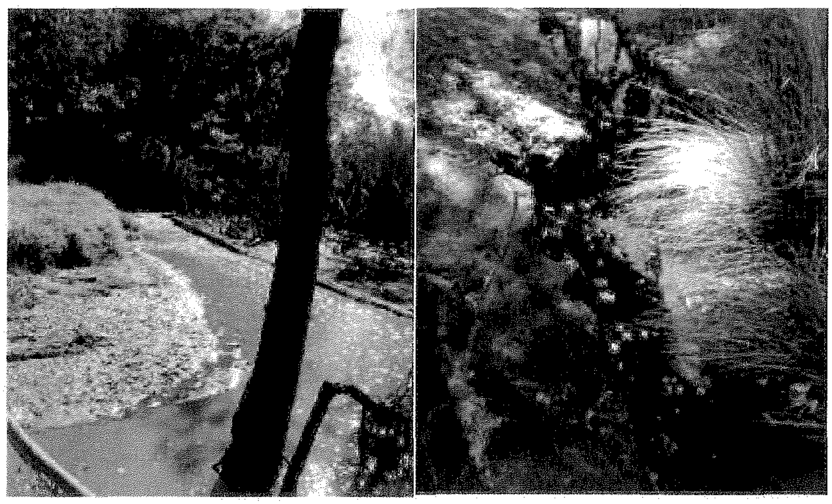


Figure 3: Channel directing flow to evaporation dams for MSSC

2.3 Water make analysis

The bulk of the water make was assumed to be rainwater in origin. The total mined area is 4 920 000 m^2. Approximately 26 % of the mined area is impacted by severe subsidence which increases recharge into the mine workings. The evaporation ponds have an area of 64 020 m^2.

Average rainfall and pan evaporation annual rainfall statistics from 1986 to 2009 data from Kromdraai was used to determine the recharge into the mine workings. Table 1 gives measured discharge, calculated evaporation from the evaporation ponds and average rainfall onto the mine were used to determine recharge factor for MSSC. Recent rainfall data was not available at the time of writing the report and so average rainfall depths were used.

Table 1: Data use to determine the recharge into Middelburg Steam and Station Colliery

	Monthly rainfall (mm/month)	Measured discharge (m^3/d)	Evaporation from ponds (m^3/d)	Rainfall on mine (m^3/d)
June	9	920	131	131
July	2	1 048	144	144
August	8	720	190	190
September	18	833	246	246
October	80	760	297	297
November	119	1 103	280	280
December	129	1 379	309	309
January	127	3 199	303	303
February	97	2 780	253	253
March	94	2 558	249	249
April	37	3 524	192	192
Total	734	18 824	2 594	2 594

The resulting yearly recharge factor is approximately 20 % giving an average expected water make of 1 940 m^3/d. From the data measured a peak pumping rate of 3 800 m^3/d may be expected.

3.0 KROMDRAAI WATER BALANCE MODELLING

3.1 Description of Kromdraai water system

There are currently 3 operational opencast pits at Kromdraai. These are the Central Pit, South Pit and the Excelsior block pit. Mining in the North Block has been completed and is being rehabilitated.

The mining method at Kromdraai has a bearing on the volume of water that requires treatment. Water flows to the mine workings are assumed to be mainly from surface ingress of rainwater according to mining progress (pre-stripped, pit, spoils heap, levelled, rehabilitated and underground).

A liming plant at the Kromdraai neutralises water that is pumped out of the opencast pits and old workings. On average, the liming plant treats in the region of 10 000 m^3/day of water pumped from the Kromdraai pits and advance dewatering of the underground workings.

The mine water/geohydrological modelling of Hodgson (2001) was used to set up the input spreadsheet for the mine component of the model. The main storage areas and possible future pumping points were identified by Hodgson (2009) as shown in Figure 4. Table 2 gives the contributing areas, storage volumes and expected dates when mining is completed.

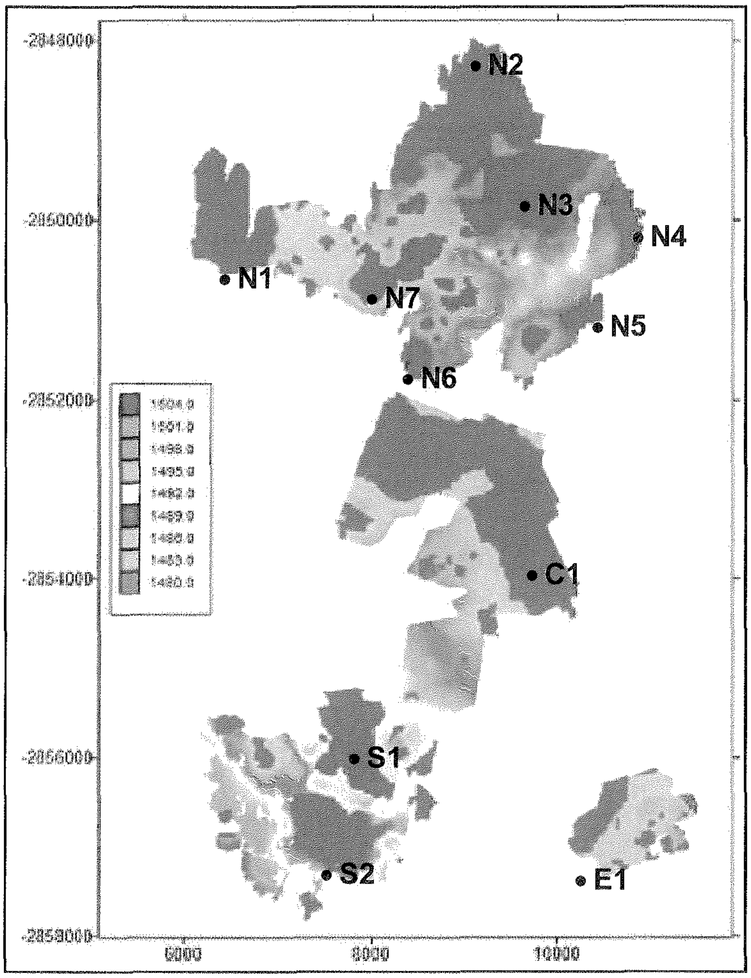


Figure 4 : General plan of Kromdraai showing the location of the main storage areas and proposed pumping points (Hodgson, 2009)

Table 2: Data used for in the water balance around the respective low pit areas

	Mining areas contributing water (m^2)	Storage volume (m^3)	Lowest floor levels (masl)	Mining completion date
N1	1 006 000	1 540 000	1 445	Completed
N7	1 453 000	243 000	1 462	Completed
N6	1 006 000	154 000	1 470	Completed
N4	2 014 000	192 000	1 470	Completed
N2	1 608 000	1 320 000	1 462	Completed
N3	1 308 000	222 000	1 462	Completed
N5	260 000	40 500	1 476	Completed
C1	4 895 000	8 300 000	1 445	2017

	Mining areas contributing water (m^2)	Storage volume (m^3)	Lowest floor levels (masl)	Mining completion date
S2	1 353 000	380 276	1 484	2017
S3	1 558 000	497 900	1 482	2013
E3	1 076 000	614 000	1 458	2016

The coal floor of the mine working is uneven. From a water point of view, the floor of the mine workings can be considered as a series of ponds in which water can be stored. The recharge water to the workings will report to the floor and accumulate in the low points of the coal floor to form ponds.

If the elevations of the ridges between different in-pit pond areas are reached, water will spill over from one pond area to the other until water level is higher than all ridges in coal floor. The water level will then increase as a single continuum until the decant elevation is reached to form a single pond. If the decant elevation is reached before the different in-pit pond areas interlink then decant will occur at more than one point in the mine block. At Kromdraai, spill-over and decant elevations were determined for each of the in-pit pond areas. Spill-over elevations between the in-pit pond areas are those lower than the decant elevations.

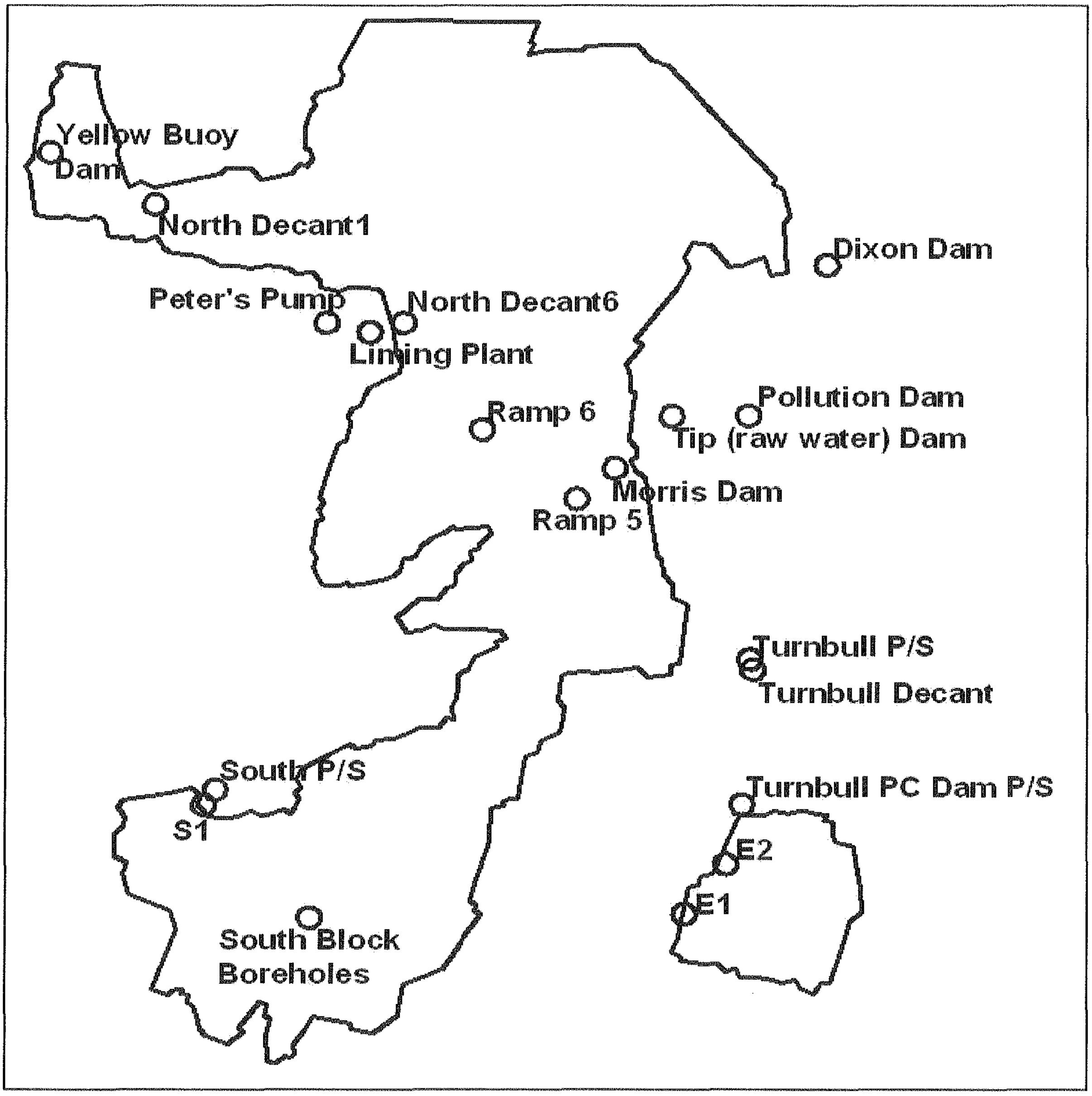


Figure 5 : General plan of Kromdraai showing the location of the main pits, the pumping points of water to the liming plant and discharging points of water from the liming plant as shown in Figure 6

Figure 6 shows the general water reticulation for Kromdraai. Some lines of the liming plant are named and given in brackets. Given the operational requirements of the mine, the reticulation should change regularly because the sources feeding the various lines going into the liming plant shown in Figure 7 are changed continuously. The lack of metered data did not allow model calibration according to the current mine pumping.

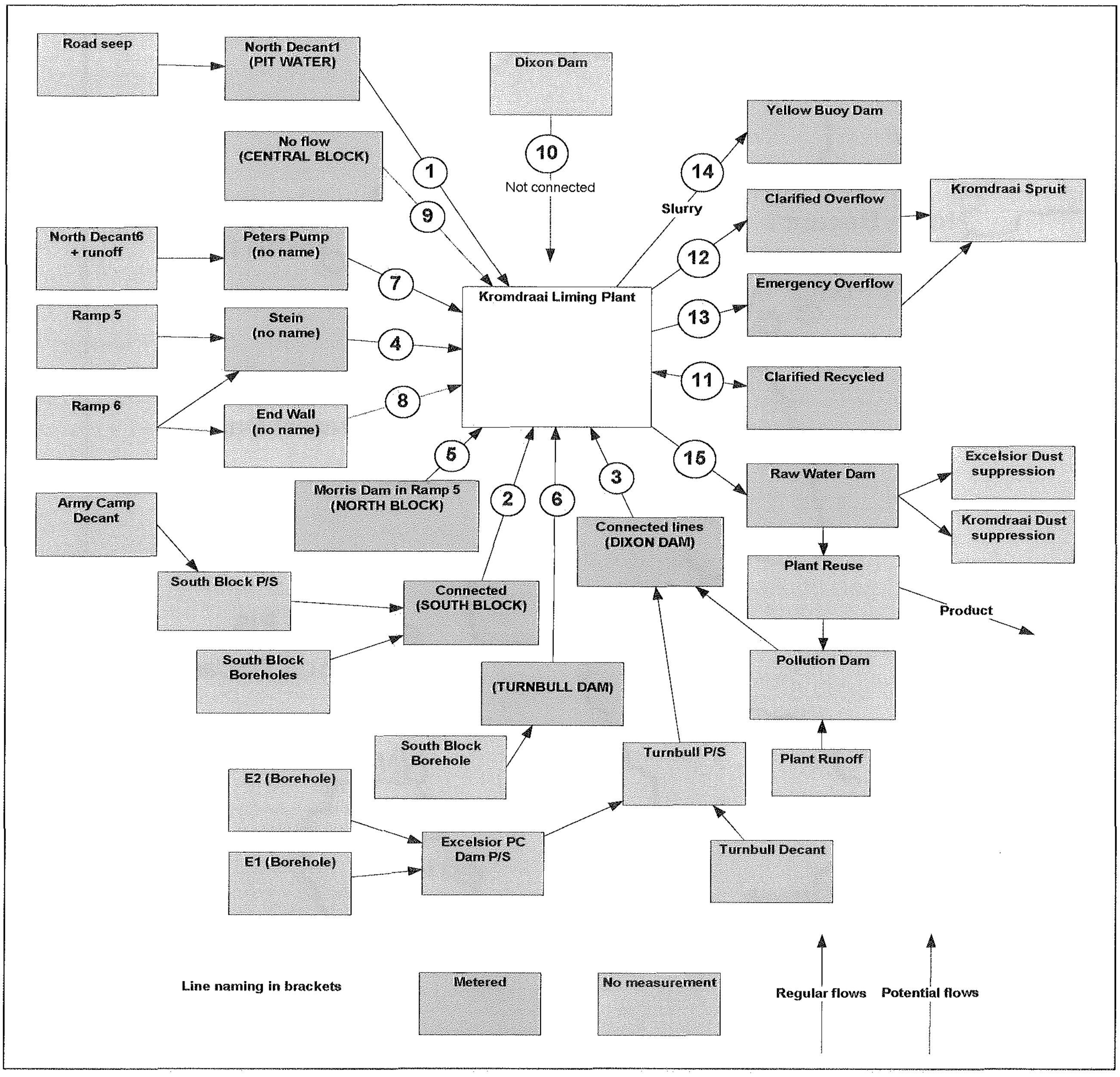


Figure 6: General plan of Kromdraai mine water reticulation

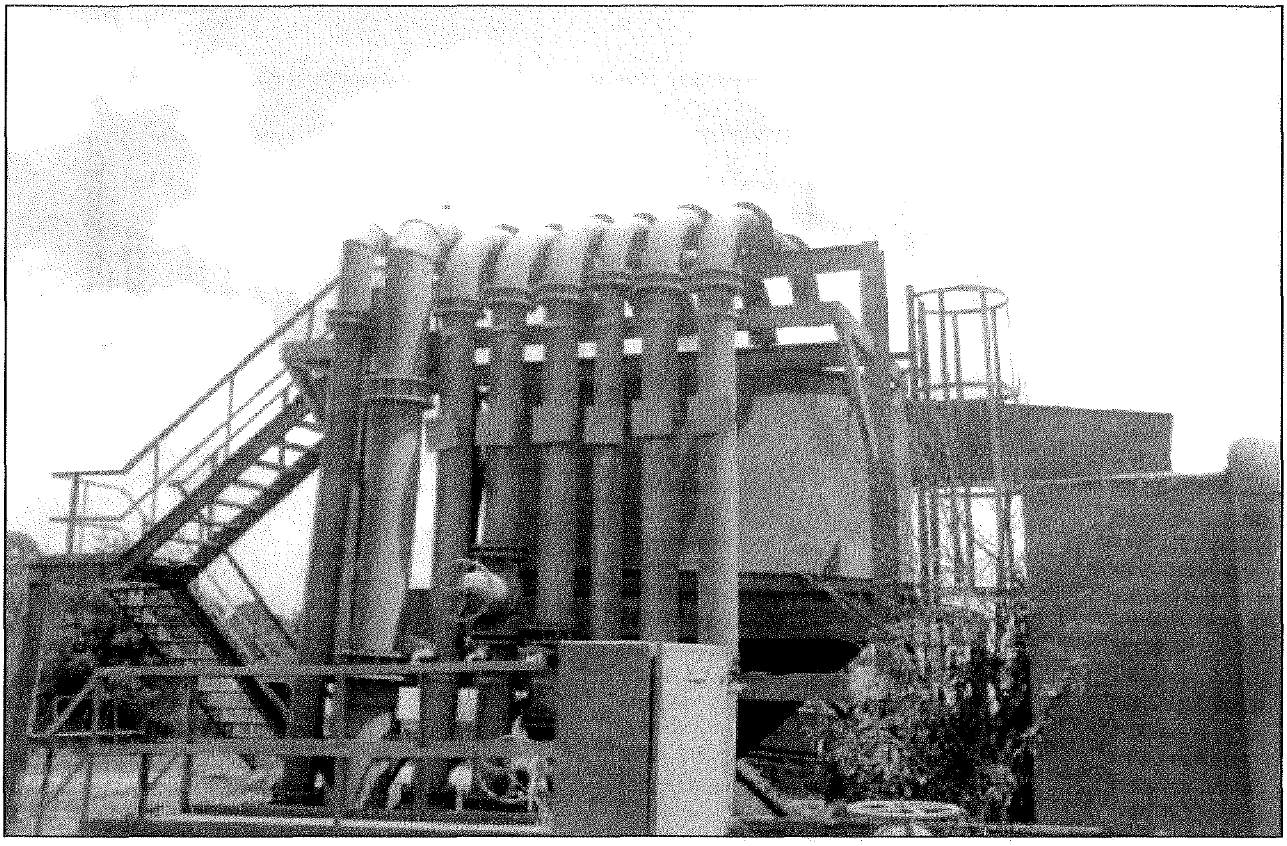


Figure 7: The Kromdraai liming plant

3.2 Description of Kromdraai water system model

The water balance around the in-pit pond areas is modelled in detail. The following hydrological interactions are modelled:-

- evaporation;
- runoff from any contributing catchments;
- abstractions and pumping;
- infiltration and other inflows; and
- spills-over from adjacent in-pit ponds and decants.

Information used for the volume and recharge/decant calculations includes coal floor seam and roof elevations, stage volume relationships and the mine schedule to life of mine. The floor contours and schedule were obtained from the Kromdraai mine surveyors and stage volume relationships were obtained from Hodgson (2009) for the pond areas.

The Kromdraai water make is modelled using actual rainfall data from a nearby site. The historical daily rainfall is shown in Figure 8 and Figure 9 shows the resulting yearly rainfall for the period of simulation.

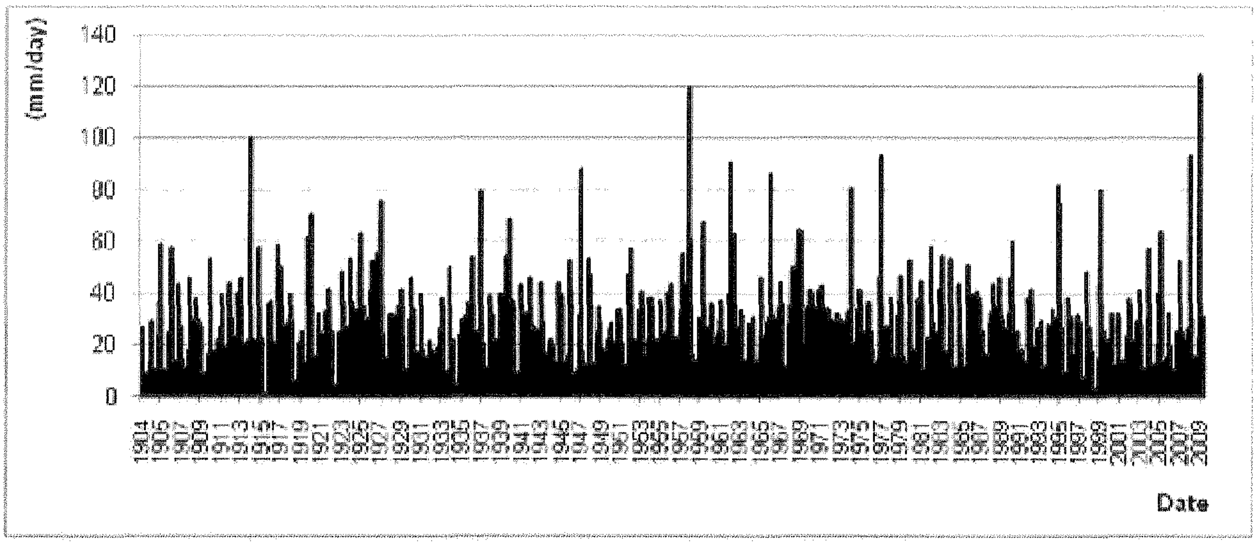


Figure 8: Daily rainfall measured at gauge 0515382 W

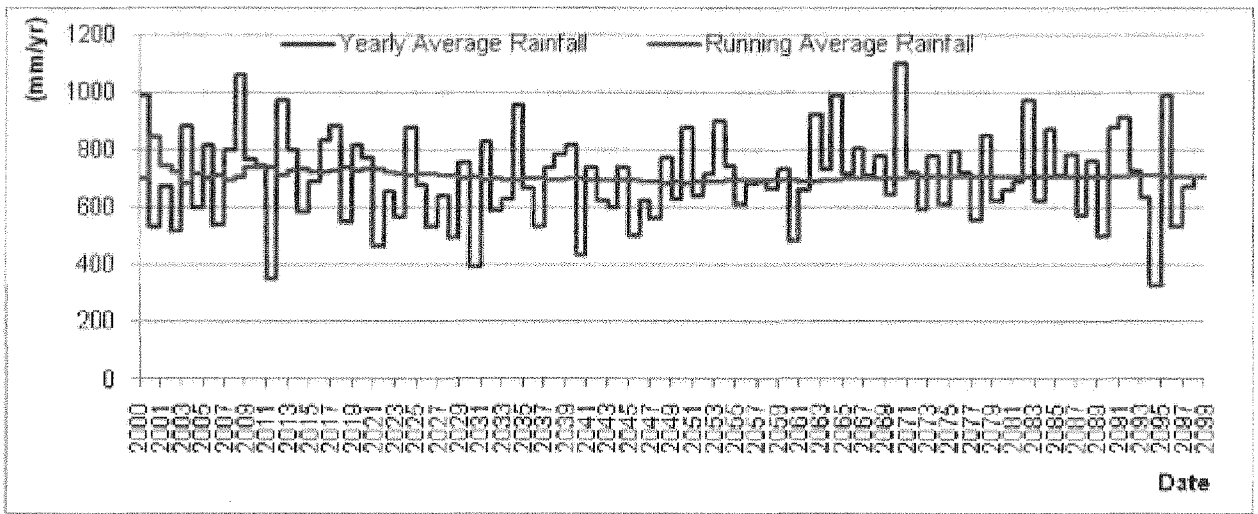


Figure 9: Yearly rainfall as used in the model giving an average of about 700 mm/yr

The model includes the following water routes and storages:-

- The growth of the mine in-pit pond areas according to the mine plan;
- The pond area storages and the spills between pond areas; and
- The pumping of water to surface to regulate water levels in the pond areas.

Infiltration into the underground in-pit pond areas is based on the water balance around the evaporation layer. Runoff is calculated based on surface characteristics of this layer and the remaining rainwater infiltrates to the pond areas after evaporation. The evaporation layer characteristics are the maximum and minimum moisture content, permeability, SCS runoff parameters and curve numbers. Mined areas will generally have lower runoff and higher seepage than undisturbed areas. Such surface characteristics changes are accounted for in the model as mining progresses.

Where opencast pits are developed through underground mining, the opencast surface area is subtracted from the underground area.

3.3 Kromdraai model parameterisation

The type of cover material and rehab effort influences recharge into the pits. Figure 10 shows the rehabilitated North Block soil that was assessed in 2003 and 2007 by Steenekamp (2008). Figure 11 gives the rehabilitation cover thickness and Figure 12 shows the post mining land capability giving a bulk density of between 1 900 kg/m^3 and 2 200 kg/m^3. Table 3 provides the soil characteristic associated with the bulk densities of this magnitude.

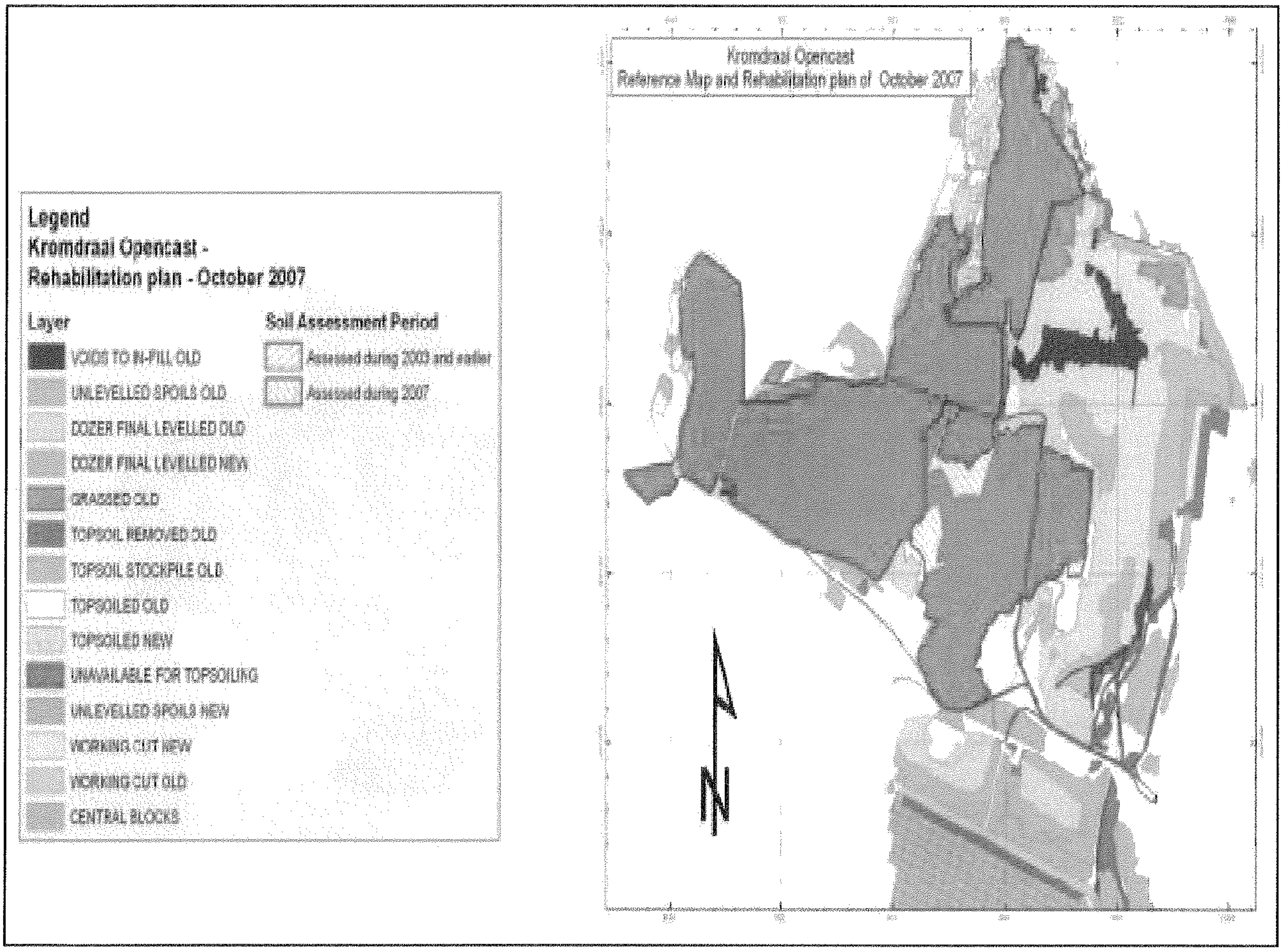


Figure 10: Reference map and rehabilitation plan of October 2007 (Steenekamp, 2008)

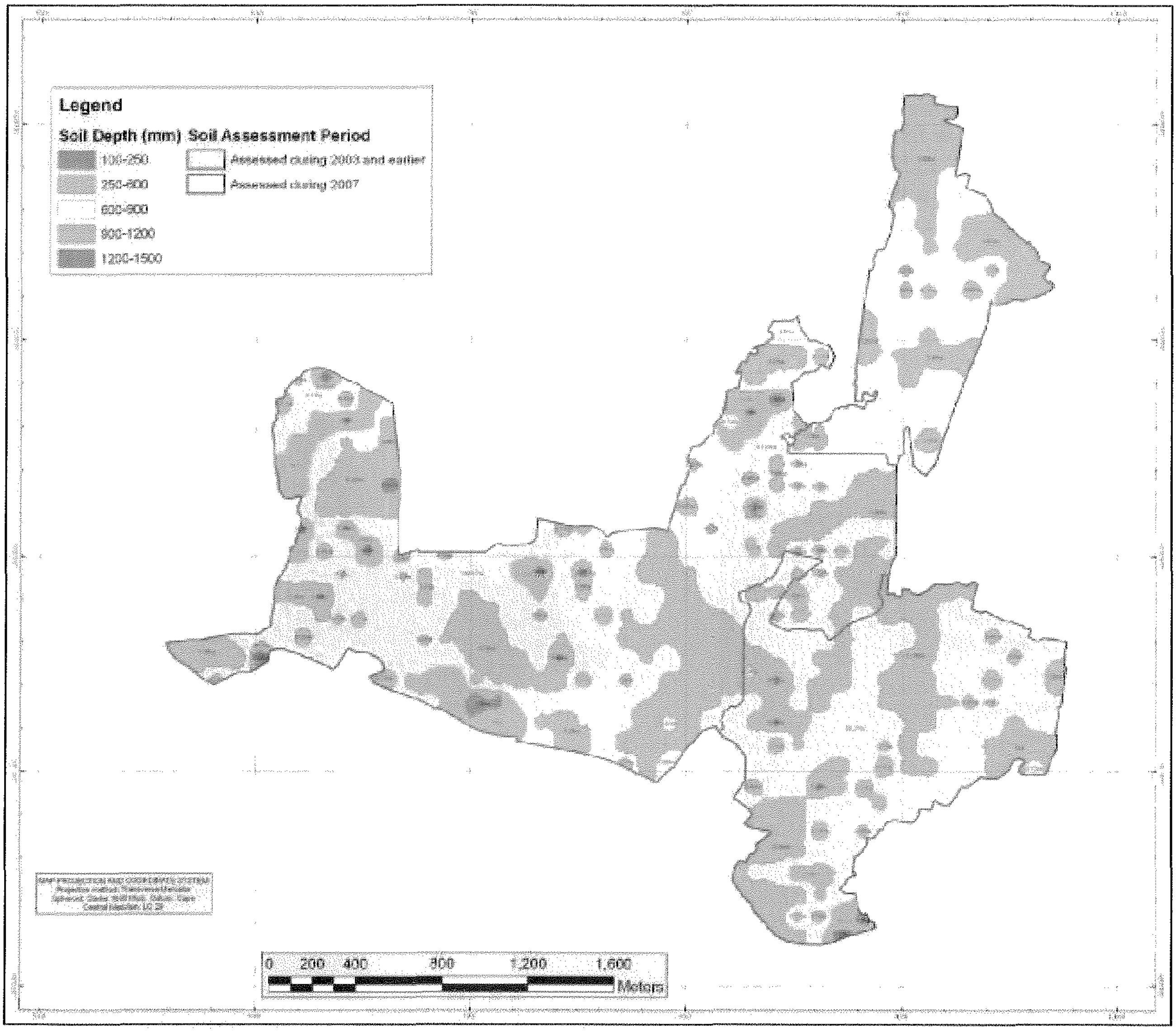


Figure 11: Rehabilitated soil depth in reference to Figure 10 (Steenekamp, 2008)

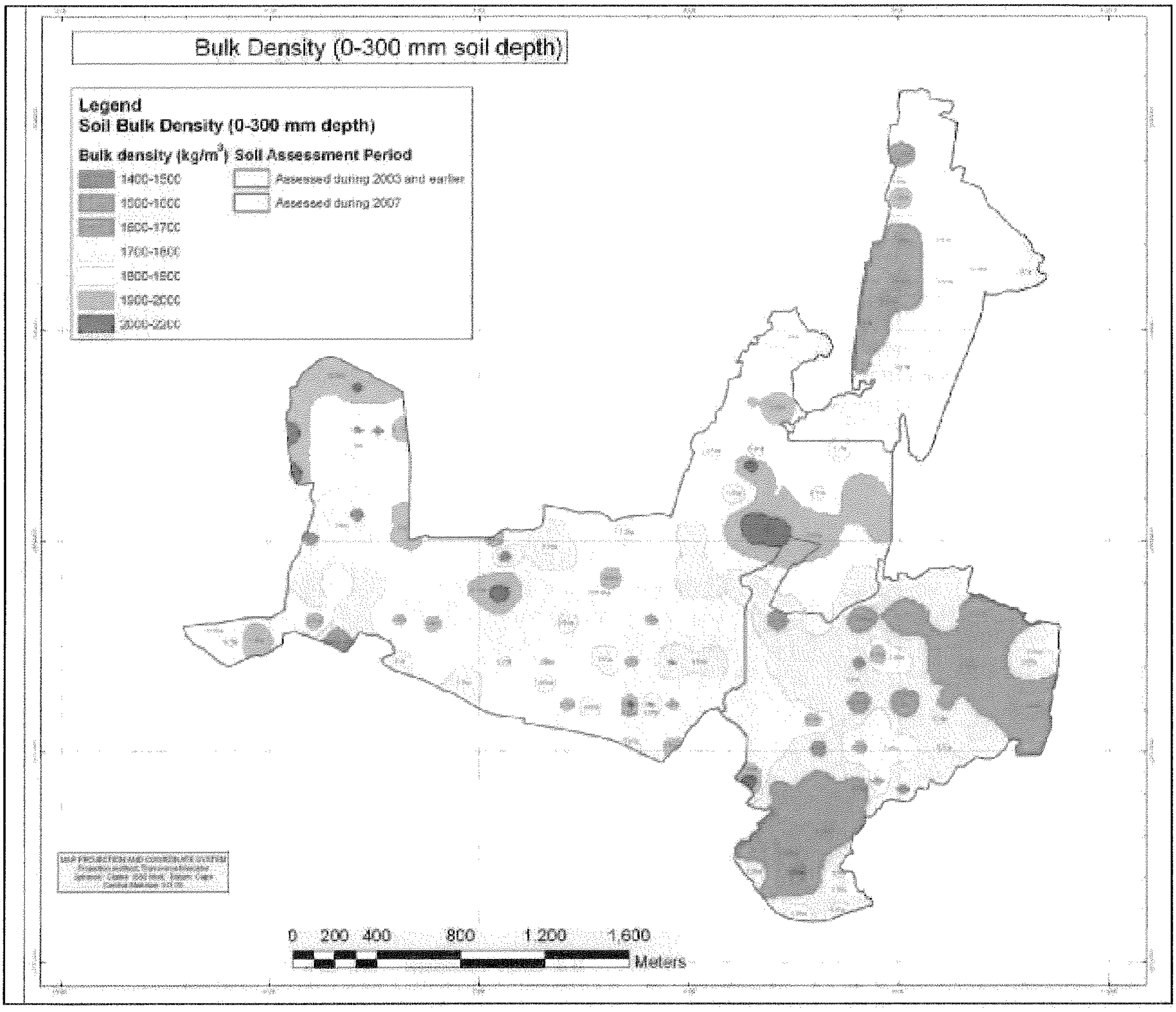


Figure 12: Rehabilitated land capability in reference to Figure 10 (Steenekamp, 2008)

Table 3: Soil classification (Look, 2007) associated with the bulk densities found at Kromdraai

Description	Porosity %	Void ratio	Water content % (fully saturated)	Dry density (kg/m^3)	Bulk density (kg/m^3)
Loose uniform sand	46	0.85	32	1 400	1 800
Dense uniform sand	34	0.51	19	1 700	2 100
Loose well-graded sand	40	0.67	25	1 600	2 000
Dense well-graded sand	30	0.43	16	1 800	2 200

In accordance with Craig (1997) the permeability was selected to be 5 000 mm/d which is typical for the sandy soil shown in Figure 13. A runoff curve number of 55 was chosen according to Table 4.

Table 4: Runoff curve numbers (SCS, 1986)

Description of Land Use	Hydrologic Soil Group*			
	A	B	C	D
Rangeland	68	79	86	89
Grassland	39	61	74	80

* Group **A** Soils: High infiltration (low runoff). Sand, loamy sand, or sandy loam Infiltration rate > 3 000 mm/d when wet. Group **B** Soils: Moderate infiltration (moderate runoff). Silt loam or loam. Infiltration rate 1 500 to 3 000 mm/d when wet. Group **C** Soils: Low infiltration (moderate to high runoff). Sandy clay loam. Infiltration rate 500 to 1500 mm/d when wet. Group **D** Soils: Very low infiltration (high runoff). Clay loam, silty clay loam, sandy clay, silty clay, or clay. Infiltration rate 0 to 5 mm/d when wet.

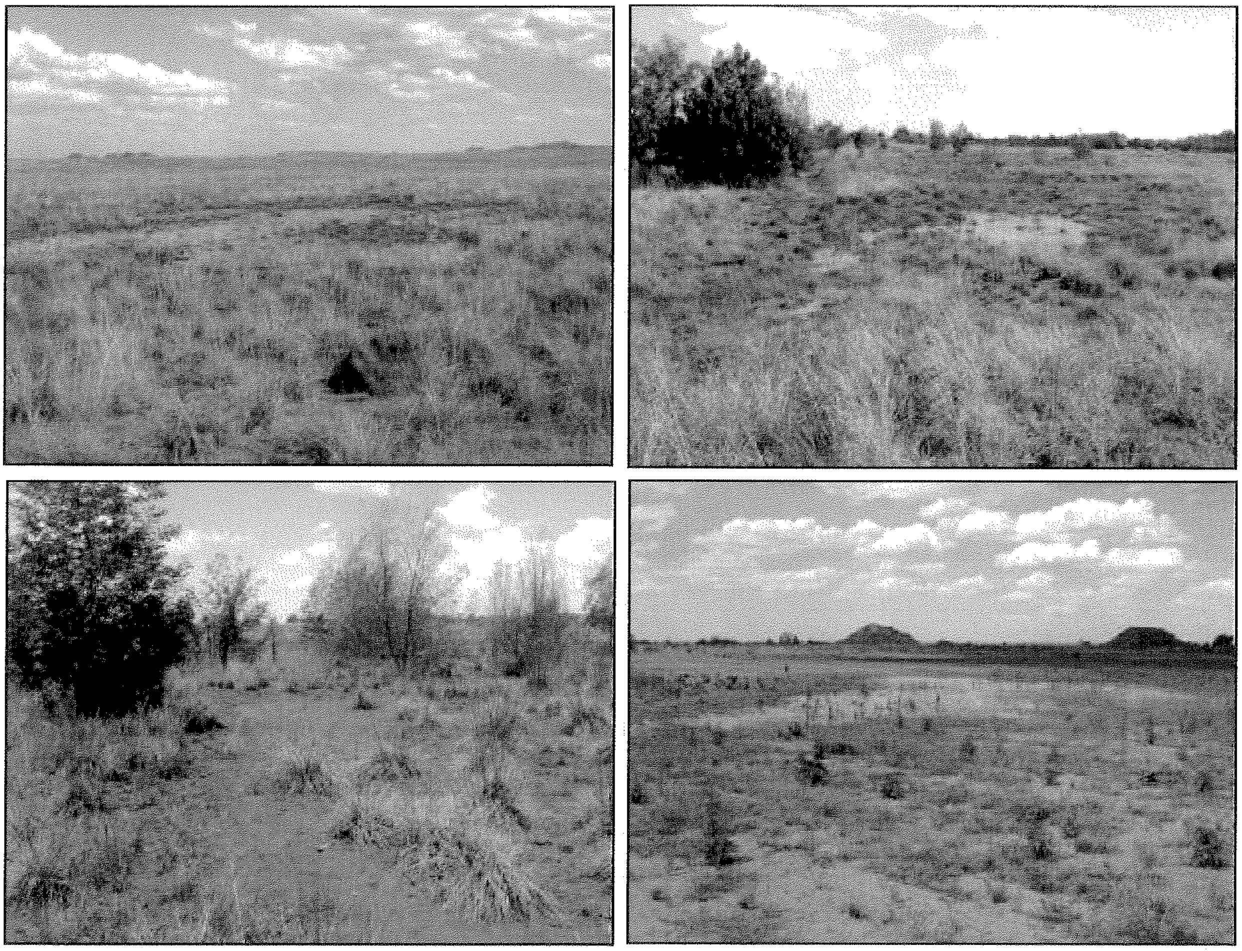


Figure 13: Pictures taken during the North Block rehabilitated soil assessment by Steenekamp (2008)

According to Table 3 and the ground conditions shown in Figure 13 which was conducted during the rehabilitation assessment in 2007, the soils are considered to have a runoff curve number of 55. The runoff parameters of the mine at the various stages of mining are given in Table 5. These properties are assumed to be representative of the entire mine.

Table 5: Runoff parameters for Kromdraai

	Depths (m)	Hydraulic conductivity (mm/d)	SCS curve runoff number
Prestripped	1	500	60
Spoils	5	6 000	20
Leveled	0.5	8 000	40
Rehabilitated	0.6	5 000	55
Underground	2	500	60

3.4 Analysis of measured data and model calibration

The model was checked using the current water/geohydrological projections of Hodgson (2009) shown in Figure 14. Hodgson (2009) projections include utilising storage in Central Pit in 2013 for dewatering from North Pit in order to minimise decanting from the North.

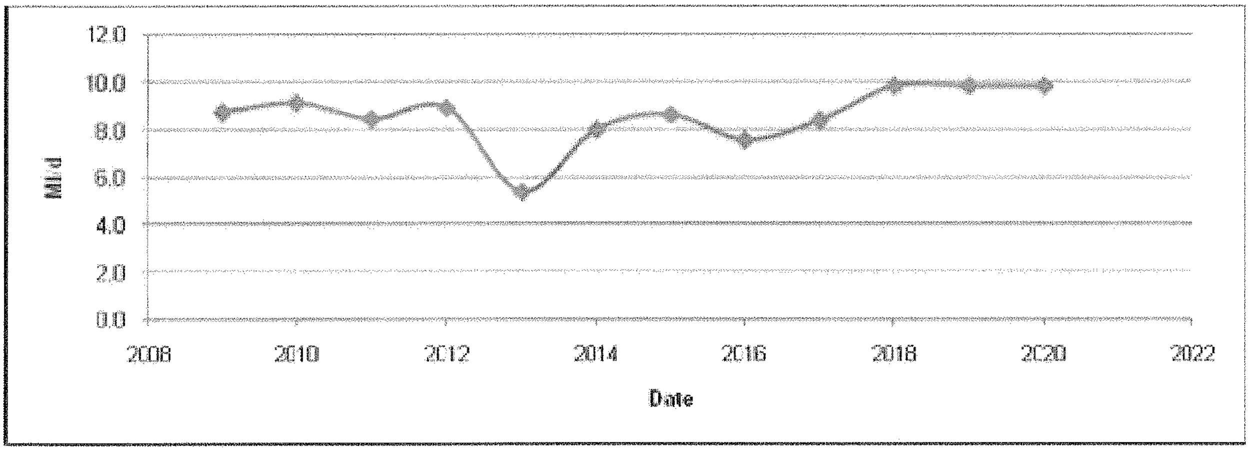


Figure 14: Projected mine excess mine water for Kromdraai (Hodgson, 2009)

The mine water make given the soil characteristics determined above and the rainfall sequence used is shown Figure 16. The expected variation in the annual recharge calculated as a percentage of annual rainfall and the average recharge over the simulation period is shown in Figure 17.

Reasonable pumping data were obtained for South Block and is shown in Figure 15. Taking the current flow to the liming plant of 10 000 m^3/d and excluding the 2 900 m^3/d pumped water from South Block gives 7 100 m^3/d. This flow is therefore assumed to be from North Block, Central Block and Excelsior Block. The current opencast mined out areas of 8 654 000 m^2 for North Block, 3 066 000 m^2 for Central Block and 707 000 m^2 for Excelsior Block gives a recharge factor of 30 % of the MAP. This is consistent with the initial average recharge determined by the model as shown in Figure 17 but does however not account for storage changes (for example in the North Block) and dewatering from Central Block.

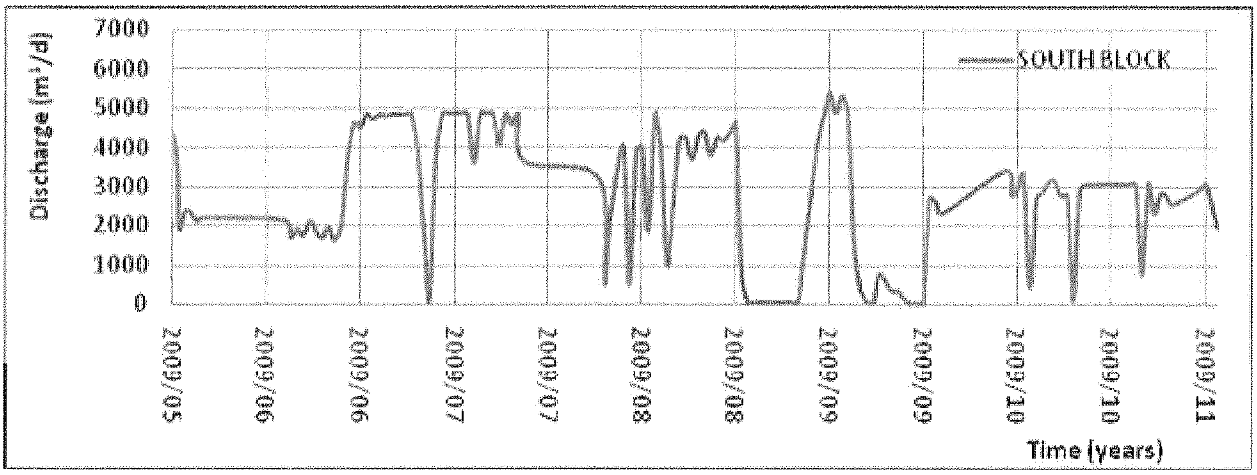


Figure 15 : South block dewatering giving and average of 2 900 m^3/d

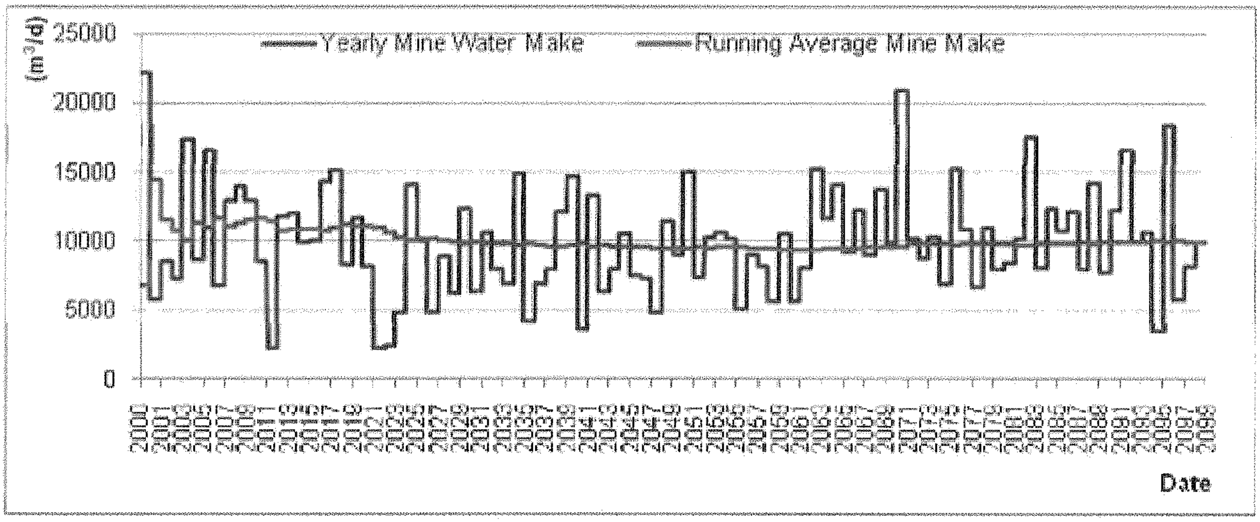


Figure 16 : Mine water make averaging about 10 000 m^3/d for the rainfall sequence shown in Figure 8

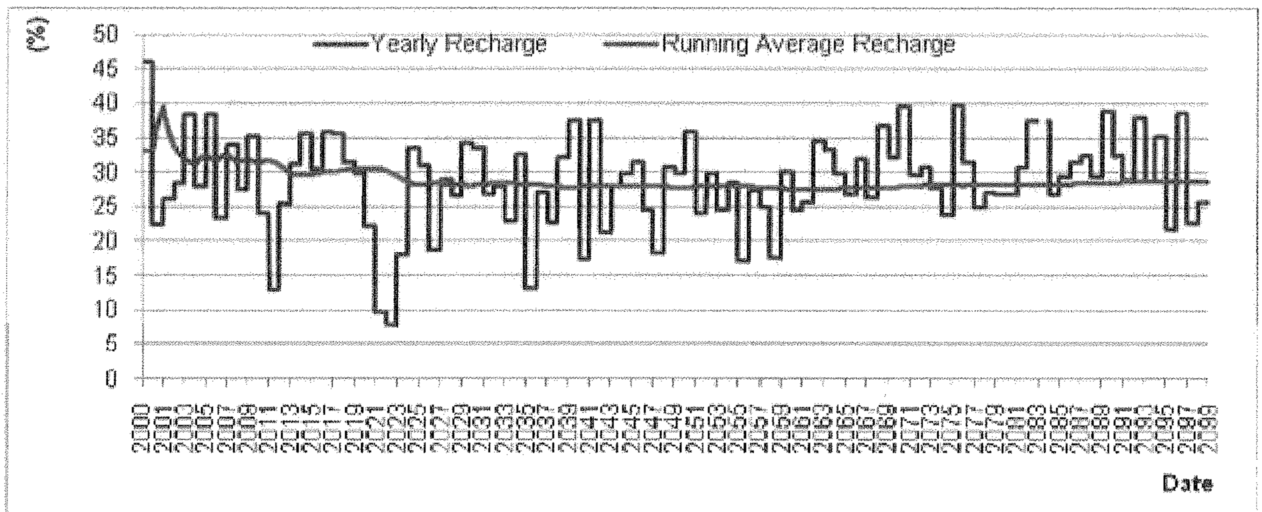


Figure 17: Percentage recharge averaging about 30 % of the rainfall sequence shown in Figure 8

3.5 Model application

Model simulations were performed for water management options related to future pumping.

In order to reach a reduce acid-mine-drainage reaction as much as possible various pumping rates were specified each associated with a particular water level. When covered, no oxygen is available for the reactions and the water quality in the mine is significantly better. The decant water quality will thus be the better under the circumstances (Clean Stream Groundwater Services, 2008). Hence, pumping rates are specified for 3 control levels in order keep to the carbonaceous backfill discard material covered with water as much as possible without decant or seep to the environment. These are for reduced pumping, duty pumping and peak pumping. The pumping levels are given in Table 6.

Table 6: Control levels for varying pumping rates associated the water levels of various in-pit pond areas shown in Figure 4

	Duty Pumping level (masl)	Peak Pumping level (masl)	Decant level (masl)
N1	1 447	1 455	1 461
N4	1 471	1 474	1 480
N6	1 467	1 471	1 476
C1	1 447	1 460	1 465
S2	1 483	1 484	1 489
S3	1 485	1 488	1 493
E1	1 460	1 463	1 468

Pumps operate at different flow rates, making it possible to pump at a low rate when the basin is almost empty and much faster when it nears the decant level. This approach to pumping reduces the maximum length of time that the pump will be non-operational (when the pit is empty) as well as reducing the risk of decants occurring.

Table 7 gives the pumping rates associated with the various in-pit pond areas.

Table 7: Pumping rates associated with various control levels for the in-pit pond areas shown in Figure 4

	Reduced Pumping* m^3/d	Duty Pumping (24hrs/d) m^3/d	Peak Pumping (24 hrs/d) m^3/d	Decants over 100 yrs
N1	8	4 000	4 600	4
N4	8	4 000	4 500	10
N6	4	2 000	3 000	0
C1	20	10 000	12 500	0
S2	2	800	1 100	2
S3	2	900	1 300	0
E1	2	700	1 000	0

*Reduced pumping will be for 20 minutes a week.

In-pit pond areas contributing to points N2, N3, N5 and N7 were not consider for pumping due to the following:-

- These in-pit pond areas are likely to overflow to other lower lying in-pit pond areas before decanting to the local environment; and
- The lower in-pit pond areas have enough storage available for pumping away overflows from other in-pit pond areas.

In-pit pond area C1 is considered for additional water storage. Water from other in-pit pond areas will be pumped to this pit since it will have sufficient storage which allows pumping at a constant rate for long periods without running dry. By dewatering the in-pit pond areas at the above mentioned rates the model predicts the water levels of the in-pit pond areas. These are given in Figure 18 to Figure 28 over the 100 year simulation period. The water levels shown are as a time series according to pumping rates given in Table 6.

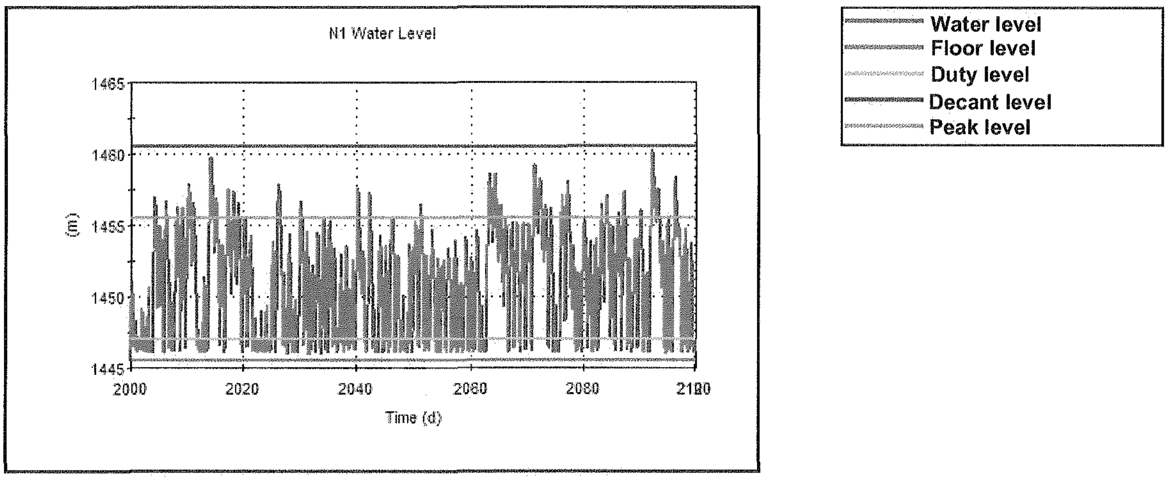


Figure 18: Water level for in-pit pond area N1 for an average pumping rate of 2 900 m^3/d to pit C1

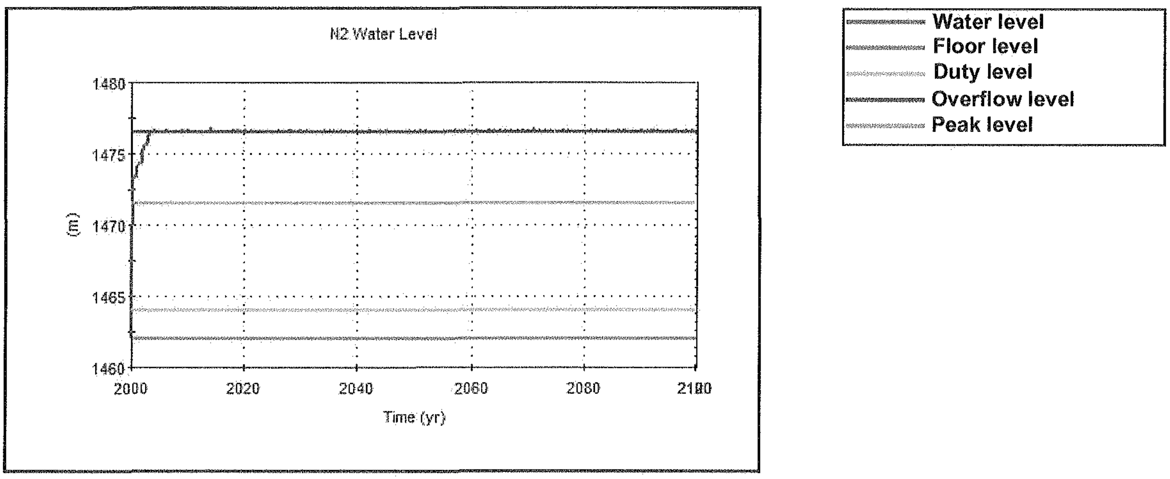
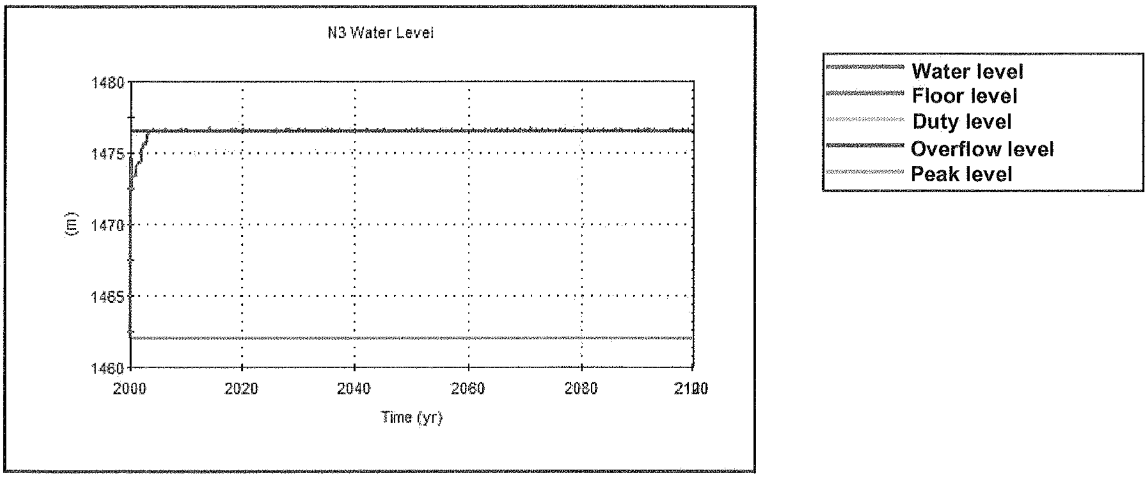


Figure 19: Water level for in-pit pond area N2 for an average overflow of 1 100 m^3/d to in-pit pond area N3



3

Figure 20: Water level for in-pit pond area N3. Overflows are to in-pit pond areas N2 and N7

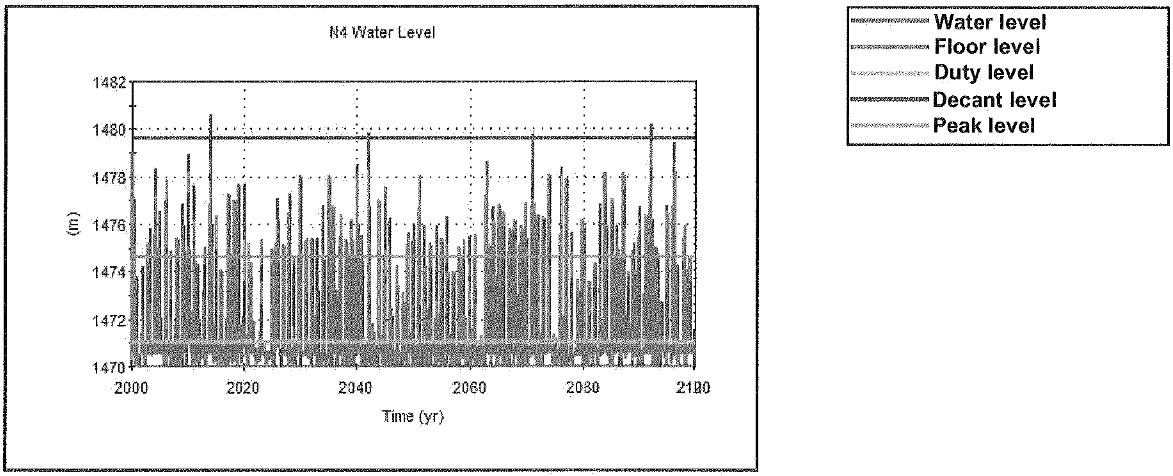


Figure 21: Water level for in-pit pond area N4 for an average pumping rate of 1 100 m^3/d to pit C1

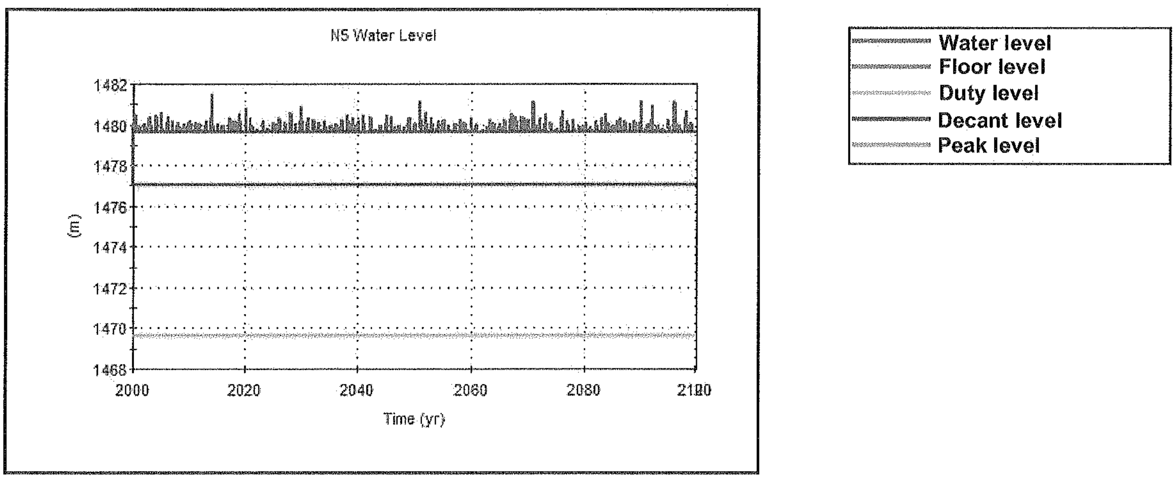


Figure 22: Water level for in-pit pond area N5. Overflows report to in-pit pond area N7

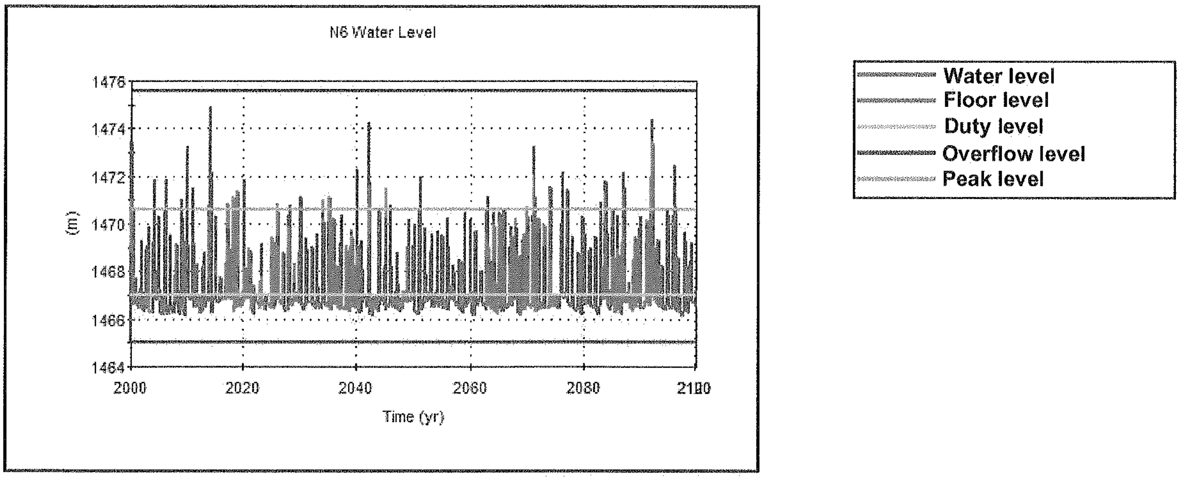


Figure 23: Water level for in-pit pond area N6 for an average pumping rate of 700 m³/d to in-pit pond area C1

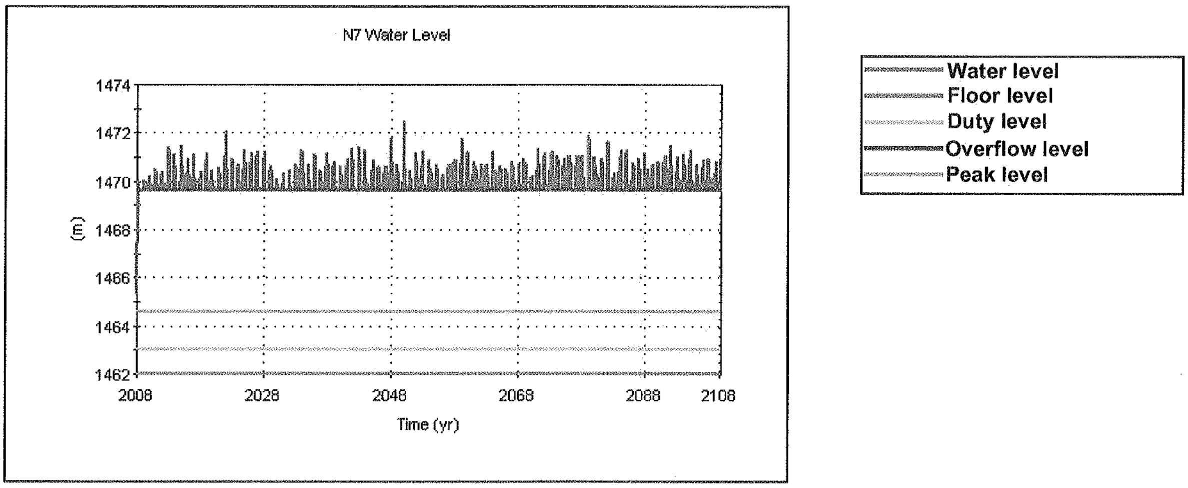


Figure 24: Water level for in-pit pond area N7 for an average overflow of 2 400 m³/d to pond area N1

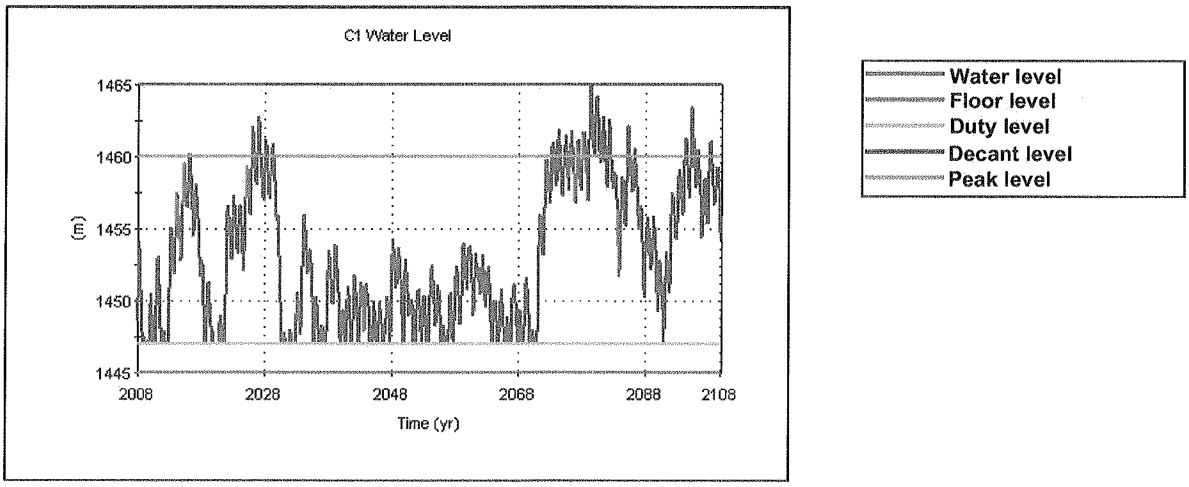


Figure 25: Water level for in-pit pond area N1 for an average pumping rate of 9 800 m³/d out of the system

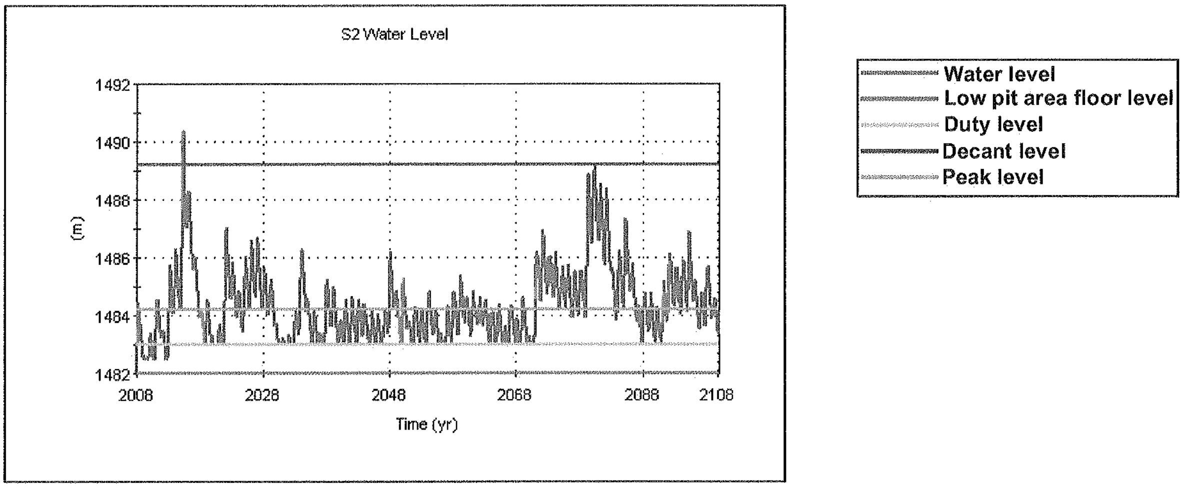


Figure 26: Water level for in-pit pond area S2 for an average pumping rate of 1 000 m^3/d to pit C1

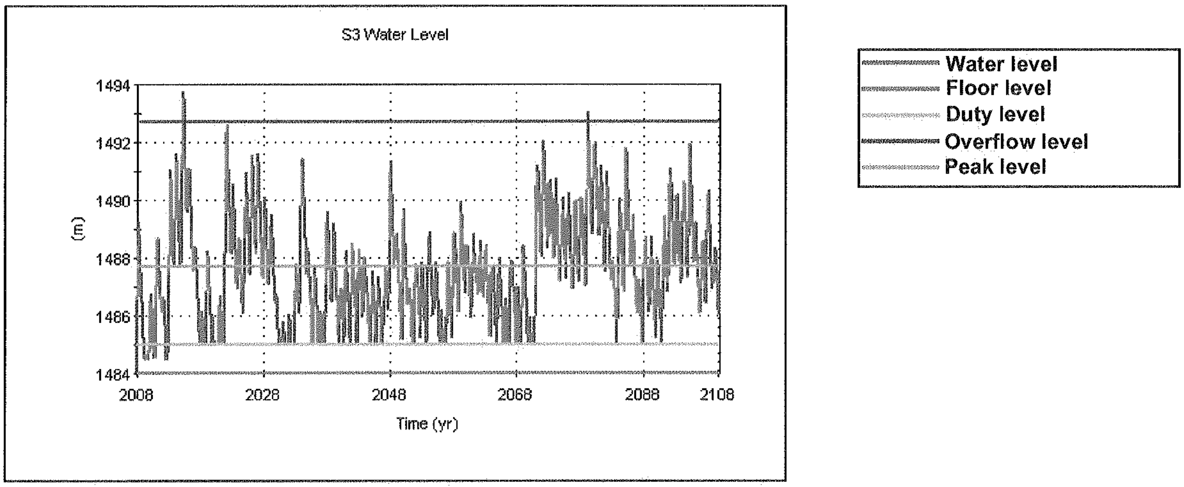


Figure 27: Water level for in-pit pond area S3 for an average overflow of 850 m^3/d to pit C1

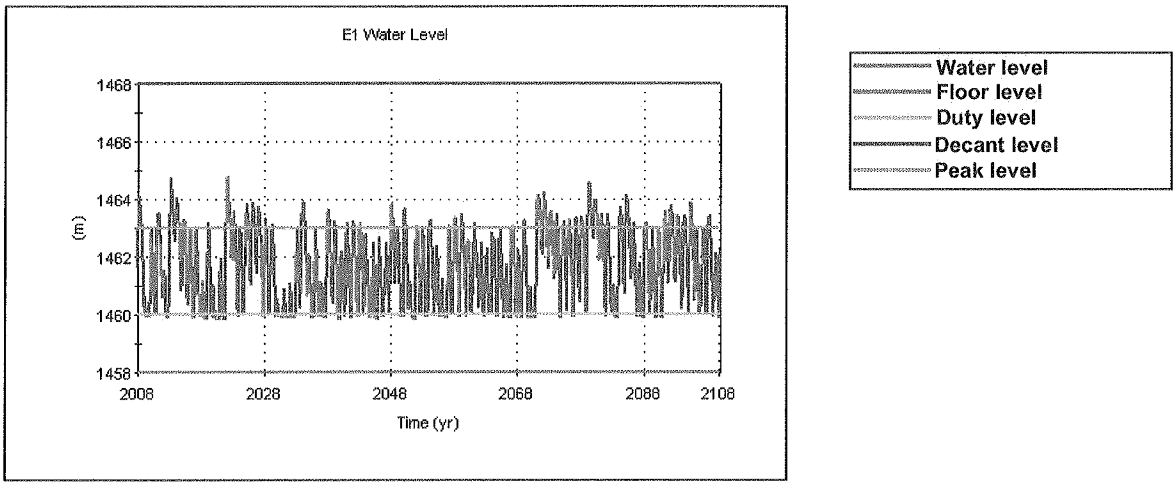


Figure 28: Water level for in-pit pond area E1 for an average overflow of 600 m^3/d to pit C1

4.0 CONCLUSIONS

4.1 Middelburg Steam & Station Colliery

The rainfall recharge for Middelburg Steam & Station Colliery is determined from measurements of the decant water volumes, calculated evaporation from the decant evaporation ponds and average rainfall onto the mine. A recharge factor of 20 % were calculated giving an expected yearly water make of 1 940 m^3/d. A peak pumping rate of 3 800 m^3/d may be expected.

4.2 Kromdraai

A water management model for Kromdraai was developed in Goldsim software. The model was calibrated using existing data. The modelling results indicate that the model is capable of simulating:

- runoff and recharge based on current soil and land cover data;
- impact of life of mine progression on mine water make; and
- storage and pumping options associated with the water levels in the in-pit pond areas.

From the results the following is important for water management on the mine:-

- Available data indicates that in-pit pond areas N2, N3, N5 and N7 do not require pumping as overflows could effectively be pumped away at lower lying in-pit pond areas;
- Water levels for in-pit pond area N6 may be controlled at N7 as there is a larger balancing volume to be used and any excess decant from N6 which should then be minimal be gravity fed to the central collection point;
- Recharge is determined to be 30 % of rainfall which may be reduced by improving rehabilitation to increase the fraction of runoff;
- Mine water make is in the order of 10 000 m^3/d;
- In-pit pond area C1 has sufficient storage which allows constant pumping rates for long periods of time; and
- In-pit pond area N4 has insufficient storage and may decant. The decant may collect in the Dixon Dam and be pumped separately.

Table 8 gives the average pumping rates determine for regulating water levels of the in-pit pond area at optimally.

Table 8: Average pumping rates required for optimal regulation of the water levels for in-pit pond areas shown in Figure 4. Storage in in-pit pond area C1 are utilised for dewatering of other in-pit pond areas

	Required average pumping rates (m^3/d)
N1	2 900
N2	0
N3	0
N4	1 100
N5	0
N6	700
N7	0
C1	9 850
S2	1 000
S3	850
E1	600

5.0 CURRENT MODELLING LIMITATIONS AND FUTURE WORK

This work will be extended by:

- including Middelburg Steam & Station Colliery in the Goldsim modeling;
- refining the Goldsim model set-up, configuration and simulation capability; and
- making recommendations based on the modelling results.

Confidence in the calculated recharge of Middelburg Steam & Station Colliery will increased through the use of rainfall data for the same period as decant flow measurements.

The coal floor contours and decant elevations need to be confirmed by the Kromdraai survey department as the these could have a major implication for pumping rates at various in-pit pond areas.

Model calibration for Kromdraai were largely based on metered dewatering but did not account for pit storage changes. Model calibration for Kromdraai may be improved depending on the availability of metered pumping and water level data.

6.0 REFERENCES

Clean Stream Groundwater Services. (2008) Estimation of Bulk Mine Water Volumes, Recharge and Decant of Current Workings and Closure Scenario at Kromdraai.

Craig, R.F (1997) Soil Mechanics, 6th Edition. Routledge, UK.

Hodgson, F. (2009) Presentation on Kromdraai – Water Balance Modelling.

Look, B.G. (2007) Handbook of Geotechnical Investigation and Design Tables. Taylor & Francis Group.

Steenekamp, P.I. (2008) Rehabilitation Performance Assessment (Soil) Landau Colliery - Kromdraai Opencast. Rehab Green Environmental and Rehabilitation Monitoring Consultants CC. Report no, RG/2007/07/14/1.

U.S. Soil Conservation Service. (1986) Technical Release 55: Urban Hydrology for Small Watersheds. U.S. Department of Agriculture.

GOLDER ASSOCIATES AFRICA (PTY) LTD.

J Grobler
Water Resources Engineer

T Coleman
Project Reviewer

JG/AD/TC/jn

Reg. No. 2002/007104/07

\\joh1-s-fs1\gaadata\projects\12485 - kromdraai mine water reclamation scheme eia\reports\eia report\appendices\appendix a\12485-water balance (final).docx

APPENDIX A

Document Limitations

DOCUMENT LIMITATIONS

This Document has been provided by Golder Associates Africa Pty Ltd ("Golder") subject to the following limitations:

i) This Document has been prepared for the particular purpose outlined in Golder's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

ii) The scope and the period of Golder's Services are as described in Golder's proposal, and are subject to restrictions and limitations. Golder did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Golder in regards to it.

iii) Conditions may exist which were undetectable given the limited nature of the enquiry Golder was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.

iv) In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Golder's opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Golder to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

v) Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

vi) Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Golder for incomplete or inaccurate data supplied by others.

vii) The Client acknowledges that Golder may have retained sub-consultants affiliated with Golder to provide Services for the benefit of Golder. Golder will be fully responsible to the Client for the Services and work done by all of its sub-consultants and subcontractors. The Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from Golder and not Golder's affiliated companies. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any legal recourse, and waives any expense, loss, claim, demand, or cause of action, against Golder's affiliated companies, and their employees, officers and directors.

viii) This Document is provided for sole use by the Client and is confidential to it and its professional advisers. No responsibility whatsoever for the contents of this Document will be accepted to any person other than the Client. Any use which a third party makes of this Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Document.

GOLDER ASSOCIATES AFRICA (PTY) LTD

At Golder Associates we strive to be the most respected global group of companies specialising in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organisational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

Africa	+ 27 11 254 4800
Asia	+ 852 2562 3658
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Africa (Pty) Ltd.
Thandanani Park
Matuka Close
Midrand
South Africa
T: [+27] (11) 254 4800

Golder Associates

APPENDIX B

Specialist Report: Human Health

INFOTOX (Pty) Ltd

Established 1991

Retrieval and scientific interpretation of ecotoxicological information

P O Box 98092 Waterkloof Heights 0065 SOUTH AFRICA
Tel: +27(12) 346 4668 Fax: 086 513 5478 Cell: 0824165864

E-mail: info@infotox.co.za

Final Report

Project done on behalf of

Golder Associates Africa

Baseline Human Health Risk Assessment for the Domestic Use of Reclaimed Water from the Emalahleni Water Purification Project

Report No 001-2010 Rev 2.0

Compiled by

MH Fourie PhD HPCSA (Medical Biological Scientist)
W C A van Niekerk PhD QEP(USA) Pr Sci Nat (Environmental Science)

7 July 2010

Copyright Warning and Intellectual Property

MH Fourie PhD	WCA van Niekerk PhD
HPCSA	QEP (USA) Pr Sci Nat
Medical Biological Scientist	Managing Director

7 July 2010

Executive summary

Golder Associates Africa ("Golder Associates") appointed INFOTOX (Pty) Ltd ("INFOTOX") to conduct a Human Health Risk Assessment (HHRA) for the consumption of potable water delivered by the Mine Water Reclamation Scheme operated as a joint initiative project between Anglo Coal and BHP Billiton in the eMalahleni (Witbank) area. A collection system was set up to pump excess mine water from Kleinkopje Colliery, Greenside Colliery and South Witbank Colliery to a central Water Treatment Plant (WTP) where it is treated to potable water standards, and distributed to the municipal water reservoir for redistribution to eMalahleni. This WTP was commissioned and has been operational since October 2007.

INFOTOX was appointed by Golder Associates to conduct a baseline HHRA prior to the proposed expansion of the existing WTP by Anglo Coal, and a second HHRA based on the modelled potable water quality subsequent to the expansion. The HHRAs are therefore concerned with the human health risks potentially related to the use of the reclaimed, purified water as a domestic water supply by the public.

Potential public concerns, amongst others, are:

- Health effects due to potential chemical or microbiological contamination;
- Health effects due to potential radiological contamination, and
- Damage to water-using household apparatus or to household articles and clothes due to certain constituents in water.

The health risk interpretations are for an assumed scenario of chronic exposure as would be associated with the reasonable maximum exposed individual. Importantly, this includes all possible scenarios of childhood exposure. This scenario is conservative, but increases confidence in the HHRA results, since it ensures that all scenarios of lesser exposure are adequately assessed.

The baseline HHRA related to the use of currently produced potable water is based on daily and weekly water quality analyses from the potable water reservoir of the WTP for the period June 2008 to September 2009. The high frequency of sampling and the extended sampling period (16 consecutive months) ensure a high degree of confidence in the validity of the samples as a representation of the water quality to be expected from the WTP. The human health risk assessment presented in this report is therefore a valid interpretation of the health risks potentially related to the ingestion of potable water produced by the WTP over the long term.

The HHRA related to the future use of potable water produced by the WTP subsequent to the proposed expansions is based on modelled concentrations of substances in potable water. A number of substances were not included in the model and microbiological contamination cannot be modeled, therefore potential health risks associated with those cannot be assessed with certainty. The modellers (Keyplan (Pty) Ltd) are of the opinion that the water quality subsequent to the proposed expansion will not be worse than that preceding the expansion. The potential heavy metals, radioactivity and microbiological contamination that were not modelled; therefore, may be tentatively assessed based on this assumption.

The following conclusions are reasonable and are supported by the results of the HHRAs, based on the analyses and modelled results presented to INFOTOX:

- None of the radioactive or non-radioactive substances present in the current potable water product of the WTP are of potential health concern.
- Drinking water standards for pH, turbidity and ammonia are not adhered to in all potable water samples. These parameters are related to consumer acceptability and are not directly related to consumer health risks. Non-adherence indicates potential quality control issues, but consumption by the public does not present a potential human health risk.
- Microorganisms were detected in a very limited number of samples of the potable water currently delivered by the WTP and are not associated with a significantly increased risk of infectious disease if the reclaimed water is intended for domestic use.
- The HHRA based on the current WTP product considered a large number of samples obtained at a high frequency (daily and weekly) over an extended period of time (16 months). The large sample base supports a high degree of confidence in the HHRA.
- The database available for assessment of potential human health risks subsequent to the proposed expansion of the WTP is limited and therefore the conclusions regarding the future potable water product are tentative. Consumption of those substances for which modelled concentrations are available is not expected to result in unacceptable human health risks.
- Conclusions regarding the potential risks associated with microbiological contamination subsequent to the proposed expansion of the WTP and with the substances that were not modelled cannot be reached with confidence. However, it is understood that the concentrations of substances and microorganisms in potable water delivered by the expanded WTP will not be higher than those currently delivered. If this were indeed shown to be the case, consumption of reclaimed water should not be associated with significant human health risks.
- Ammonia concentrations in the potable water delivered by the expanded WTP were not modelled. If the dedicated ammonia stripper proposed for the expanded WTP does not result in lower ammonia concentrations than those measured in the current product, ammonia may have a detrimental effect on consumer acceptability of the product delivered by the expanded WTP. However, the presence of ammonia at concentrations measured in the current water product is unlikely to affect consumer health.
- It is recommended that the modelled concentrations, and the concentrations of substances not modelled, be confirmed by sampling and analysis of substances in the potable water delivered after commissioning of the expanded WTP. This is also applicable to potential microbiological contamination of the future potable water product.

Table of contents

List of Tables

1 Introduction

1.1 Terms of reference

A joint initiative project between Anglo Coal and BHP Billiton was undertaken in 2004/2005 to establish a Mine Water Reclamation Scheme in the eMalahleni (Witbank) area. A collection system was established to pump excess mine water from Kleinkopje Colliery, Greenside Colliery and South Witbank Colliery to a central Water Treatment Plant (WTP) where it is treated to potable water standards and distributed to the municipal water reservoir for redistribution to eMalahleni. In addition, some treated water is distributed to the mines for their use. This WTP was commissioned and has been operational since October 2007.

Anglo Coal is proposing an expansion of the existing WTP, which will involve increasing the capacity of the existing WTP at Greenside Colliery to treat approximately 50 megalitres of mine water per day. Golder Associates appointed INFOTOX to conduct two Human Health Risk Assessments (HHRAs). Firstly, a baseline HHRA is required concerning the current water quality. Secondly, an HHRA is required based on the modelled water quality subsequent to the proposed expansion of the existing WTP Anglo Coal.

The HHRA is therefore concerned with the human health risks potentially related to the use of the reclaimed water as a domestic water supply by the public, both before and after the proposed expansion.

1.2 Public concerns about reclaimed water in the distribution network

It is expected that water quality parameters will generally be within regulatory limits, since the purpose of the WTP is to treat water to potable water standards for distribution to the municipal water reservoir. However, it can be expected that even small exceedences of the standards might be interpreted as an unacceptable risk by the community and some authorities. Small differences in concentrations of constituents in the treated water *versus* water supplied by standard utility companies might be interpreted as posing an unacceptable risk to thousands of people that might drink the water. The concerns might be raised even at constituent concentrations within the drinking water standards.

Generally, members of the public think about health risks associated with chemicals in a framework that can perhaps be described as "intuitive toxicology". People tend to base their intuitive assessment of perceived health risks on preconceived assumptions, social and personal value systems about a particular health risk. The result is often a highly subjective public perception of potential health effects and the risk thereof. These perceptions are often associated with a lack of understanding of the hazards and the culmination of circumstances, e.g., the frequency, route and period of exposure, that are required to present a risk. This state of affairs often precipitates fearful and emotional public responses to exposure scenarios associated with low levels of risk.

The public generally rates the level of health risk due to radioactivity as undoubtedly very high, irrespective of the level of ionising radiation that is present and it is often reasoned that the risk of cancer must be significant whenever ionising radiation is present in the water. However, this is not necessarily the case, and only an HHRA can provide a meaningful assessment of potential cancer risks, if present at all. The risk of hereditary effects due to radiological exposure is lower than the risk of developing radiogenic cancer and protection against cancer is adequate to protect against hereditary effects (ICRP 2007).

1.3 Aims of the HHRA of treated water

The primary aim of the HHRA is to address all potential concerns of interested and affected parties with regard to potential human health risks associated with the routes of exposure applicable to consumers of potable water distribution networks.

Potential public concerns, amongst others, are:

- Health effects due to potential chemical or microbiological contamination;
- Health effects due to potential radiological contamination, and
- Damage to water-using household apparatus or to household articles and clothes due to certain constituents in water.

2 Health risk assessment methodology

2.1 Non-radioactive substances: the tiered approach

The original paradigm for regulatory human health risk assessment in the USA was developed by the USA National Research Council (NRC 1983). This model has been adopted and refined by the US Environmental Protection Agency (USEPA) and other agencies in the world (IPCS 1999), and is widely used for quantitative health risk assessments.

The risk assessment paradigm essentially divides human health risk assessment into a number of logical steps, as follows:

- **Hazard assessment** is the identification of chemical and biological contaminants suspected to pose hazards and a description of the types of toxicity that they may evoke. This is achieved by comparison of water quality test results with national and international drinking water guidelines or standards (Section 2.3).

- **Dose-response assessment** (toxicological assessment) addresses the relationship between levels of biological exposure and the manifestation of adverse health effects in humans, and/or how humans can be expected to respond to different doses or concentrations of contaminants.

- **Exposure assessment** includes a description of the environmental pathways and distribution of hazardous substances, identification of potentially exposed individuals or communities, the routes of direct and indirect exposure, and an estimate of concentrations and duration of the exposure.

- **Risk characterisation** involves the integration of the components described above, for the purpose of determining whether specific exposures to an individual or a community might lead to adverse health effects. Risks are indicated by numbers such as a hazard quotient of larger or smaller than one, or a cancer risk of one in a hundred thousand or one in a million.

- **Uncertainty review** identifies the nature and, when possible, the magnitude of the uncertainty and variability inherent in the characterisation of risks. The results of any risk assessment reflect scientific uncertainty associated with limitations in available data and assumptions that are made in the absence of such data, and the variability in exposure and toxicological response expected, given the diversity within the human population. The assumptions and limitations that form part of all risk characterisations should be discussed in the risk assessment report. The uncertainty review demonstrates the level of confidence in the outcome of the risk assessment and indicates whether additional data might be required, or whether elements of the precautionary principle should be applied.

Human health risk assessment for exposure to contaminants in the environment is conducted in a tiered approach. The level of risk assessment does not at all influence the outcome of the assessment of the actual risk. It merely relates to the level of detail in which the assessment is conducted. The Tier-1 risk assessment refers to very conservative assumptions and overestimates rather than underestimates risk. For example, it is assumed that members of the community could be exposed to a selected contaminant, without any consideration of human behaviour or activity patterns. The higher tiers require more in-depth investigation of exposure scenarios and relevant epidemiological and toxicological literature, thereby reducing uncertainties and increasing the scientific information base. Increased confidence in the assessment reduces the necessity for conservative assumptions and large safety factors. Exposure assessment and risk characterisation hence become more realistic and relevant in Tier-2 and Tier-3 assessments.

2.2 Radioactive substances

The approach taken in the WHO Guidelines for controlling radiological hazards has two stages: firstly, initial screening for gross alpha and/or beta activity to determine whether the activity concentrations (in Bq/litre) are below levels at which no further action is required and, secondly, if these screening levels are exceeded, investigation of the concentrations of individual radionuclides and comparison with specific guidance levels (WHO 2006).

2.3 Tier-1 screening assessment: water quality and drinking water guidelines

Since the purpose of this study is to assess the potential health risks associated with utilisation of reclaimed mine water as drinking water in the public distribution network, it is important to assess the quality of the reclaimed water in the context of national and international water quality guidelines. The national norms are the South African National Standard for Class 1 water developed by the South African Bureau of Standards (SABS) (SANS 241:2005) and the South African Water Quality Guidelines for Domestic Water Use (DWAF 1996). The international guidelines and standards referred to in Table 3.1 below are those established by the World Health Organization (WHO 2006) and the US Environmental Protection Agency (USEPA 2006 and 2009(a)).

With regard to domestic water use in South Africa, the South African Water Quality Guidelines for Domestic Water Use serve as the primary source of information for determining the water quality requirements of domestic water uses. These guidelines are technical documents aimed at users with a basic level of expertise concerning water quality management. The Guidelines are concerned not only with health risks, but also with acceptability of drinking water to the consumer with regard to organoleptic properties, appearance and possible staining of or damage to household articles and apparatus. The Guidelines are intended to provide the information required to judge the fitness of water for domestic purposes, primarily for human ingestion but also for bathing and other household uses (DWAF 1996). The South African National Standard for drinking water (SANS 241:2005) is focussed on drinking water use and is suitable for adoption by utility providers (e.g., Rand Water Board) as a delivery specification. Drinking of water with quality adherent to the SANS precludes a significant risk to health over a lifetime of consumption, having made provision for different sensitivities that may occur between life stages (babies and infants, the immunocompromised and the elderly).

Drinking-water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. Under the authority of the Safe Drinking Water Act, the USEPA has set standards for approximately 90 contaminants in drinking water. After reviewing health effects studies, the USEPA established a Maximum Contaminant Level Goal (MCLG), which is the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. MCLGs are non-enforceable public health goals. Since MCLGs consider only public health and not the limits of detection and treatment technology, sometimes the limits are set at a level that water systems cannot meet. For example, if there is evidence that a chemical may cause cancer, and there is no dose below which the chemical is considered safe, the MCLG is set at zero. Therefore, for each of these contaminants, the USEPA has set a legally enforceable standard, called a maximum contaminant level (MCL), which represents the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLG as is feasible, using the best available analytical and treatment technologies and taking cost into consideration (USEPA 2006).

The legal limits reflect both the level that protects human health and the level that water systems can achieve using the best available technology. Water suppliers are not allowed to provide water that does not meet these standards (USEPA 2009(b)). Drinking water that meets these standards is safe to drink, but it must be clear that MCLs are based not only on consideration of health effects and, therefore, are not generally suitable as screening guidelines for assessment of drinking water in cases of suspected industrial contamination.

The WHO guidelines are health-based. The aim of the guidelines is to achieve quality of water that is acceptable for life-long consumption, based on limiting the health risks to the consumer (WHO 2006). Since the WHO guidelines are based solely on limiting health risks, these are more suitable as screening guidelines than the USEPA drinking water guidelines.

The USEPA has also developed a set of human health-risk-based screening concentrations (RBCs) for tap water (human consumption) (USEPA 2009(a)). The primary use of RBCs is for chemical screening during baseline risk assessment of drinking water, to select contaminants of potential concern. The RBCs were derived using exposure equations and generic exposure factors (not site- or exposure-scenario specific) developed by the USEPA under the Superfund Program. The updated RBC list of April 2009 contains guidelines for almost 700 substances.
In terms of the goals related to the Tier-1 screening process, the aim is to use the most

conservative screening concentrations, but screening concentrations that are based on updated and sound toxicological en epidemiological data. Considering the approaches used by the various regulating authorities listed in this discussion, SANS 241:2005 was the primary source of screening concentrations for the water reclamation project presented in this document, followed by the other sources in the following general hierarchy:

SANS 241:2005 → DWAF 1996 → WHO 2006 → USEPA drinking water standards 2006 → USEPA RBC

Therefore, if a South African guideline was not available, precedence was given to the WHO guidelines amongst the international guidelines, followed by the USEPA drinking water standards. However, this is not a rigid process, since the hierarchy may be overturned by new information that continually becomes available in the field of human toxicology and epidemiology.

3 Tier-1 assessment of the existing water quality prior to the proposed expansion

3.1 Existing water quality data

INFOTOX was provided with the results of daily and weekly water quality analyses from the potable water reservoir of the WTP for the period June 2008 to September 2009. For the sake of consistency in the presentation of results, concentrations reported on a weekly basis were assumed to be valid for each day of the weekly period for which the result was reported. The summary statistics of the water quality parameters and substance concentrations are given in Table 3.1, with the relevant drinking water standards and guidelines. Values of parameters and concentrations of substances that exceeded the SANS limits are shaded. If a SANS limit was not available, the measured concentration was shaded if the listed guideline was exceeded.

Table 3.1: Water quality parameters and substance concentrations (mg/litre) of samples of potable water with associated water quality guidelines.

Parameters and substances	Mean value	99^{th} Percentile*	SANS limit**	Guideline	Guideline Reference
pH	7.9 (median)	10.0	5.0 - 9.5	6.5 - 8.5	DWAF 1996
Conductivity mS/m	20.1	37.2	<150 (t/a)	70 (t/a)	DWAF 1996
Turbidity in NTU§§	1.4	7.9	<1 (t/a)	<1 (t/a)	DWAF 1996
Total alkalinity (as $CaCO_3$) (mg/litre)	12.8	24.4	not regulated	100 - 200	DWAF 1996
Colour in Pt-Co§	6.2	42.6	<20 (t/a)	<15 (t/a)	DWAF 1996
TDS (mg/litre)	122	231	<1000 (t/a)	450 (t/a)	DWAF 1996
Suspended solids (mg/litre)	1.9	17.6	not regulated	Quantitative criteria not prescribed***	DWAF 1996
NH_3 as N (mg/litre)	1.17	3.6	<1	<1 (t/a)	DWAF 1996
NO_3 and NO_2 as N (mg/litre)	2.7	5.2	<10	11	WHO 2006

Parameters and substances	Mean value	99th Percentile*	SANS limit**	Guideline	Guideline Reference
SO_4 (mg/litre)	43.6	103	<400	250 (t)	USEPA 2006
Na (mg/litre)	20.8	40.8	<200	30 (t)	USEPA 2006
Ca (mg/litre)	10.1	24.3	<150	200 (t)	WHO 2006
Mg (mg/litre)	0.84	3.06	<70	100 (t)	WHO 2006
K (mg/litre)	4.4	9.2	<50	100 (t)	DWAF 1996
Zn (mg/litre)	0.04	0.34	<5	10	DWAF 1996
Mn (mg/litre)	0.01	0.04	<0.1	5 (health); 0.10 (t/a)	DWAF 1996
Al (mg/litre)	0.02	0.12	<0.3	<0.15	DWAF 1996
Fe (mg/litre)	0.01	0.14	<0.2	0.1	DWAF 1996
Ba (mg/litre)	0.013	0.07	not regulated	0.5	WHO 2006
Sb (mg/litre)	0.004	0.01	<0.01	0.021	WHO 2003
As (mg/litre)	0.007	0.01	<0.01	0.01	DWAF 1996
Cd (mg/litre)	0.002	0.003	<0.005	0.005	DWAF 1996
Cr (mg/litre) (assumed to be total Cr)	0.007	0.01	<0.1	0.05	WHO 2006
Co (mg/litre)	0.007	0.01	<0.5	0.05	WHO 2006
Cu (mg/litre)	0.008	0.03	<1	1.0	DWAF 1996
Pb (mg/litre)	0.007	0.01	<0.02	0.01	DWAF 1996
Hg (mg/litre)	0.001	0.001	<0.001	0.001	DWAF 1996
Ni (mg/litre)	0.007	0.01	<0.15	0.07	WHO 2006
Se (mg/litre)	0.007	0.01	<0.02	0.02	DWAF 1996
V (mg/litre)	0.007	0.01	<0.2	0.10	DWAF 1996
Cl (mg/litre)	13.3	21	<200	250 (t)	USEPA 2006
F (mg/litre)	0.14	0.23	<1	2	USEPA 2006
Phenols (mg/litre)	0.004	0.005	<0.01	<0.01	DWAF 1996

Values or concentrations that exceeded the SANS limit are shaded. If a SANS limit was not proposed, the concentration was compared with the listed guideline.

* Value exceeded by only 1 per cent of the samples.

** Limits for Class 1 Water.

(t/a) The guideline is based on a taste threshold or other undesirable aesthetic effects.

(t) The guideline is based on a taste threshold.

*** General procedures should be adhered to, namely that the distribution system should not show any visible sediments upon inspection (DWAF 1996).

§ Water colour measured in Pt-Co colour units, using the visual colour comparison method. Pt-Co identifies the colour scale to be used, namely the platinum-cobalt scale, and the standard colour units of the scale are defined by the American Public Health Association (APHA). http://www.chemicalonline.com/article.mvc/APHA-0002?VNETCOOKIE=NO

§§ Nephelometric turbidity unit.