Summary Report

Phase 1b: Institutional and Pricing Models for the Sustainable Treatment and Reuse of Mine Water: Issues, Opportunities and Constraints

November 2013

Prepared by:

PEGASYS
CHANGING LIVES CHANGING WORLDS

www.pegasys.co.za

Prepared for:

Strategic Water Partners Network

EXECUTIVE SUMMARY

The Thematic Working Group for Effluent and Waste Water Management (EWWM) of the Strategic Water Partners Network (SWPN) is carrying out a programme of work to: (i) establish the issues, opportunities and constraints inherent in the treatment and reuse of mine water; (ii) develop potential institutional and pricing models for sustainable mine water treatment and reuse, which will provide an enabling environment for private sector intervention in the sector; and (iii) develop and implement a change management strategy towards the most appropriate models identified. These three objectives correspond to Phases 1, 2 and 3 of the broader programme, respectively.

Phase 1a broadened the AMD problem analysis to address the management of mine water from coal and gold mining in South Africa, which took it beyond treatment and reuse of AMD from coal mining in the Olifants River. There is a recognition from an institutional and financing perspective, that effectively addressing mine water problems needs to distinguish post-operational mining areas (in which the majority of mines are non-operational), operational mining areas (in which there is a mix of operational and non-operational mining, but with a limited lifespan), and developing mining areas (in which new mines are being opened and most mines are operational). Furthermore, there is an understanding that the problems being faced in the gold mining areas are quite distinct from those in the coalfields.

Following this, the Witwatersrand goldfields, Witbank coalfields and Waterberg coalfields were prioritised as areas reflecting the post-operational, operational and developing phases of mining, respectively. The scoping of Phase 2 reviewed these three areas, while being cognizant of the potential trajectory of a mining area into the future.

The solution needs to reflect the specific mine-related water quality concerns in the relevant catchment, and the regionally most sustainable mining practices, rehabilitation opportunities and management arrangements. This may involve a combination of appropriate mine siting (and practices), treatment & reuse, passive treatment and ingress management within the catchment, the mix of which may evolve during the development trajectory of the mining area. Furthermore, the solution needs to reflect the nature of current water supply-demand stress and the changes in future demand patterns (and sources) in the relevant catchments and its connection to the entire inter-connected Vaal supply system. All of these need to consider the changing nature of mine water from operational activities, through immediate post-operational rehabilitation-stabilisation, to long-term steady state mine water contributions, as well as the corresponding changes in climate (precipitation and temperature) and regional and spatial development.

There are likely to be a number of institutional-financial business model/s required to enable the cooperative management of mine water within an area (these may not be mutually exclusive), ranging:

- from those that focus on ensuring effective area wide processes,
- through those required to collaboratively plan and implement specific interventions,
- to those that are specifically focused on locally collecting, treating and reusing mine water.

The form of these institutional-financial business models would need to reflect the functions they are required to perform, would need to address their current viability and long-term sustainability as conditions change, and may require adjustment to the enabling policy and regulatory environment.

Following the discussions and priorities agreed during the final work session of Phase 2 on 1st November 2013, it was agreed to focus on the Witbank area. The rationale for this recommendation was that Witbank has a combination of expanding, operational and non-operational mines, has a 20-year window of opportunity to address the challenge during active mining activities, has significant information, is located in an area with serious water quality and water supply concerns, and has emerging institutions and multi-lateral interest in developing a sustainable solution.

The scoping of Phase 2 distinguishes the core collaborative aspects (interventions, institutions and funding), from broader pre-requisites and requirements for scaling and transfer to other areas.

Outcome 1: Priority collaborative interventions

The primary purpose of these collaborative interventions is to contribute to the short, medium and long term management of water quality (specifically sulphate, linked to acidity and salinity) in the Loskop catchment, with a potential secondary consequence being the supply of treated water to local or regional demands. In this light, the critical issues around which there are opportunities for collaboration in the Witbank coalfields are:

- *Coherent catchment water and regional mining-environmental planning*
- *Improved government and peer regulation*
- *Coordinated information sharing and aligned corporate governance*
- *Collective treatment and reuse or mine water*
- *Collective mitigation or management of mine water*
- *Effective long-term liability provisioning for mine rehabilitation and water management*

Outcome 2: Institutional arrangements

The selected suite of interventions needs to be enabled through appropriate institutional mechanisms (and arrangements). From a SWPN EWWM perspective, a single area-catchment based coordination-implementation body should be explored. This may be supported by different internal business units, contracting of implementing agents and/or even the establishment of other collaborative bodies, as the means of actioning specific interventions. The implications for the institution between the three operational and post-operational phases of the Witbank coalfields will need to be assessed. From the preceding outcome description, this implies the regional body may have responsibility for:

- coordinating regional mine and water rehabilitation planning;
- coordinating monitoring and information acquisition and dissemination;
- developing and operating mine water treatment facilities and distribution;
- implementing mine rehabilitation and land redevelopment initiatives; and
- managing a dedicated mine water liability fund collected.

Outcome 3: Funding mechanisms and arrangements

The financial feasibility of any intervention is dependent on both the state quantifying and providing for its financial liability applicable to the current ownerless mines and the private sector similarly towards its operating

mines. The current lack of intergovernmental collaboration and regulation represents an enormous risk and non compliance, by especially smaller mining groups, with environmental and related regulations are leading to an increased future liability by the state.

Structuring funding solutions whilst an optimal institutional solution is being investigated will have to deal with inter alia:

- Significant equity/capital injections by both the State and the Mines. This commitment will probably have to based upon a pro rata contribution linked to each parties calculated liability as per above
- Significant operating cash flow to be provided by the State and the Mines based upon its pro rata obligations
- Creation of a special purpose "ring fenced" entity that can be;
    - Capitalised using the equity / capital contributions of the parties
    - Used to facilitate the allocation and ring fencing of project risks to the parties best able to manage such risks. The end game being a "risk free entity"
    - Used to raise the external finance required to accommodate the full project capital. and importantly the project life cycle costs
- Such suggested entity will have the opportunity to utilise different capital market financing mechanisms and or instruments i.e. Project finance, export credit facilities, project bonds, direct investment by capital market institutions (Insurance – and or pension fund investors. A properly structured project may even be able to be rated by the international rating agencies.
- funding the ongoing operating costs of the collaborative body;
- financing the development and operation of treatment and reuse infrastructure;
- financing the rehabilitation and management of mining and land re-development.

Outcome 4: Enabling framework interventions

A number of broader policy and institutional issues need to be addressed to ensure the enabling framework is in place to facilitate the collaborative interventions, institutional arrangements and funding mechanisms outlined above. To be implementable, it is possible that the enabling framework focuses on the needs of this area alone, rather than attempting to restructure the entire enabling framework for South African mining and water management. The business case must clarify these requirements and propose actions required to achieve the necessary policy outcomes, including:

- ✓ any legal requirements for establishing the relevant regional collaborative institution;
- ✓ the authorisation of water use and related licenses and contracts required for the treatment and reuse of mine water;
- ✓ mining, water and development authorisations required for the collaborative rehabilitation and re-development of mining areas;
- ✓ revision of the mine liability financing mechanisms, with the establishment of the appropriate legal or contractual mechanisms;
- ✓ linked to this may be revision of the closure requirements and liability for those mines that have made adequate provision into the liability financing mechanism; and
- ✓ strengthening of the regulatory capacity for mining and water use, through the relevant institutions operating in this region.

Outcome 5: Lessons and opportunities for transfer of the approach

It is important that the “pilot” collaboration in the Witbank coalfields is informed by and supports the broader mining impacts on water resources in South Africa. To this end, lessons from the Witwatersrand should be captured in the definition of the interventions, institutions and funding in Phase 2, while the implications for other mining areas should be highlighted.

While not explicitly part of Phase 2, the preceding process would be significantly supported by a more national process driven by the relevant political and business leaders to engage the key broader political economic issues around the role of mining in the South African development landscape, corporate governance in the mining industry and the development of innovative partnerships between public and private sector built on trust.

Table of Contents

1. Introduction

1.1. Context

In South Africa the activities of the mining sector have resulted in serious environmental consequences. Potential sources of water pollution from mining include drainage from surface and underground mines, wastewater from beneficiation, decant and leachate from mine tailings, and surface run-off from mining areas. The phenomenon of Acid Mine Drainage (AMD) has been reported from a number of distinct areas within South Africa, including the Witwatersrand Gold Fields, Mpumalanga, KwaZulu-Natal Coal Fields and O'Kiep Copper District. The priority areas that have been flagged include the West Rand, Waterberg area and the Olifants river catchment and there is great urgency as many of the affected watercourses are in close proximity of densely populated urban areas.

The Thematic Working Group for Effluent and Waste Water Management (EWWM) of the Strategic Water Partners Network (SWPN) is carrying out a programme of work to: (i) establish the issues, opportunities and constraints inherent in the treatment and reuse of mine water; (ii) develop potential institutional and pricing models for sustainable mine water treatment and reuse, which will provide an enabling environment for private sector intervention in the sector; and (iii) develop and implement a change management strategy towards the most appropriate models identified. These three objectives correspond to Phases 1, 2 and 3 of the broader programme, respectively.

The EWWM working group appointed a consultant that took the group through a process of identifying the issues, opportunities and constraints related to the use of treated mine water (Phase 1a of the project). The output was a set of deliverables including a final report with high level problem statements (gap analysis) and opportunity statements. While some gaps were identified in the considerations and key messages, they did not allow the working group to move to Phase 2 of the project. This led the EWWM working group to commission an additional study (Phase 1b) to take the group through a structured problem solving process to fill in these gaps. Ultimately, the objectives of this project need to align with the broader objectives of the SWPN and has been structured as such.

1.2. Purpose of this report

The Terms of Reference for Phase 1b states that the purpose of the study is to *take the issues, opportunities and constraints already identified in Phase 1a*, in order to:

- *Undertake a robust and structured process defining and prioritising the problems and developing high level tasks in preparation for scoping Phase 2 of the project.*
- *As part of the above process, further workshops to confirm or dispel assumptions made in the issues, constraints and opportunity key statements.*
- *As part of the above process to obtain the available facts, data or analysis that illustrates the real issues, constraints or opportunities.*
- *As part of the above process, develop a risk matrix associated with the defined problem statements.*

The ToR goes on to indicate that, *key to the identification of the problem statements is to understand the magnitude of the problem, the sustainability of the proposed end solutions, the current gaps within existing policy and regulatory frameworks and the appropriate institutional, pricing and funding models to support the development and implementation of mine water treatment and reuse projects at a local or regional level*.

During the inception phase, two important shifts in focus were required by the Steering Committee, namely that the project should:

a) be expanded to the management, rather than only the treatment and reuse or AMD, which implies, firstly that options such as ingress reduction and passive treatment of AMD should be considered, secondly that a regional water quality and supply reconciliation management approach is relevant, and thirdly that appropriate solutions may not necessarily contribute directly to closing the water supply gap; and
b) Focus primarily on "mine water" generated from gold and coal mining, as the biggest impacts of AMD are seen here with the intention to expand the scope to other sources of "mine water".
c) consider mine waste water quality problems associated with AMD, which implies that in addition to pH concerns, salinity, metals and radioactive contamination from coal and gold mining activities may also be relevant.

It is also important to note that Phase 1a provided a consolidated view of the issues, opportunities and constraints related to the reuse of AMD to close the water gap on a catchment scale, through the selection of the relatively information-rich Witbank coalfields in the Olifants River catchment as a way to define the "wicked problem" of AMD. However, this case approach resulted in its most significant critique, namely that there was a singular focus on a specific treatment solution in the Upper Olifants to provide supply to the Middle Olifants.

1.3. Approach to the Problem Assessment

Phase 1b attempted to address these weaknesses by trying to understand the underlying causes and impacts of AMD in South Africa in order to be able to identify the opportunities and challenges to manage the AMD problem. The approach is consistent with the Phase 1a in that the policy, legal, financial, and institutional dimensions are considered, but diverges in that the specific mining facility experience and the regional problem definition are done in a more generic manner to ensure that the interpretation is transferable to other similar problems.

The Terms of Reference proposed a process of position papers and consultative workshops related to thematic issues, namely sustainability of mine water treatment and reuse projects; policy and regulation; institutional issues; and pricing and financial issues. However during the inception process it became clear that the complex and inter-related character of the problem required a more multi-faceted and structured problem definition and response analysis process. Further, in order to focus Phase 2 and enable the EWWM to move forward, it is necessary to structure and prioritise the various issues and problems around the management of AMD. It was thus proposed to structure the process around the following elements:

1 Problem definition and analysis to address the underlying causes of AMD related to the lifecycle of mining (i.e. opening, operating and closing mines)

2 Scenario analysis to address the future development and climate change possibilities that need to be considered in different AMD mining regions in South Africa.

3 Response analysis to highlight the potential levers that the SWPN may have some influence over and thus provide the focus for possible interventions.

4 Prioritisation of the interventions according to risk, importance and urgency in order to scope Phase 2.

This approach is framed by Figure 1.1, where the problem definition is related to the current situation and future change related to both the (water resources) *impacts* and (mining) *root causes*, while the opportunities for response (levers) may be focused on the enabling framework (addressing the root causes), the business model/s to mitigate AMD (addressing the specific mining facility or area with an AMD concern), or the catchment (addressing AMD concerns that are being experienced or threatened).

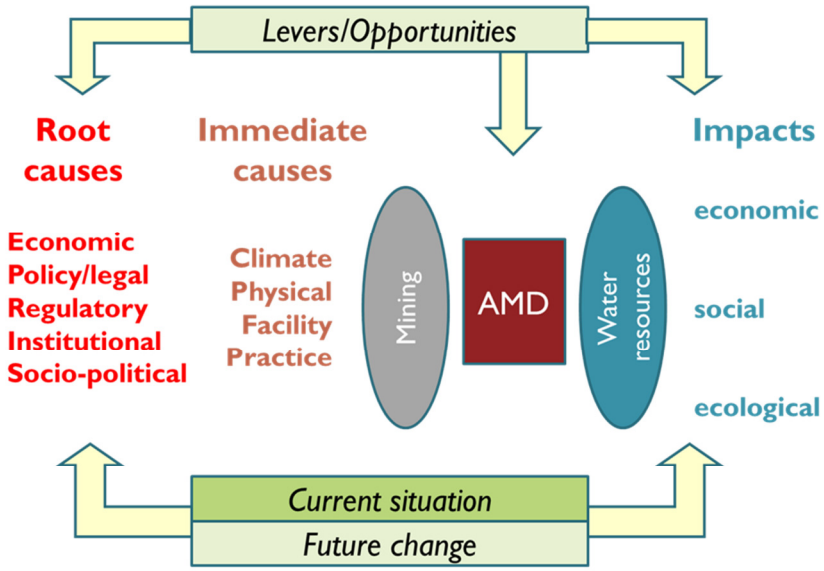


Figure 1.1: Mining areas susceptible to AMD in South Africa

It is important to note two additional considerations, namely (i) that the entire process was to be completed within six weeks (which constrained the possible analysis and inter-workshop consultation) and (ii) that the understanding and expectations of the objectives of the project by the EWWM working group and project team evolved through the structured process over this period.

1.4. Structure of the Report

This report attempts to capture the key aspects of the resulting problem definition, the potential areas of intervention, and finally the scope of Phase 2.

Chapter 2 details the framing of the AMD problem analysis that emerged from the structured process, opportunities to address the problem and applicable constraints, including a review of the critical messages from phase 1a.

Chapter 3 provides a regional analysis of the AMD problem, opportunities and constraints in South Africa, focusing on three priority regions affected in different ways by AMD.

Chapter 4 provides the scoping of phase 2 of the broader project and a way forward, within the context of broader opportunities for SWPN.

2. General Problem Definition for AMD

2.1 Understanding the General Nature and Extent of the AMD Problem

The incidence and threat of AMD is prevalent in a number of concentrated mining regions in the north-eastern parts of South Africa, as indicated in Figure 2.1. The primary contributors to AMD in South Africa are the gold and coal mining industries, linked to both operational and non-operational mines.

Figure 2.1: Mining areas susceptible to AMD in South Africa (Source Oelofse, S & Strydom, W. 2010).

While all of these areas represent an existing concern or potential threat to AMD at a local scale, the goldfields of the Witwatersrand (as well as the Free State and North West) and the coalfields around Witbank are already posing significant water quality problems to the Upper Vaal and Upper Olifants River catchments, respectively. This in turn constrains the use of water resources for urban, industrial, power and/or agriculture, either due to inadequate fitness-for-use of the supply quality or through the operational dilution requirements from better quality sources.

On the other hand, potential expansion of coal mining into the Waterberg and Mpumalanga Highveld poses acidity and salinity threats to these currently good quality but already highly allocated water sources with international shared watercourse dimensions.

2.2 Issues, Opportunities and Constraints Identified in Phase 1a

Phase 1a involved the investigation of AMD treatment and reuse, based on a series of thematically based papers. The main issues, opportunities and constraints are summarised below.

2.2.1 Window of Opportunity and Business Unusual

An important recognition of Phase 1a is that treating AMD to any "fit for use" quality is technically feasible and becoming more financially viable through rapid technological development, and that South Africa has installations that demonstrate the successful use of treated AMD for domestic water supply. However, managing AMD at a catchment scale, including for water supply planning and reconciliation purposes, requires new and possibly complex policy, institutional and financial arrangements.

2.2.2 Policy and Legislative Considerations

Policy and legislation has evolved to address more conventional water and mining management approaches, and requires reframing to address the specific challenges of AMD.

Key policy and legislative issues are:

- A lack of cooperative governance and alignment between relevant legislative instruments, with the responsibilities of DEA and DMR being unclear despite amendments to the National Environmental Management Act (NEMA, 1998), Mineral and Petroleum Resources Development Act (MPRDA, 2002) and National Water Act (NWA, 1998), which seem to be done in isolation.
- Need for regulatory hierarchy and oversight related to mining and water, including arrangements for regular monitoring and evaluation and the requirement of the discharger providing regular information, including DWA overseeing water-related matters.
- Recognition of AMD as a water resource either negatively if not properly managed by way of diminishing available resource or positively by contributing to closing the gap between water availability and water requirements.
- Authorisation for AMD treatment and reuse at a regional level may require a new framework for a collective EIA, EMP, IWWMP, and Water Use Licensing approach (to that currently applicable at a facility-level) with considerations for how water returned to the resource will be allocated.
- Management of risks related to discharge or reuse of water with emphasis on environmental quality standards and human health standards, taking into consideration the impacts of water quality, water flow, in-stream biota and riparian vegetation.
- Existing and new contractual agreements with the local Water Services Authority (WSA) or other institution for bulk water supply to the municipal sector or any other sector, including assurance of supply, required water quality standards, tariff structures and possibly a catchment water-management charge.
- A procedural hierarchy for ownerless mines detailing the roles and responsibilities of individual departments within the State is lacking.
- Post closure liabilities related to water management are often underestimated because there is no consistent approach to accurately forecasting the full closure liability and this is not adequately provided for financially.

Key opportunities:

- There is a broad alignment in the various policy and legislative instruments for AMD treatment and discharge and for rehabilitation of land after mining, but water policies and strategies are challenged in terms of dealing with the complex issue of an unconventional water resource such as mine water.
- The draft NWRS-II recognises that alternative sources of water (including reuse) may be required to supplement conventional sources of water, and that these are not necessarily easy or inexpensive to implement, will require improved governance, leadership and management models, and extended funding models, as well as partnerships to mitigate shared risk.
- The revision of the Pricing Strategy and implementation of the Waste Discharge Charge System provides an opportunity to address some of the financial and institutional challenges of mine water management, such as ring-fencing, as do related classification and CMA establishment processes.
- Particular legislative and regulatory streamlining required to enhance AMD reuse projects, includes:
  - Development of AMD as an unconventional water resource within the catchment with a supporting water pricing arrangement and institutional model
  - Clarity on the acceptable financial arrangement related to reuse and associated pricing for the 'sale' of treated and reclaimed water
  - Structure and incentives for the private sector, specifically mining companies, to partner with public sector in delivering AMD projects
  - Mechanisms (financially and institutionally) to manage the post-mining water-related liabilities associated with AMD
  - Mechanisms to mobilize the private sector, specifically mining companies and the state (as an owner of mines, not the regulator) to collaborate on incorporating defunct and ownerless mines into regional AMD projects.

Key constraints:

- Whilst the policy and legislation have a clear intent to improve the levels of 'cooperative government' in practice, but do not provide direct alignment from a regulatory process and reuse project perspective, nor do they address the complex issue of developing an unconventional water resources (such as mine water reuse) project through mobilization of the private sector.
- Regulatory capacity related to mining and water is not adequate to controlling and enforcing mining activities to mitigate AMD at a mine or regional scale and requires strengthening and alignment to address the complex challenges of unconventional projects and competing demands.

2.2.3 Institutional Considerations

Institutional arrangements are in continued transition, derived from more conventional policy and legislation and are largely fragmented in mandate and function.

Key institutional issues are:

- What body might be responsible for developing and operating AMD treatment works and its relationships with other stakeholders (particularly the mines and local government).

- The institutional capacity to provide leadership and assume the roles and responsibilities associated with a regional / catchment approach.
- Effective co-ordination between different public and private sector organisations and companies.

Key opportunities:

- There is an opportunity for innovative institutional arrangements to address the AMD challenge and to turn it into a reliable water resource contributing to the reconciliation of water supply and demand in the catchment, at different scales or levels:
  - At a local level involving a single, group or cluster of facilities
  - At a river system level (natural drainage areas/catchments)
- The establishment of area based mining institutions to coordinate and integrate the development of mine water reclamation projects.
- Decision-making may vary across these applications and could involve businesses, municipalities and national government, using existing or focused-built capacity in government entities (i.e. CMA or WUA) and/or the private sector (mines and service providers).
- There is potential to develop an industry/sector-agreed evaluation/accreditation system for agencies/organisations implementing water reuse projects.

Key constraints:

- The recent South African track record for wastewater treatment by local authorities and municipalities is not good.
- Compliance and monitoring of water use has been weak and will need to be strengthened to protect water quality.
- Water reuse projects have many sophisticated technical, engineering, financial, operational and maintenance requirements.
- Water reuse projects typically require more sophisticated treatment technology and systems compared to conventional water treatment and require capacitated staff
- Challenges around the disposal of the waste products (high density sludge and concentrated brine) produced from improved treatment technologies.
- An “institutional vacuum” around implementing water reuse projects in certain areas
- An ideal institutional model to satisfy all the diverse stakeholder needs, linking small and ownerless mines, does not exist in South Africa

2.2.4 Financing and Pricing Considerations

Financing and pricing has been focused on more conventional water supply and treatment approaches, but requires a reframing to be appropriate for innovative AMD management approaches and institutional arrangements.

- Allocation of costs between participating mines in a regional scheme for infrastructure required to treat water to a standard at which it can be discharged into the environment based on the type of capital costs allocated in accordance with each participant’s potential contribution, and operating costs allocated in accordance with participants’ average contribution.

- Allocation of costs between polluters and reclaimed water users where the polluters pay for the treatment of AMD to a standard at which it can be discharged and water users pay for additional infrastructure to treat water to a potable or process standard and distribute it from the AMD treatment plant to the storage reservoirs.

- If mines are to pay for AMD treatment, the unit cost of treated AMD water must be allocated to the polluting mines ensuring that they do not make a profit from the resale of AMD, a DWA requirement, but also that they do not make a loss from the treatment process, making discharge a more viable option.

- Sustainability of treatment facilities requires volumes of water sold to meet the basis of costing for full cost-recovery, actual unit prices at least equalling a "fair" unit price, and mines being able to supply the required volume of water to treatment plants.

Key opportunities:

- There is an opportunity for government or development funding that is cheaper than commercial funding, toward AMD treatment since the marginal cost to develop the next water resource is higher than current water prices, potentially making AMD treatment schemes more attractive. Opportunity for blended procurement methodology to make the scheme viable.

- Participation in regional schemes is incentivised through lower life cycle based costs than individual facility treatment, although mines should be allowed some flexibility in volume and quality of water supplied to further encourage participation in regional schemes by compensating for the loss of control associated with facility level treament.

- There are various potential markets for the resale of treated AMD, including mines, municipalities, industrial users, agriculture and Eskom as well as the sale of waste products through beneficiation to the market.

- There are a range of potential sources of financing for a regional model, including the state, mines, treated AMD users, private investors, commercial banks and development agencies.

Key constraints:

- Cost of the available conventional and non-conventional water resources are underlying drivers of the price at which this water can be sold and are significantly less (based on 2010 prices) than the cost of water from AMD treatment.

- Capital, capital replacement and operational costs related to AMD reuse are known but costs relating to the long term management of residues (sludge, brines and by-products) are not well quantified and remain a short term constraint.

- The long-term liability of changes in AMD quantity and quality is uncertain and could limit long term commitment especially when several mines contribute to a single scheme.

- The commercial or pricing connection between the AMD polluter and reclaimed AMD user is a constraint as AMD producers are expected to pay for the treatment of AMD but the costs of distribution to the user are not included in the AMD treatment scheme.

2.2.5 Key Messages

From these issues, opportunities and constraints, the following messages where identified.

- **Key Message 1: Participation in Policy and Legislative Review Processes**

  National Water Resources Strategy 2 recognises the importance of unconventional water resources such as mine water for meeting future water demand. There is an opportunity for stakeholders to participate in review of strategies and enabling legislation to implement AMD reuse.

- **Key Message 2: Cooperative Governance and Public Private Partnership**

  Regulatory capacity between central, provincial and local government departments and within each department is a constraint on the regional AMD model, while mining companies have substantial capacity to implement AMD treatment and reuse projects. Public private partnership may alleviate some capacity challenges.

- **Key Message 3: Conducive Institutional Landscape**

  The institutional landscape is sufficient to facilitate the establishment of an appropriate AMD reuse institution (such as the Olifants CMA) that could be leveraged in terms of capacity / experience.

- **Key Message 4: Private Sector Participation**

  A collaborative effort between public sector (provincial and local government), mining sector and other water use sectors will be required to develop, administer and manage an AMD reuse organization / institution, recognizing that trade-offs will be required.

- **Key Message 5: Increasing marginal cost of future supplies**

  In most catchments easily accessible and “affordable” water has been exhausted and new resource development projects require a higher marginal cost. Users need to be sensitised to this fact through accurate and transparent communication.

- **Key Message 6: Catchment based approach**

  Water pricing linkage between producers of reclaimed AMD and local water users (municipalities) and users further downstream is needed.

- **Key Message 7: Future institutional arrangements drive funding**

  The selection of an appropriate funding model / mechanism must take future AMD-related institutional arrangements into consideration.

- **Key Message 8: Sustainable Long Term Planning at Catchment Level**

  Due to the transfer schemes between catchments compounded by the state of stress (water allocation is higher than water availability) in most catchments, a water resource development related intervention in a particular catchment requires the development of a national and catchment wide Water Reconciliation Plan that extends beyond the life of the Coalfields (± 2045).

- **Key Message 9: Communication and Management of Public Perceptions**

  All role players and the broader public need to be kept informed and given the opportunity to participate in the rollout of a regional / catchment scheme in which reclaimed AMD is used to alleviate the catchment water deficit. Perceptions must be managed about the costs, motivations for, liabilities and implications of AMD treatment and reuse.

- **Key Message 10: Solutions should not be limited to treatment only**

  It is important to note that the treatment of AMD is not the only solution. It is crucial that other initiatives be investigated in conjunction with treatment to reduce treatment cost in the long term.

2.3 Key Issues and Underlying Causes of AMD

The Phase 1a problem analysis is thorough, but focuses (a) primarily on the treatment and reuse of AMD, rather than its management, and (b) through a thematic lens, rather than as multi-faceted problem statements (highlighting the relationships between technical, policy, institutional and financial aspects). The report ***Considerations Related to Using Treated Acid Mine Drainage to Close the Water Gap in a River Catchment: Final Report*** with its thematic appendices is critical to understanding the following discussion, and should be read in conjunction with this report.

It was therefore necessary to expand the problem analysis in Phase 1b, to unpack AMD management at a regional-collaborative scale and at a mine facility-individual scale. Furthermore, it was necessary to extend the problem analysis to the life-cycle stages of a mining facility (i.e. opening, operating, and closing), as well as the mining phases at a regional scale (i.e. expansionary development, ongoing operational, and sunset non-operational), as there are specific it inter-related challenges associated with each of these stages and phases.

2.3.1 Framing the AMD Management Problem

The stage of mining life cycle influences the way in which the particular facility contributes to or exacerbates the AMD problem and who is liable for the AMD impact. The regional groupings affect AMD by way of facilities in the same region impacting specific watercourses at different levels.

Both the facility and regional problem analyses are influenced by the enabling policy and institutional framework. The stage of mine life cycle at facility-level and phase of development at regional-level are interconnected, with the regional evolution paralleling the facility life cycle. A region in development mode, with newly discovered resources or recent plans to extract known resources will contain relatively new mines and threaten to contribute to AMD as do new mines. The same applies to an area in operational mode which will be predominantly consist of operational mines or an area in post-operational mode where resources are at or near depletion and most mines are closed or non-operational. Figure 2.2 frames the overall AMD problem using this framework at high-level.

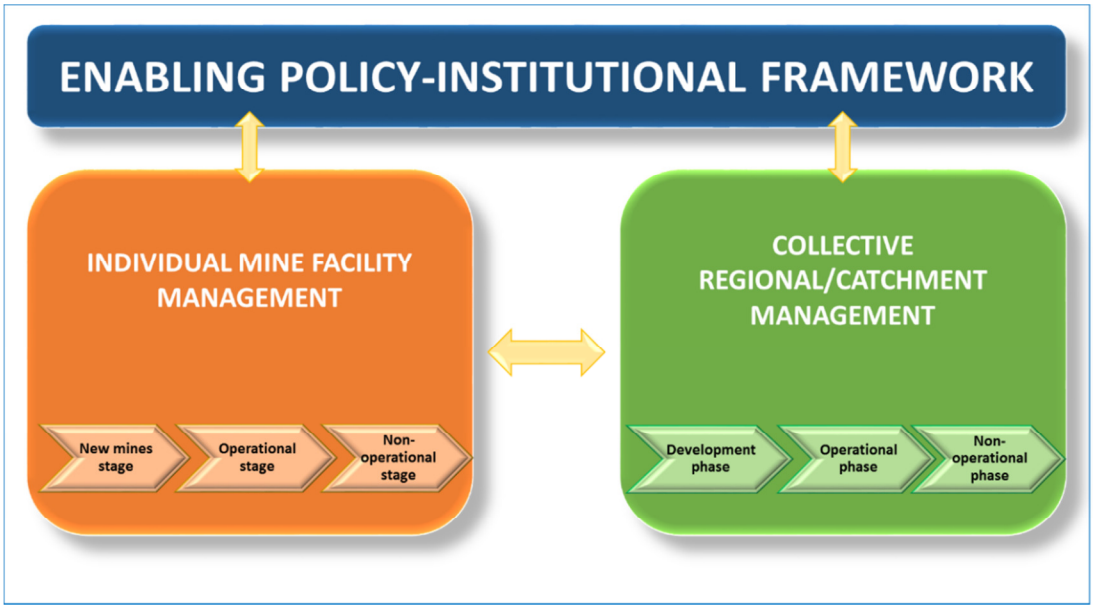


Figure 2.2: Conceptual Framing of the Facility and Regional AMD Problem

Enabling Policy-Institutional Framework

The enabling framework contains all the wider policy and institutional elements that determine the way in which mines and water resources are managed and regulated at a facility and at a regional level, thereby affecting AMD-related impacts associated with mining activity. These elements relate to policy, socio-political imperatives, development priorities, institutional arrangements, corporate governance and environmental requirements.

Mine-Facility-Individual Management

Ultimately, AMD derives from mining activity at individual facilities. The problem and root cause analyses were conducted at a facility level based on the mining life cycle. Figure~~Figure 2~~.3 shows a conceptual framing of the problem analysis at a facility-level, for AMD impacts on water resources.

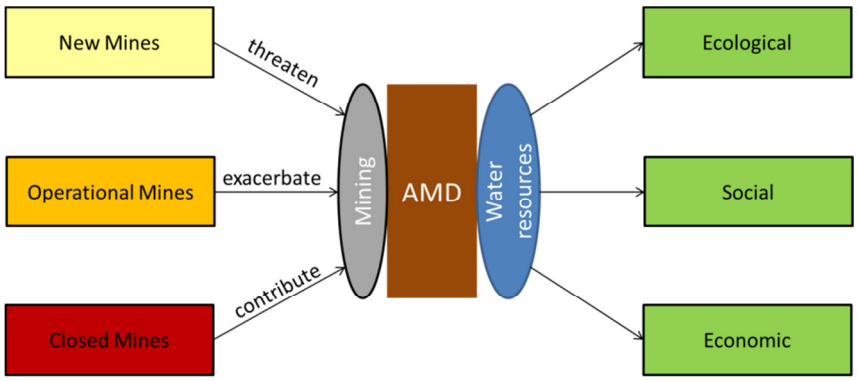


Figure 2.3: Facility-level Framework for Problem Analysis

Depending on the mining life cycle stage of the facility, it contributes differently to AMD and should be considered as such, even though decisions made during earlier stages affect the AMD impacts in later stages. New mines threaten to create AMD and the critical problem in this stage relates to the opening and licensing process for mines. Operational mines create AMD through dewatering and run-off from the facility, with problems relating primarily to operating practices and non-compliance. And non-operating mines leave an AMD legacy through decant and runoff, which are caused by inadequate rehabilitation and inefficiencies in the mine closure process.

Regional-Catchment-Collective Management

In addition to facility-level management, effective regional or catchment management is important in addressing the AMD problem. Regional concentrations of mining activity represent the *cumulative* AMD impacts as AMD concentrates in shared watercourses potentially affecting the entire region and not only a single facility. Similar to the contribution of mining facilities based on the stage of life cycle, regions in different phases of development contribute differently to AMD and have distinct opportunities to mitigate their impacts. This ranges from regulatory management by the public sector through collaborative action by the private sector. In addition, the national, regional and local development drivers should be considered as this project expands beyond the ecological processes to resource protection, water planning and reconciliation and development.

2.3.2 Clustered AMD Issues

A detailed problem analysis was conducted according to the preceding structure, some of the detail of which is reflected in Appendix A. It is important to recognise that the Phase 1a analysis focused on the

Regional-Catchment-Collective Management aspects, so the Phase 1b problem analysis focused on the Mine-Facility-Individual Management aspects to ensure a comprehensive understanding of AMD.

This analysis resulted in the grouping of AMD related issues and problems into twelve primary issues, some of which are relevant to the type of facility and others to the region. Similarly, while there is an inherent focus of each issue on the development (opening), operational, or post-operational (closing) phase of mining activity, there exist certain challenges:

- *Inconsistent or incoherent mining regulation (between mining, environment and water)*
  Mining Licenses and Water Use Licenses are issued by independent departments each with its own specific licensing requirements. The disjunction between the requirements allows mining operations to continue unlawfully under a license to mine without a Water Use License. It is important to identify the EMP as a real opportunity for reconciling some of these problems i.e. the EMP has to be robust with input and enforcement from DMR, DEA and DWA. The EMP can include the mine water management practices of a mine and can be adapted when these change. This could also help in making better financial provisioning.

- *Uneven mine licensing and enforcement*
  Weak enforcement of Mining License requirements during the operations of a mine results in mines continually adopting environmentally unsustainable practices in favour of economic benefit. It is important to note that beyond the legal provisions, in practice, government officials in DMR and DWA do not agree on how this legislation should be enforced.

- *Ineffective Water Use Licensing*
  New mines are required to obtain Water Use Licenses upfront to legally use water for mining, and discharge waste in a manner that affects watercourses. The Water Use Licensing procedure does not clearly classify catchments in accordance with the level of environmental protection applicable. The prioritisation of economic development over catchment conservation or *vice versa* is not clearly defined.

- *Weak enforcement of Water Use Licenses*
  In addition to inadequate Water Use Licensing requirements, the *enforcement* of these requirements is applied inconsistently for reasons such as capacity and resource limitations, lack of information, inconsistency in the enforcement between established miners and junior miners, lack of political will and corruption.

- *Diverse corporate compliance*
  Mines apply varying corporate governance standards due to inconsistencies between various license requirements and weak enforcement of such. While some mines may comply with minimum licensing requirements, others are more proactive, applying stricter corporate governance practices to appease external governance pressures such as listing requirements, investor and client demands or the risk of reputational damage. Others may not comply at all as the net cost of compliance exceeds the penalty imposed for non-compliance.

- *Uneven understanding/information of AMD*
  Research done in isolation creates disparities in information between mines and the State. Mines conduct internal research, not required to be shared publicly or with the government. Additionally a lack of information compounds the problem of weak licensing requirements – it is unknown what

the liability estimate is and therefore the licensing standards do not include accurate liability requirements.

- *Ring-fencing of marginal mines and liabilities*
  International financial reporting standards oblige companies to make provision for their pollution liability on the balance sheet. However, this provision does not get translated into an accessible cash amount that can be used for water treatment. To avoid liability, mining operators marginalise individual facilities from the company by selling them to other mining operators, thereby transferring their liability.

- *Unclear closure and liability requirements*
  Ambiguity around the state's post-closure liability has led to government inaction. Post-closure liability is also faced with difficulty in computation due to difficulty in forecasting future impact and the timeframes applicable.

- *Inadequate non-operating mine AMD financing*
  Ambiguity of liability estimates combined with forecasting complexity results in insufficient financing to address AMD impact after mines cease operations. Additionally, policy regarding how money that is held in the post-closure fund is collected and invested (in bonds, unit trust funds, etc.) is indistinct raising questions about whether the fund is managed efficiently. This is exacerbated by the mines not having a direct "walk away" solution, and which results in the mines "dragging their feet" when it comes to defunct mines.

- *Limited catchment classification/AMD planning*
  A catchment can be classified based on the level of priority given to protecting it. Unclear classification methodology constrains catchment planning. This is due to inadequate capacity and resources at a departmental level compounded by no defined metrics for catchment classification and techniques to address AMD linked to the mining process.

- *Fragmented inter-mine and government cooperation*
  Currently mines treat water at a facility level and independently. Combining resources and sharing the cost of regional water treatment may be more economically viable. DWA has prevented mines from profiting from the resale of treated water from a regional treatment facility resulting in the individual treatment practice. In addition, cooperation between the state and mining operators is lacking due to mistrust between the private and public sector.

- *Viability of regional business model*
  The combination of the previous eleven issues prohibits the existence of a functional and viable business model associated with an efficient and AMD-responsible mining network. Institutional and financing arrangements for addressing AMD are unclear and limited with uncertainty about how each part of the regional business model should be structured and how they should interact.

2.3.3 Specific causes, response opportunities and confounding factors

Each of these twelve primary issues can be further unpacked into a causal analysis that highlights the underlying causes. Table 2.1 presents the specific causes for each of the primary issues (that are potentially within the influence of the SWPN), together with related high-level opportunities for response. These response opportunities represent factors that may be controlled or influenced within the ambit of the SWPN, and that may mitigate impacts or emphasise positive aspects in a system.

Table 2.1: Primary Issues, Causes, Response Opportunities and Confounding factors for AMD in South Africa

PRIMARY ISSUE	SPECIFIC CAUSES	RESPONSE OPPORTUNITIES	CONFOUNDING FACTORS
1. Inconsistent or Incoherent Mining Regulation (between mining, environment and water)	Fragmented Legislation, Institutions and guidelines *- different requirements for mining, environmental and water use licenses*	Integrated procedure for mining licenses, including effective use of the EMP	Lack of political clarity around prioritizing economic development vs. resource protection Challenges with cooperative governance in SA
	Piecemeal mining license applications *- mining application occur at random without coordination between various license applicants*	Incentivize mines to coordinate licensing applications	
	Inconsistent application between government departments	Improve accountability and systems	
	Weak WU licensing requirements *- penalty insufficient to force compliance (companies operate illegally and budget for penalty)*	Strengthen licensing and enforcement (issues 3 & 4)	
2. Uneven Mine Licensing and Enforcement	Inadequate resources and capacity of government departments	Improve capacity and resource availability	Lack of political will Corruption
	Inconsistent application of licensing requirements	Develop more clearly defined enforcement procedures and specific measures / actions for non-compliance	
	Ineffective licensing procedure		
3. Ineffective Water Use licensing (delayed licensing & inappropriate conditions)	Limited catchment classification to guide licensing (from issue 1)	Policy interpretation in procedures	
	Lack of clarity around licensing methodology/approach *– multiple licenses per mine facility*	Develop integrated water use licensing procedure	
	Lack of capacity and accountability of DWA government officials	Improve licensing procedure	
	Flaws in licensing procedure - Non-decision culture - Corruption	Adopt effective performance management	
4. Weak Enforcement of Water Use Licenses	Lack of capacity in regional offices (limited decentralization of decisions)	Ensure capacity and resource availability	Judicial failures (courts set precedent) Lack of political will *- when is strong action applied*
	Uneven information available to government about mines and their registration (system)	More decentralized capacity and linkage to DMR systems	
	Inappropriate licensing procedure complicates enforcement	Develop a concise licensing procedure	
5. Diverse corporate and Regulatory compliance	Diverse adoption of standards *- some beyond minimum* *- some complying* *- others not complying*	Link company legislative compliance with mining licensing	Shareholder requirements Adoption of good
	Innovation on-mine management options	Corporate stewardship	
	Regulatory weakness and uncertainty and inconsistency in enforcement	Strengthen regulation (Issues 1, 2, 3 & 4)	

PRIMARY ISSUE	SPECIFIC CAUSES	RESPONSE OPPORTUNITIES	CONFOUNDING FACTORS
	Uneven understanding and information between mines	Build mining awareness (Issue 6)	accounting practice
	Different perspectives on risk engagement of buyer		Political influence
6. Uneven understanding and information of AMD problem and responses	Lack of coordination and sharing in research on operations and rehabilitation	Mechanism and incentives to facilitate cooperation and sharing of information	Diverse interest from mining companies
	Limited regulatory instruments to drive compliance reduces the innovation required	Strengthen regulation (Issues 1, 2, 3 & 4)	
	Uneven awareness of regulatory requirements		
7. Ring-fencing of marginal mines and liabilities	Inadequate liability accounting requirements for sale of assets - *definition of liability around AMD*	Clearly define liability requirement with sale of mine Standardize methods for forecasting liability (Address issue 8)	Corporate profitability drivers / expectations BEE drivers Separation of corporate governance and mining regulation
	Unclear regional and upfront liability definition		
	Inadequate due diligence on purchaser and financier	Standardize requirements and methods for due diligence	
	Requirement for mining, environmental and water regulators to endorse sale for mine	Improved requirements between corporate and mining regulation	
8. Unclear Closure and Liability Requirements	Difficulty in forecasting liability - *what is the financial liability after closure* - *how long must mines be liable for*	Improved policy interpretation & guidance Standardize methods for forecasting liability	Government clarity on the role of mining in the economy, including the role of funds and taxes during operation
	Lack of clarity and understanding around state liability and process - *results in government inaction*	Clarify closure requirements & process Clarify liability issues	
	Weak operational regulation constrains closure options	Strengthen regulation (Issues 1, 2, 3 & 4) Improve information on options (Issue 6)	
	Inadequate closure rehabilitation requirements for extension	Develop techniques to measure rehabilitation requirement	
9. Inadequate non-operating mine AMD financing	Limited cash provisioning by companies - *enables avoidance of liability*	Rethink the AMD portion of the financing provisioning	Corporate governance rules around liabilities and mining resistance
	Closure fund liability estimates don't address AMD or water management sufficiently (unless in EMP or WUL)	Improve legislation linked to EMP AMD requirements Explore additional mining levy	

PRIMARY ISSUE	SPECIFIC CAUSES	RESPONSE OPPORTUNITIES	CONFOUNDING FACTORS
	Poor fund investment - *lack of clarity on collection & investment* - *mechanisms to access are unclear*	Explore separate vehicle linked to regional processes	
10. Limited Catchment WR Classification and Regional AMD Planning	Uncertain Classification Methodology - *how to classify region* - *resource intensive method* - *treating mining related regions* - *how to prepare for or respond to AMD*	Develop and apply clearer policy interpretation for mining	Lack of clarity around prioritizing economic development vs. resource protection
	Centralized national WR recon planning		
	Lack of capacity and resources	Ensure capacity and resource availability for priority catchments	
	Uncoordinated regional mine planning		
11. Fragmented inter-mine and government cooperation	Unclear Institutional Arrangements - *lack of defined champion*	Establish a mechanism that facilitates cooperation	Lack of trust between mines and government
	Uncertain Policy - *e.g.: government has restricted mines from profiting from resale of water*	Develop policy certainty for key enabling aspects	
12. Viability of regional management business model	Ineffective regulatory conditions driving regional cooperation	Addressing Issues 1, 2, 3, 4, 8 & 10 Addressing Issue 11 Addressing Issue 7 & 9 Addressing Issue 5 & 6	
	Unclear institutional arrangements and mechanisms for regional management		
	Inadequate non-operating mine AMD financing and mechanisms for regional management		
	Uneven understanding/ information on AMD response at a regional scale		

Four fundamental confounding factors (or meta-constraints) arise from this analysis, all of which are beyond the direct influence of the SWPN, but do need to be raised and possibly engaged in South Africa with a broader stakeholder group:

- National clarity on the role of mining in South Africa, as a private sector business venture or as a contributor to the national economy and regional development relative to the consideration of environmental protection, as well as the long-term liabilities that government should take on from the tax revenue and rehabilitation provisioning generated during the operational lifespan, relative to the company liability post closure.

- Flexibility in corporate governance, provisioning and accounting for liabilities around AMD (despite good guidelines), which allows companies to shed liability and not disburse provisions that are made, either by not planning effectively or ring-fencing marginal mines later, which is linked to ambiguity from shareholders, rating agencies and financial institutions around the accounting for and honouring of long-term liabilities.

- The political imperative for BEE-related mining, and its implications for the above balance between economic development and resource protection, as well as the and the way in which this has been enabled by the broader mining industry (particularly around the ring-fencing and sale of marginal mines and liabilities).

- Understanding of the shared risks and aligned interests between the public sector (regulators, planners and infrastructure managers) and private sector (mining and service providers), related to levels of distrust, different perspectives, language and *modus operandi*, and expectations around acceptable motivations for engaging AMD.

While these confounding factors are beyond the direct control of the SWPN, it has influence in both the political and corporate realms through the Minister of Water Affairs on the one hand and the management of large South African companies on the other. Each of these factors require greater debate at a national level that may be prompted by these political and business leaders, and there is an obligation on both parties to take this forward in the interest of addressing the long term water related impacts on mining in South Africa.

These issues are addressed in the scoping for Phase 2, but need to be linked to the broader ongoing national debate around the water-energy-food nexus and aspects of the green economy opportunities for the country. There is an opportunity for the water and mining sector to be champions in taking these processes forward and develop the types of cooperative partnerships being proposed through the UN post-2015 sustainable development process.

2.3.4 The Combined AMD System Problem Analysis

AMD has been described as being a "wicked" problem, which implies it is difficult to define and solve, and that this is compounded by unclear institutional responsibilities. Furthermore, there are numerous inter-connected factors driving the AMD problem in South Africa and intervening to address a single factor has other implications in that it impacts other parts of the AMD problem. A holistic approach to addressing the AMD problem must therefore be taken but in order to do so, the problem itself, its causes, feedback loops, and points of intervention must be described.

The primary issues have been represented in a system diagram in terms of their impact on AMD (in Figure 2.4). The issues have been arranged according to the stage in mining life cycle (which coincides with the stage of development of the region) as well as whether they relate primarily to the individual facility or the entire region.

It is apparent from this system analysis that the fundamental AMD problem is driven by the following main clusters of issues:

- Diverse understanding, perceptions and responses by mining companies to AMD depending on whether it is a small scale miner or established miner

- Inconsistency, incoherence and weak enforcement of regulations on mining in terms of AMD

- Unclear AMD mine closure and liability requirements, resulting in inadequate AMD financing

- Inadequate regional planning and cooperation for AMD, related to water quality and supply

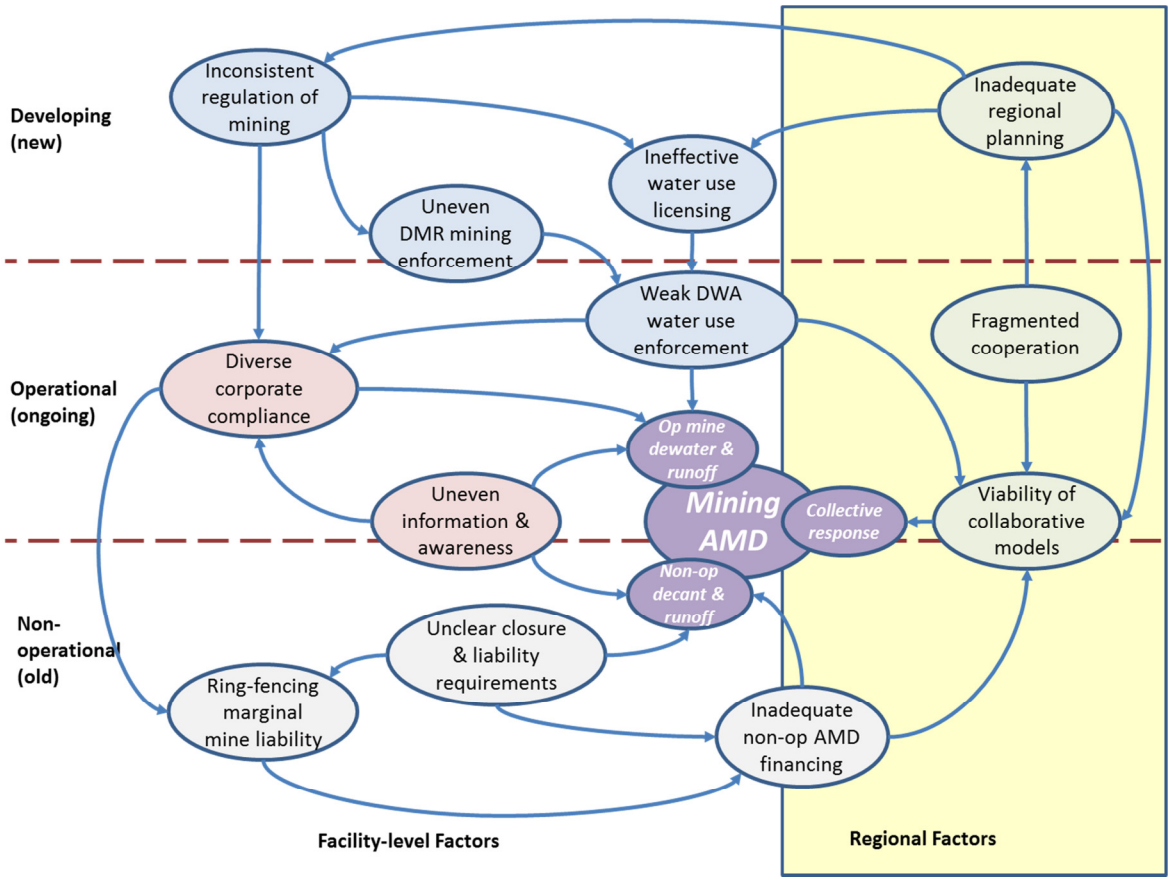


Figure 2.4: AMD Problem – Complex System Diagram of the Twelve Clustered Issues

2.4 Opportunities to Address Key Dimensions of the AMD Problem

As in life, problems provide opportunities, so the main opportunities for SWPN to engage the broader mining environment contributing to AMD may be developed around these four issues.

2.4.1 Corporate accountability and information

Mines and corporate decisions around area of operations, operating practices and rehabilitation are at the centre of AMD. Global and domestic (South African) corporate governance requirements largely influence these decisions, with some mines exceeding minimum regulatory standards through a stewardship or duty of care driver, while other mines ignore even the most basic mining and AMD regulatory requirements. Increasingly, financial institutions and clients buying the minerals (such as Eskom) are taking account of the risks associated with water, through disclosure processes such as CDP Water and GRI and driving environmental compliance through the contracts with their coal suppliers. SWPN is the manifestation of corporate concern or interest around water, initially by large companies, but there is an opportunity to extend this stewardship leadership perspective to other smaller companies, through business associations and financial bodies. As a start, the practice of ring-fencing marginal mines and selling them off to avoid liabilities needs to be jointly addressed.

On the other hand, much is being doing to improve mine siting, management and rehabilitation practices to reduce AMD from operational and non-operational mines, respectively. However, these practices and the knowledge to evaluate how and when to use this information is not widely available. There is a valuable opportunity for the mining sector in collaboration with the mining and water regulators to develop an information sharing mechanism, possibly starting at a regional scale around the specific issues being faced.

2.4.2 *Mining regulatory environment*

As the legal analysis in Appendix B.1 demonstrates, the legal framework for managing AMD associated with mining exists, but is not being consistently implemented or enforced. However, there is a large degree of overlap in the regulation of water management at mines by a number of different authorities in terms of different laws. This has resulted in a call for these laws to be harmonised and streamlined. To this end, the Minister of Mineral Resources has recently announced an intention for the application process for mining rights and water use licences to be streamlined and co-ordinated between the relevant departments. This is likely to require substantial amendments to the NWA as well as the MPRDA.

Such streamlining will be welcome in view of the fact that the delay in the issuance of water use licences has remained a contentious issue. In order to relieve some of these delays, the DWA introduced processes to expedite their finalisation which has to some degree alleviated the bottlenecks in the application process. Notwithstanding this process, many mines have commenced mining activity without the requisite licence in the hope that the licence will be granted in the near future. Until such time as the licence is granted, however, such operations are unlawful. Furthermore without a licence in place the management, oversight, monitoring and reporting requirements needed to address adverse water related impacts at the operations will only be undertaken on a voluntary and not mandatory basis.

Legal policy and legislative coherence is a necessary, but not sufficient condition for effective implementation of the regulatory system. The capacity and alignment of the regulatory officials is also critical, and includes (i) clear intent in the implementation of the regulatory regime, (ii) adequate human, financial and infrastructural resources, (iii) effective procedures and systems to promote alignment, and (iv) accessible information and multi-official networks to support the regulators in making decisions. Engaging the broader capacity issues between DMR and DWA is therefore a prerequisite to effective AMD regulation and management, specifically at a regional scale.

2.4.3 *Mine closure requirements, liability and financing*

As is evident from Appendix B.2, there are a number of provisions which may be used by the State to impose liability for and seek recovery of costs in respect of water pollution and associated with mining activities. Certain of these remedies face a number of challenges in their implementation which are inherent to the nature of the pollution concerned and challenges in the implementation of environmental laws generally, or which arise from the manner in which these provisions are drafted and the duplication of functions. Similarly, a lack of capacity to implement and adequate financial incentive to comply with the law, have also presented challenges in implementing these provisions. A thorough review of these laws together with the regulatory functions required for their implementation is likely to substantially assist in ameliorating some of these challenges.

While this is a major exercise, opportunities may be sought to tailor the mine closure and financing challenge at a regional level, through agreement between the regulators and mines, as well as some degree of legislative intervention to enable the collection of funds and the allocation of liability. Possible mechanisms include a levy on mining activity, adaptation of the waste discharge charge system, or ring-fenced mining company cash provisions for AMD mitigation.

2.4.4 Regional planning, management and cooperation

Regional reconciliation and catchment water quality planning is quite sophisticated and has been effective in augmenting water supply when applied to a system or catchment in South Africa. However, until recently there has been less progress with the implementation of water resources classification (under the National Water Act), the development of coordinated regional mining plans, nor AMD specific regional plans that bring mining, water supply and water quality concerns together. Effective response to AMD problems in difficult catchments would benefit greatly from coherent AMD mining-catchment management plans that link the required mine siting, operational management and rehabilitation requirements to the needs of water supply (reconciliation) and water quality (fitness-for-use).

This needs to be done in a collaborative manner with the regional mining industry, the regional mining and water regulators, and the local municipalities, business and service providers (possible water users). Recognising this need and then establishing an institutional mechanisms (or body) with adequate legitimacy to collaboratively drive such a process is critical in the current environment of low trust and cooperation between parties at the regional level. Again, SWPN is uniquely positioned to play a role in facilitating such a mechanism or vehicle.

Tackling these issues at a national scale is overwhelming, but focusing on these as pre-requisites in priority areas is more achievable and would provide a demonstration of the need to roll this out in other regions. For the SWPN, this provides a valuable opportunity to identify which aspects of these four meta-issues are more relevant or critical to unlocking implementation of a coordinated intervention in a priority region facing AMD. Exploring these aspects is the focus of the next Chapter.

2.5 Drivers of Future Change Affecting AMD

As outlined above, the challenges of AMD last well beyond the operational lifespan of mining and any solution will likely need to be robust under different developmental and climatic futures, well into the latter half of the 21st Century. While there are a number of uncertainties, a preliminary analysis of degree of uncertainty and magnitude of impact on AMD related issues surfaced three key elements:

- The broader development trajectory of South Africa and specifically in those regions facing AMD problems. This is particularly relevant in terms of the demand for water and its required fitness-for-use, with a focus on the inter-connected Vaal, Olifants (east), Limpopo and Inkomati River systems and their supply to Gauteng, Mpumalanga (Highveld/Witbank), Waterberg urban and energy generation demands, as well as irrigation and mining demands in these systems. An important aspect of this is the certainty of the projected demands (and augmentation options and costs) in these systems, which represents water stress in these systems (related to both available water and its quality) and provides off-take for potentially treated AMD.

- The mining, energy and carbon development trajectory in South Africa, particularly in terms of its dependence on conventional coal mining (in contrast to emerging energy extraction technologies), which is linked to both global and domestic climate/energy policy processes and market forces. This is particularly relevant in terms of the pressure to develop new coal-fields in the Mpumalanga Highveld and Limpopo Waterberg.

- The potential variability and possible shifts in climate related to catchments facing AMD challenges, particularly related to changes in rainfall (average and extreme events) and increasing

temperatures (driving evaporation and changes in demand patterns). Thus ultimately affects ingress and thus hydrologically driven aspects of AMD decant and dewatering, as well as the potential competing demands for water supply. Unfortunately the climate projections for the AMD related catchments in South Africa are relatively uncertain, varying from moderate wetting to significant drying.

These future risk factors obviously need to be considered in the development of potential responses, whether at a national enabling level or for specific mining areas.

2.6 Risk Assessment

While the preceding discussion has highlighted risks and constraints, it is worth highlighting the priority risks as the basis for prioritizing the types of interventions appropriate for Phase 2. The following risk matrix indicates the top ten risks associated with mine water discharge in South Africa against the backdrop of the aforementioned problem analyses. However in doing this, it is important to recognise that all of these risks directly or indirectly affect the broader underlying risk associated with mine water impacts on deteriorating water quality and increasing water scarcity in developed parts of South Africa.

Table 2.2 lists the main current mine water related risks grouped into technical, financial, institutional-stakeholder, policy-legislative and regulatory-governance risks. Important mitigation options are also highlighted for each priority risk.

Table 2.2: Risk Matrix around mine water impacts for South Africa

Risk Category	Risk	Mitigation Option
Technical	Mining companies not adopting best mining practices for operations and rehabilitation to reflect water quality needs of the catchment	• Information sharing (within industry and between government and industry) • Improved regulation and enforcement
Financial	Inadequate provisioning by especially the State to account for the contingent liabilities related to ownerless mines. Capital and operating funding to treat or mitigate AMD impacts during operational period	• Appropriate economic and financial instruments to estimate liability of the state • Strong regulation/enforcement
	Inadequate financial provisions in post-operational period to rehabilitate, treat and mitigate impacts	• Clear closure requirements • Appropriate funding mechanisms
Institutional-stakeholder	No champion to lead mining-water management issues in a region or to action consequences	• Define a champion/body with supporting capacity
	Institutional transition in the government regulatory environment	
	Affected stakeholders become militant about the AMD impacts, creating political pressure	• Establish a vehicle for government and mining companies to channel and respond to stakeholder issues
Policy-legislative	Ambiguity on the role of mining in development and the implications for both mines and government during operations and post-operations in terms of liability	• National level dialogue on mining and its developmental and protection impacts
Regulatory-governance	Inconsistent authorisation and enforcement of Mining and Water use Licenses	• Clarity on procedure • Departmental capacity
	Inadequate planning and coordination of mining activities at a regional scale to mitigate water quality impacts of mining	• Effective classification • Regulatory efficiency and enforcement • Regional planning
	Ineffective corporate governance mechanisms	• Link company legislative compliance with mining license

3. Regional Dimensions of the AMD Problem Definition

3.1 Priority (Representative) Mining Areas and Catchments

While AMD poses a concern of threat in a number of catchments in the north-eastern parts of South Africa, for this process it is necessary to focus on a limited number of representative areas, against which the policy, institutional and financial aspects of collaborative AMD management may be demonstrated. Following the preceding problem analysis, it is apparent that there are three fundamentally different types of AMD-related challenges in South Africa, related to areas in a:

- post-operational mode (in a "sun-set" period with a majority of non-operational mines),
- operational mode (in a relatively steady-state with operational mines with a finite lifespan), or
- developmental mode (in an expansion phase with new mining areas being developed).

This perspective resulted in the prioritisation of three specific geographic mining areas with related AMD concerns of threats (Figure 3.1), representing each of these types of challenges (phases of development):

- **Witwatersrand goldfields** (zone 6), which is facing an AMD legacy concern as gold becomes depleted and decant, which causes and threatens AMD impacts in the Upper Vaal River
- **Witbank coalfields** (zone 1), which includes extensive closed and operational coal mining with about 20 year life-span, which is already experiencing AMD impacts on the Upper Olifants River
- **Waterberg coalfields** (zone 4), which is currently one of the main areas for future coal mining expansion in the country including for power generation with potential impacts on the Mokolo River and ultimately the Limpopo River.

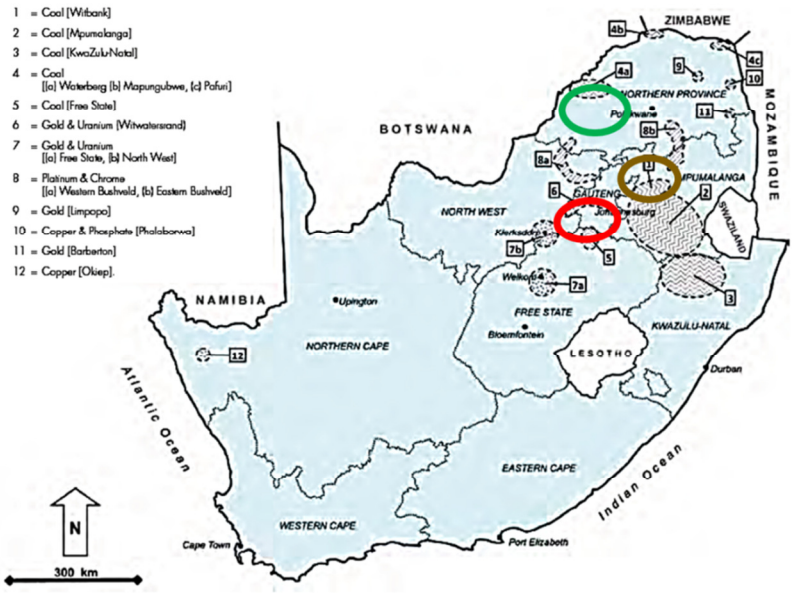


Figure 3.1: Priority AMD regions, reflecting phases of development

Each of the three regions is detailed below in terms of their characteristics influencing the incidence or threat of AMD. Each region has been mined to some extent but differs according to the remaining exploitable mineral resource. The nature of the water quality concern, the water supply reconciliation situation and the future development pathway also differs between the three catchments (and systems) within which these mining areas are located. It should be noted that whilst this report focusses mainly on water challenges, the social and economic dimensions will also need to be considered going forward. For instance, the Waterberg is classified as a Class I resource. Should mining continue in the area, the Waterberg may fall into the Class II water resource category. The challenge is whether government allows impacts on the water resource in order to promote socio-economic development or does government take a stronger stance in protection of the water resource?

Importantly, the issues, challenges and opportunities differ between these three categories, as do the appropriate regional responses. It is expected that institutional-financial models developed for each of these groups would be transferrable to other areas in a similar stage of development, but possibly less so between the categories.

3.2 Understanding Regional Aspects of the AMD Problem and Opportunities

An important shift between Phase 1a and Phase 1b was the expansion to address the management of AMD, rather than the more narrow focus on "treatment and re-use". While this typically still requires a regional perspective and interventions, it does not assume that the only and best way to manage AMD is through its collection, treatment and distribution. Decisions around the most appropriate regional collaborative AMD management approach therefore need to consider current conditions and future threats related to:

- water supply-demand reconciliation, associated with local and regional development trajectories.
- catchment classification and water quality protection objectives, associated with downstream user and environmental requirements.
- regional mining development trajectories and operational requirements, associated with the broader socio-economic development of the area (and country).

3.3 Witwatersrand Issues, Opportunities and Constraints

The Western, Central and Eastern basins are located in the Witwatersrand area (Figure 3.2), where predominantly gold and uranium mining takes place. Mining in the started in the early 1900's and since the mines inception, 15 600 tons of refined gold has been produced. During the operational time of the mines, the water that collected in the voids was pumped to the surface; however, since the closure of the mines, the voids have been steadily filling with water, and have since reached the environmental critical level for decanting. Leachate from old mine dumps also presents a risk with extremely high concentrations, although the discharge volumes are relatively small, so the total load is not that significant.

The gold industry is in its sunset phase, implying that many of the gold mines will be non-operational in a few years, if they are not "closed" already. However, there are opportunities to viably rework some of the mine dumps (already on-going) and older shafts (if they are dewatered).

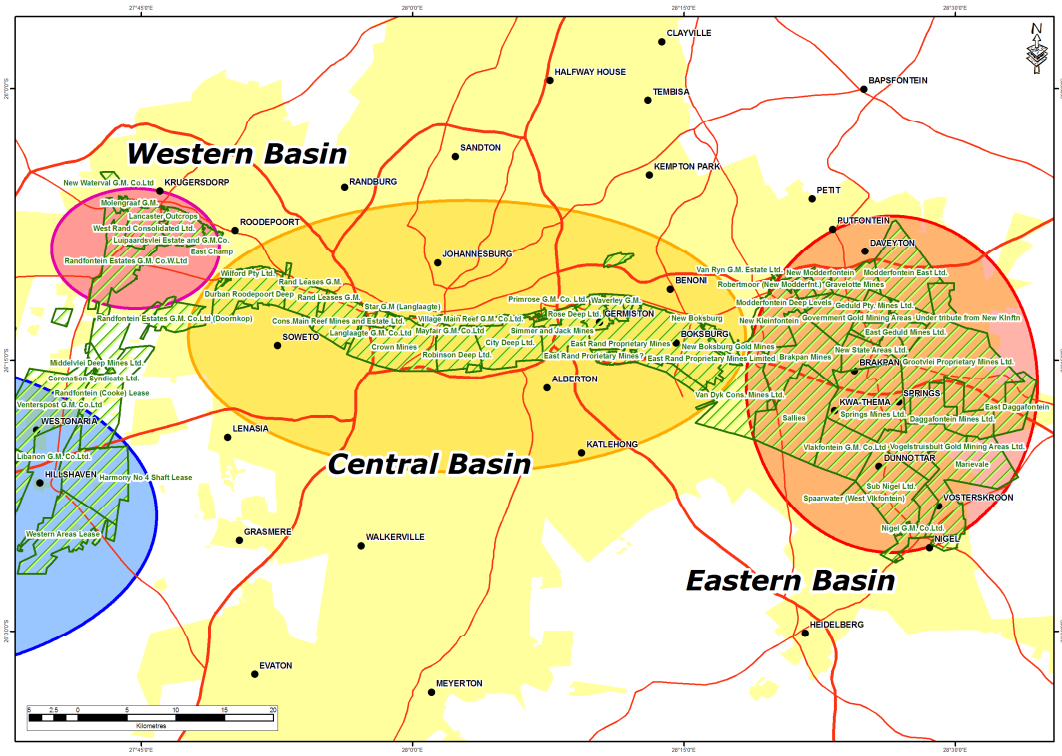


Figure 3.2: Geographic location of Western, Central and Eastern Basins

3.3.1 Characterising the Witwatersrand AMD Problem

AMD poses both water quality and water supply concerns, particularly in the Vaal River system (and to a lesser extent for the Crocodile River). From the perspective of water quality, there are local acidification impacts and regional salinity threats to the entire Vaal River main-stem (downstream of the Vaal Barrage). Figure 3.3 illustrates the decreasing trend in salinity in the Barrage, linked to the closure of a number of mines upstream (with the associated reduction in dewatering). This trend is expected to reverse as these closed mines begin to decant. The current total average salt (salinity) load to the Vaal Barrage is about 960 000 tons/year, while the estimated AMD decant from the Witwatersrand goldfields may be about 210 000 tons/year (at a TDS concentration of about 3850mg/l), which obviously poses a significant threat to salinity levels.

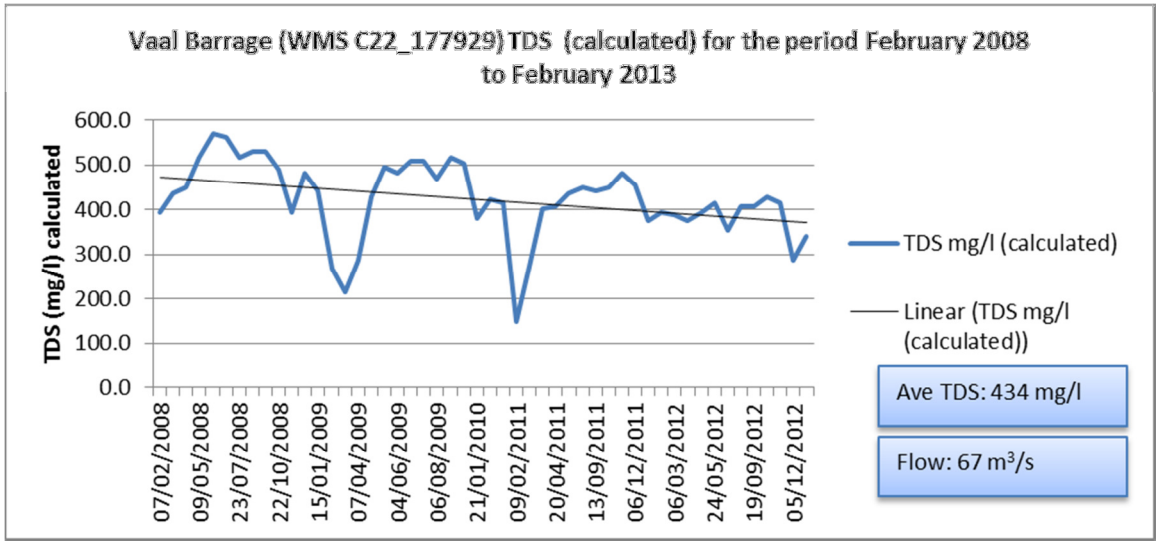


Figure 3.3: TDS trends for the Vaal Barrage

Importantly, this is below the 600 mg/l target Resource Water Quality Objective (RWQO) currently set for the Barrage (as indicated in Figure 3.4), but the Vaal Classification process is currently revising the Resource Quality Objectives (RQOs); any change to these objectives will have profound implications either for upstream dischargers or downstream water users.

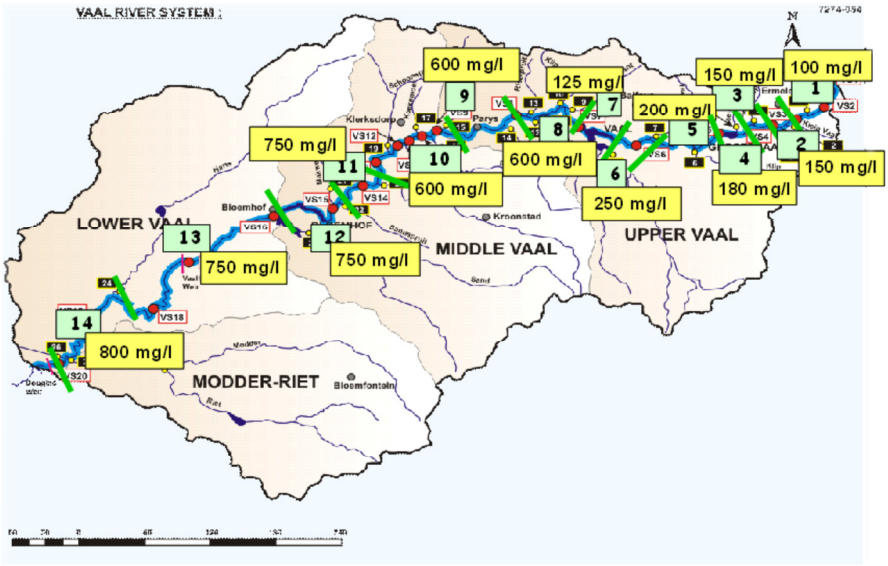


Figure 3.4: RWQO for the Vaal water management area

Furthermore, water is currently released from the Upper Vaal to maintain acceptable water quality in the Middle and Lower Vaal River. The opportunity cost of this dilution water is significant, as it is ultimately water transferred from Lesotho (linked to the Vaal System tariff). Thus AMD presents a water supply challenge for the Upper Vaal system on the one hand by potentially increasing the dilution requirements (and thus loss from the Upper Vaal) and a possible opportunity for additional water supply on the other hand (particularly if it is treated to acceptable levels for water supply or release into the river system). It is important to note that the opportunity cost of water in the Vaal River system is relatively high, with the reconciliation strategy indicating increasingly expensive augmentation schemes to support continued economic growth in Gauteng (Figure 3.5). Importantly, treatment of AMD has been identified as an important interim option in the reconciliation process.

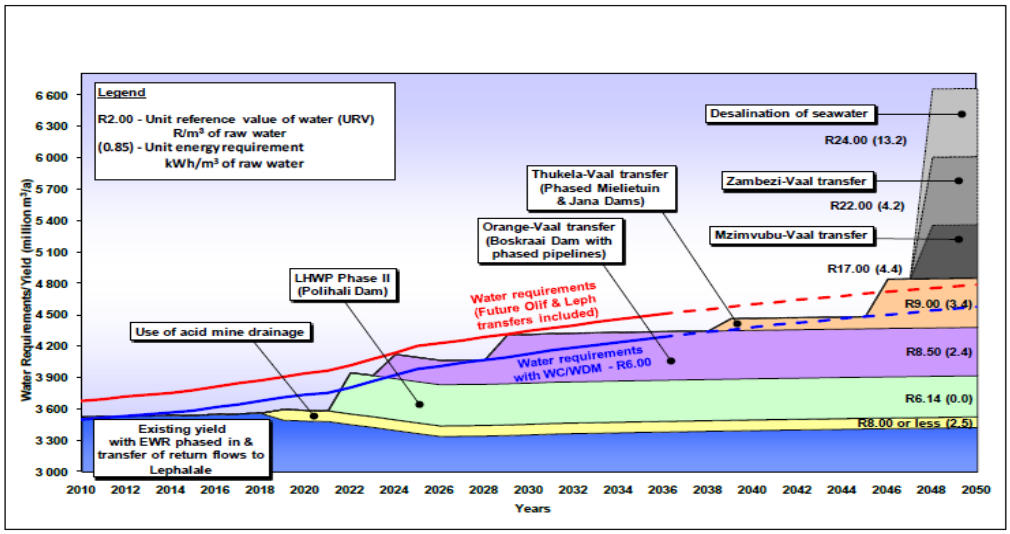


Figure 3.5: Water supply reconciliation for the Vaal System

3.3.2 Existing and Potential AMD Management Interventions

The 2010 report to the inter-ministerial committee on Acid Mine Drainage[1] identified that there existed risks owing to the flooding of the mines and decant of AMD to the environment. In order to mitigate some of the impacts, a generic approach to the management of the identified risks were proposed:

- ***Decant prevention and management:*** water levels to be held at or below the Environmental Critical Levels1 (ECLs) by pumping of water.
- ***Ingress control***: by preventing the recharge of the shallow groundwater above the mine void by the canalisation of surface streams, the sealing of surface cracks and mine openings and a number other measures.
- ***Water quality management:*** AMD is still being produced and will require treatment through active, passive and in situ treatment technologies.

The TCTA undertook a study which aimed at looking at short term interventions in the basins. The proposed solution was to construct water treatment plants in the three basins. Treatment works were implemented in the Western Basin in 2012, construction in the Central Basin commenced in January 2013 and it is anticipated that construction of the Eastern Basin will commence in early 2014.

In the past year, a preliminary feasibility study was conducted. The indicated that the following short-term actions to mitigate the impact of the AMD in the Witwatersrand:

- **Western Basin**: Decant in the basin has been stopped; the AMD is neutralised and is discharged into the Tweelopies Spruit which has resulted in improvement in the conditions of that area. Permanent pumps will be installed in the area in the short term. There is an opportunity to upgrade the works to 40ML/day (including a clarifier), but this is still under discussion.

- **Central Basin**: Installation of pumps and a High Density Sludge (HDS) neutralisation plant (46ML/d) is under construction and neutralised water will be discharged into the Klipspruit. There are some concerns raised about a 3.6km pipeline to transfer the sludge produced to an existing plant, and as a result there are on-going discussions regarding disposal of the sludge.

- **Eastern Basin:** An HDS plant in is planned and the neutralised water from the HDS plant will be discharged into the Blesbokspruit. Tenders have also gone out for the installation of "long-term" pumps (80ML/d), HDS neutralisation plant and a pipeline to transfer the sludge to an existing site for co-disposal.

The study further elaborated on potential long-term interventions and looked at various combinations of the alternative abstraction points, treatment processes, waste disposal options, and alternative end-users for the treated water from each basin.

The following options were considered[2]:

(i) Water Discharge to the environment

(ii) Water Supply to Rand Water for local potable or industrial use, or for remote industrial users

[1] *Mine Water Management in the Witwatersrand Gold Fields with special emphasis on acid mine drainage, Report to the inter-ministerial committee on acid mine drainage, December 2010*

[2] *FS:LTS to address the AMD associated with the East, Central and West Rand underground mining basins Report No. 10 – Feasibility Report DWA Report No.: P RSA 000/00/17012*

(iii) Technological considerations:

- HDS for neutralisation;
- Conventional RO for desalination; and
- A biological process (although not proven) if located near a wastewater treatment works (WWTW).

(iv) Residue management options:

- HDS and RO sludge to Sludge Storage Facility (SSF); and
- Co-disposal of brine to the SSF. Since this was common to all options it did not influence the evaluation.

The estimated capital, operating and maintenance costs for the long term interventions are presented in Table 3.1 and 3.2.

Table 3.1: Estimated capital costs

	Western Basin		Central Basin		Eastern Basin	
	R million	% of CAPEX	R million	% of CAPEX	R million	% of CAPEX
CAPITAL COSTS (CAPEX) – LTS						
Civil Works (Site works, Balancing Storage, Land)	289	21	341	15	645	22
Treatment (Ion Exchange, Desalination)	438	31	708	31	1 148	39
Residues Management (Brine Disposal, Sludge Disposal and Return Water Management)	634	45	944	41	835	28
Treated Water Delivery	44	3	283	13	337	11
Sub-total for LTS	**1 410**	100	**2 280**	100	**2 970**	100
Grand total for LTS	**R6 660 million**					

Table 3.2: Estimated operating and maintenance costs

Description	Western Basin		Central Basin		Eastern Basin	
	R million	% of OPEX	R million	% of OPEX	R million	% of OPEX
OPERATING COSTS (OPEX) – STI and LTS						
Electricity	36	21	40	15	54	17
Chemicals	59	35	122-	47	125	40
Sludge disposal	36	21	43	17	52	17
Brine disposal	4	2	9	3	9	3
General	35	21	46	18	70	23
Sub-total	**170**	**100**	**260**	**100**	**310**	**100**
Scheduled major overhauls	**60**		**70**		**120**	
Average annual O&M costs	**230**		**330**		**430**	

The capital and operating costs for the long term solutions, as well as the operating costs for the short term interventions are high and the opportunities for cost recovery need to be considered[3]. Whilst there are various options that have been identified (see below), it is important to try and reduce the transaction cost by taking into account the efficiency in cost recovery as well.

i. Polluters pay:

- Cost recovery from mines
- Contributions from mines' Trust Funds
- Cost recovery from the Waste Discharge Charge System (WDCS)
- Cost recovery from a future Environmental Levy or mining tax

[3] *FS:LTS to address the AMD associated with the East, Central and West Rand underground mining basins Report No. 10 – Feasibility Report DWA Report No.: P RSA 000/00/17012*

ii. Beneficiaries and users pay:

- Cost recovery from the Vaal River Tariff (VRT) (only applicable to Central/Eastern Basins)
- Income from the sale of raw AMD water
- Sale of treated water to Rand Water
- Sale of residue products including iron, uranium and gypsum

iii. External grants and fiscal support

The treatment of the AMD is a solution that tackles the symptom. Taking measures to ensure that the water isn't polluted in the first place is an action to mitigate the problem. It is estimated that about R166 million per year may be saved in operating costs of the above treatment options if the total reduction in ingress of 36 Mℓ/d could be achieved.

The alternative to treating (or managing) AMD is to either do nothing and allow salinity in the Vaal River to increase (although once the RQOs have been set, these are legally binding on water institutions), or to dilute the salinity increase by releases from Vaal Dam (which should be costed at the marginal tariff of the augmentation scheme required to provide water this water, be it Lesotho Phase 2 or some other source in the future. Before the mine water pumping stopped in 2008 the dilution volume ranged from 113 Mm^3 to 227 m^3 per year. This imposes a considerable cost on the system at the marginal cost of new augmentation schemes, which are above the average represented by the current Vaal River tariff (R2.80/m^3). Preliminary analysis in the feasibility study indicated that dilution is by far the most expensive option.

On the other hand, depending upon the level at which the RQOs are set, the Minister is bound to implement interventions to achieve them, and deteriorating downstream quality will impact on the fitness of this water for use and thus potential lost downstream opportunity to use water socially or productively (which is the framing of the classification process). Either the AMD should be dealt with to prevent exceedence, or approximately 1 million tons/year of salt load in the entire basin must the managed through a Vaal water quality management plan, possibly though implementation of the waste discharge charge system (WDCS) on all salt dischargers. This will have an impact on many other distributed users for which it may be more difficult to reduce salt discharge (such as municipal waste treatment works). It is for this reason that the WDCS should be considered as a mechanism for the AMD management process.

Finally, there are various related business development opportunities that may be opened up around this process, including reworking mine dumps and dewatered shafts with new extraction technologies, as well as local economic and spatial development associated with reclaimed land.

3.3.3 Potential Opportunities and Constraints for SWPN Interventions

The central challenge and thus opportunity in the Witwatersrand is to develop the business model/s through which to facilitate and enable these technical and business solutions. On the one hand, this should be focused on the ultimate catchment objectives of achieving the desired water quality outcomes, while ensuring that AMD water is used appropriately to augment raw or treated water supply, primarily in the Vaal system. On the other hand, the solution needs to be a financially viable, possibly depending on a suite of funding sources, enabled though a collaborative partnership between government (national and municipal) and the private sector (mines, industry and service providers), that limits the cost and risk to the public sector, led by an appropriate institutional vehicle that all parties can support (is credible).

3.3.4 Risks of an Intervention

While there is a possibility of slowing growth in Gauteng, the likelihood is that water demand will continue to increase and thus both the opportunity cost of water and the projected marginal supply cost of future augmentation options will continue to increase. However, there is a possible future in which the water demand does not increase over the next decades, but the likelihood is quite low. This implies that the AMD treatment options, together with the re-use and sale of the treated water to urban or industrial users should become increasingly financially viable, even within the next decade. While the AMD treatment costs may reduce with improved technology, the significant energy requirements pose an on-going financial (and possible greenhouse gas related) risk to treatment options.

Both AMD impacts and the reconciliation options are affected by potential climate change related shifts in precipitation and temperature on the Highveld over the next decades. There is relative certainty around increased average temperatures, but great uncertainty about the precipitation impacts (other than the expectation of greater variability). A drying future reduces ingress and thus the physical forcing function of AMD, but increases the opportunity cost of water. A wetting future increases ingress and AMD (and thus possible treatment capacity and costs), while providing more water for supply and possible dilution (with a slightly lower demand and thus opportunity cost). Thus there seems to be a possible self-correcting dimension to climate impacts on AMD in the Vaal system, but interestingly a drying future may be more benign for AMD treatment interventions.

While the institutional-financial models for implementing AMD treatment options are relatively straight forward, there are far greater institutional, business and liability challenges in adopting some of the more innovative opportunities around reworking dumps and dewatered mineshafts, as well as leveraging associated local government special development opportunities. This should not be ignored in the institutional functionality, but may be tactically left for a future phase of a Witwatersrand AMD management institution's evolution.

3.4 Witbank Issues, Opportunities and Constraints

The Upper Olifants catchment is characterized by intensive coal mining and associated energy and manufacturing economy and is highly used and impacted. Much of the catchment falls within the Highveld Coalfields, where most of South Africa's coal is mined. The landscape in the southern and central part of the catchment is dominated by mining operations and mining-related infrastructure. Coal mining is mainly conducted by opencast techniques, high extraction underground operations and conventional bord-and-pillar underground operations. It is estimated that coal mining in this area has a remaining lifespan of about 20 years, with a total of about 20 billion tons of coal still expected to be extracted.

The Upper Olifants has three impoundments (Middelburg, Witbank and Loskop Dams) supplying water primarily to urban and agricultural users (Figure 3.6). Surface water is impacted by dewatering, leachate/runoff from operating and reopened mining facilities, as well as decant (and leachate/runoff) the non-operational and abandoned mines.

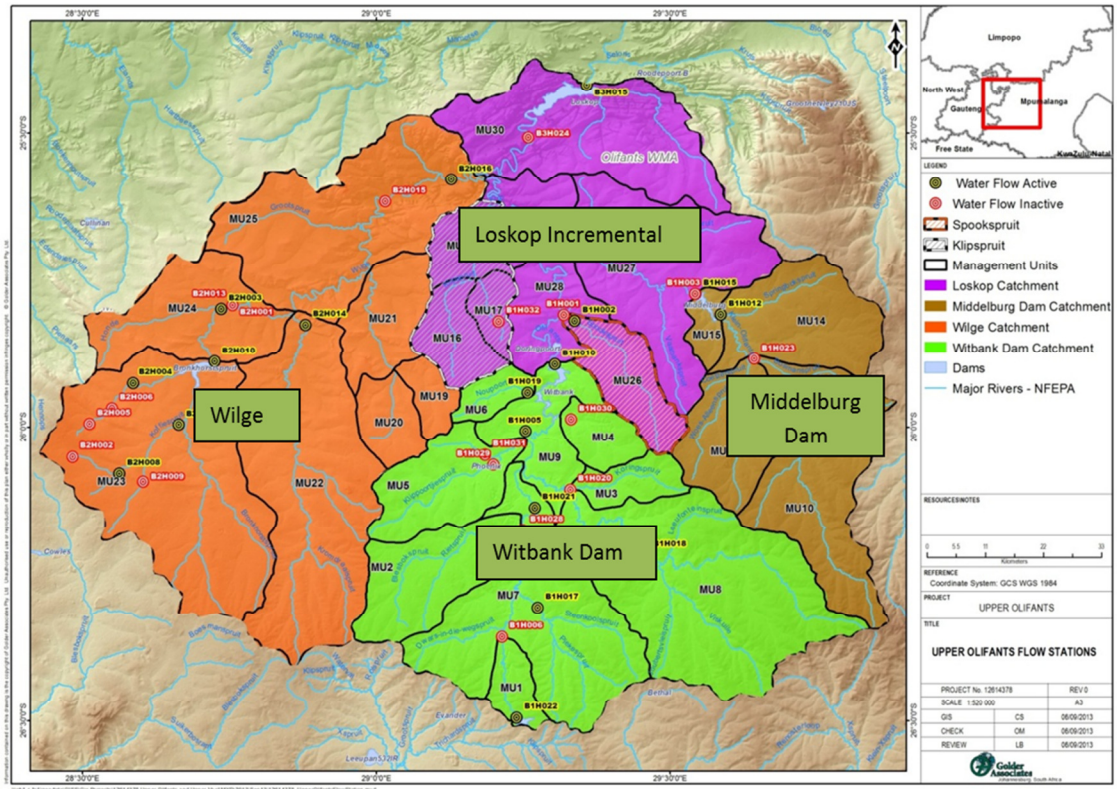


Figure 3.6: Catchments in the Upper Olifants

3.4.1 Characterising the Witbank AMD Problem

Sulphate associated with coal mining is the focus of AMD related water quality management attention in the Upper Olifants, typically representing about 50% of the total salinity load in these catchments. Resource Water Quality Objectives have been set for the various dams, namely 155 mg/l in Witbank Dam, 200 mg/l in Middelburg Dam and 120 mg/l in Loskop Dam. Over the past decade, sulphate concentrations have varied, but have either increased to exceed these RWQO in the past few years (Middelburg and Witbank Dams) or have consistently exceeded the RWQO (in Loskop Dam) with on-going coal mining activity (Figure 3.7).

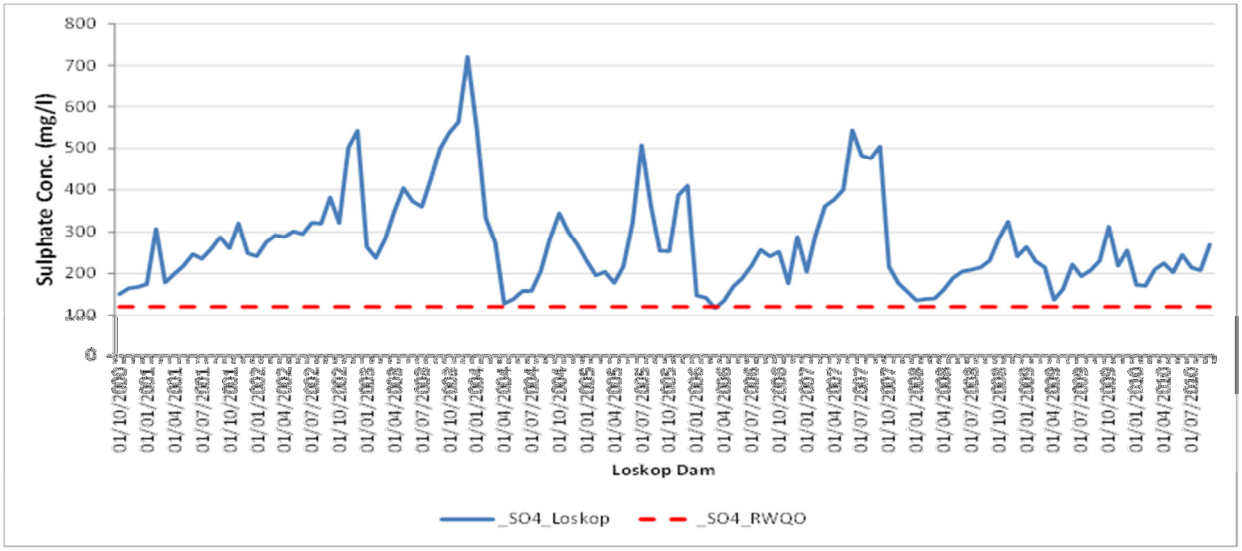


Figure 3.7: Time series of Sulphate Concentration in the Loskop Dam for the period 2000 to 2010

There is currently a classification and RQO determination process being conducted for the entire Olifants, but it is not yet clear whether these RWQO targets will change. While pH in the entire system is relatively stable, there are acidification concerns in some local streams.

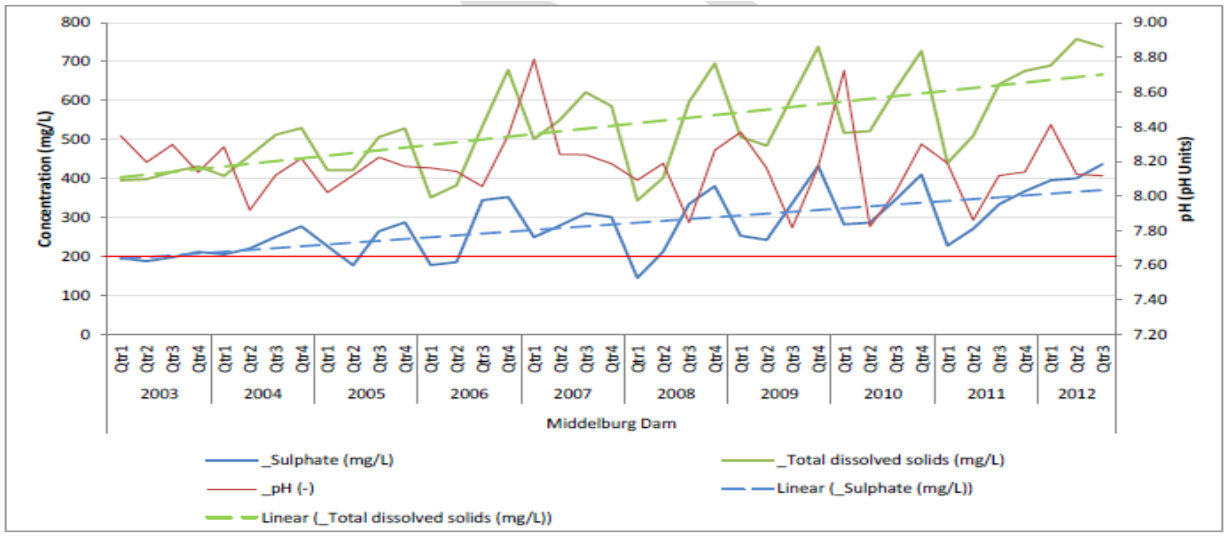


Figure 3.8: Time series of Water Quality Concentration in the Middleburg Dam for the period 2003 to 2012

The total sulphate load from the entire Loskop catchment is 140 000 tons/year (from 2007, average is approximately 60 000 tons/year), of which about two thirds is related to coal mining activities (from WDCS analysis). A reduction of about 25% of the current total load is required to achieve the RWQO, which implies a load reduction from mining of almost 40% (as the background load is not manageable), or alternatively dilution of the existing load with improved quality water (as long as this is not illegally abstracted before it reaches the dams).

Figure 3.9 indicates the estimated relative load from mining activities in the four sub-catchments, indicating that the majority of the load originates from mining activities, with 50% of this from defunct mines in the Wilge River catchment (to the west of Witbank). It is important to recognise that there are operational, non-operational and other areas on a single operating mine facility (but these are not distinguished in this analysis). The contribution from defunct or non-operational mine facilities is expected to shift towards non-operational mines over the next two decades, but the load from these facilities may vary considerably depending upon the mining and rehabilitation practice at that mine.

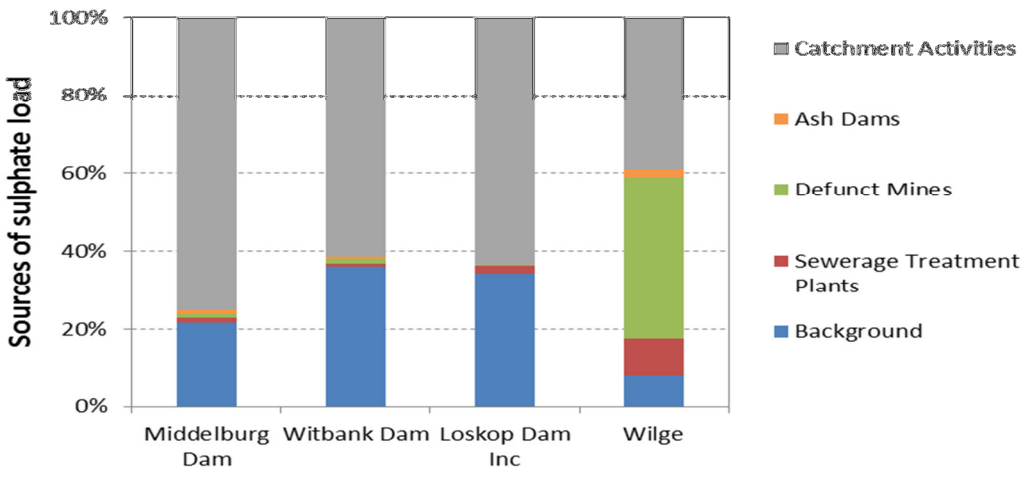


Figure 3.9: Contributions to sulphate load by sub-catchment

As AMD is both a short and long term challenge, it is necessary to conceptualise the future of AMD in the Witbank coalfields in three distinct phases, each with their own problems and opportunities:

- The next 20-years of coal mining *operations* (with rolling rehabilitation) will be characterised by dewatering and runoff impacts, with the opportunity for the mines to finance management or treatment of their impacts (as well as contribute to provisions for future management costs).
- The following 20-years will involve a *transition* to non-operational conditions, which is likely to be characterised by increasing decant and possibly runoff from rehabilitated or abandoned mines (which is expected to be highly contaminated as the voids fill and sulphate is mobilised).
- Thereafter, the system should *stabilise* and contamination may even decrease as areas remain flooded and thus mobilisation of sulphate reduces, particularly from the better rehabilitated mines, which may reduce the need to actively manage AMD to achieve RQOs.

3.4.2 Water Management & Development Context of the Upper Olifants

The Upper Olifants is linked to two important South African supply systems, namely the middle Olifants system and the Vaal system (as well as being on an international river shared with Mozambique), and many of the country's coal thermal power plants are located in this area and are linked to the Vaal system. An illustration of the AMD challenge is that while Duvha power station can physically abstract from Witbank Dam, the quality is inadequate and this is seldom used.

The reconciliation strategy projection of demand and augmentation options for the Vaal System were provided in the Witwatersrand section, while the reconciliation options for the middle Olifants River system are presented in Figure 3.9. Again, this indicates the demand and marginal cost of water in these systems, which implies there is a demand for water of adequate fitness-for-use.

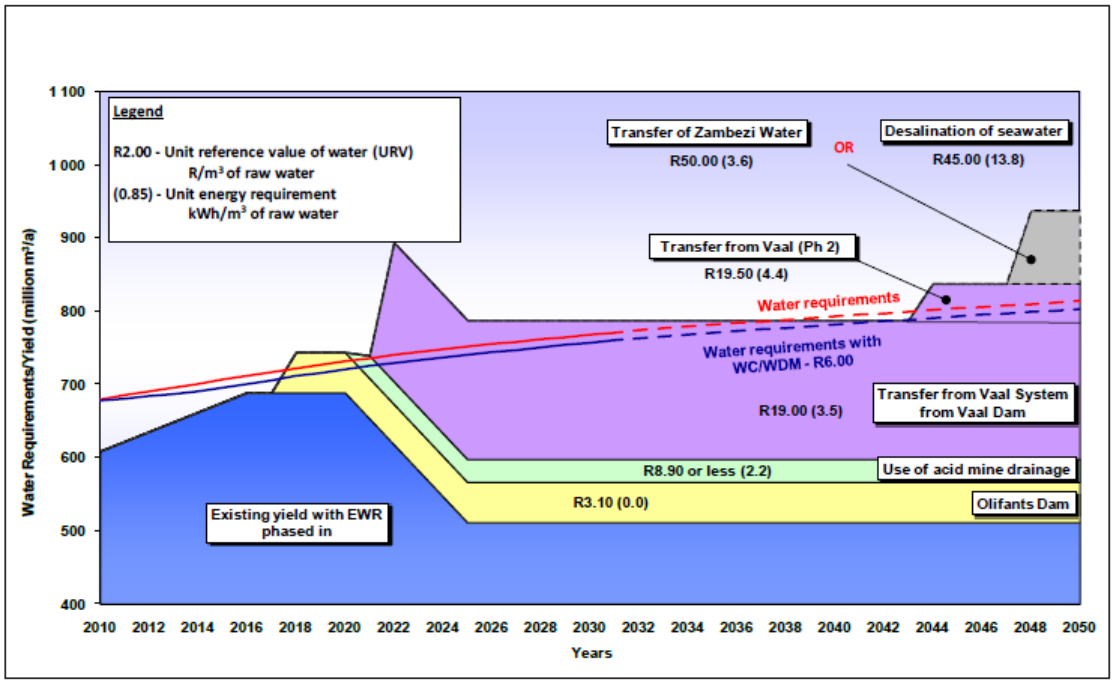


Figure 3.9: Water demand and supply options for the middle Olifants system

Two questions arise though, and that is that both the Olifants and Vaal systems are located a distance away from the Witbank coalfields. The supply challenge thus needs to be seen from both a short-term and longer-term perspective. While AMD treatment is highlighted as a short term option in both the

Vaal and Olifants reconciliation studies, the most appropriate short-term opportunity seems to be for the local municipalities and industries, as outlined below.

From a longer term (30-year) perspective, there are questions about the long-term demand for water in the lower Olifants, as mineral resources are extracted. On the other hand, the Mpumalanga power stations are planned for closure within the next 30 years, which would potentially release significant quantities of water into the eastern parts of the Vaal supply system, as future generation potential is being largely planned in the Waterberg, coastal nuclear, western renewables and international hydropower. Despite this, there appears that there will be a continued demand for water in this region for the next 30 to 40 years, which coincides with the most challenging period for AMD (20-years operational and 20-years transitional to stable non-operational).

3.4.3 Existing AMD Management Interventions

The AMD-relevant interventions that are in the process or have already been implemented in the Upper Olifants include:

Controlled Releases: Mine water management systems are required to comply with Regulation 704 of the National Water Act of 1998 (Act 36 of 1998) and to meet best practice. Although not strictly applicable to industries, Regulation 704 serves as a good guide for industrial systems. Many of the mines in the area require upgrades of their water management systems and consequently, the excess water produced from these systems have been managed using the controlled release scheme which was initiated in 2006.

Collective treatment of AMD water: With a number of mines reaching the end of their economic lives and the mine workings filling up to ultimately decant, this will have severe consequences on the regional water quality. The major mining houses are aware of this problem and plans are being developed to treat the excess mine water. Mine water reclamation schemes have already been constructed which are supplying water for potable use to the local municipalities (eMalahleni Water Reclamation Project). These schemes have to be developed and co-ordinated to address the future decants. The reclamation of the excess mine water has been earmarked as a future source of water to meet the growing water requirements in the upper and middle areas of the Olifants WMA.

Facility dewatering by Mine RO Plants: Many mines have implemented local reverse osmosis plants to treat and discharge water from operations dewatering, processing wastewater and surface runoff. This is an emerging necessity to operate these mines, but does not have long term sustainability beyond closure.

Facility management and rehabilitation: Water quality impacts are strongly dependent upon the practice adopted in the operation and closing of mine workings. Many mines are implementing more sophisticated waste water management options that potentially limit AMD impacts though passive treatment and isolation of contaminating workings. These are often beyond the minimum standards.

Water strategy processes: The current classification and establishment of Resource Quality Objectives for the Olifants River basin, implementation of the Waste Discharge Charge System in the Upper Olifants catchment and reconciliation planning in the middle Olifants, provide valuable opportunities for AMD planning in the Witbank coalfields, but this requires more coherent engagement of these process, in order to be effective.

3.4.4 Potential Opportunities and Constraints for SWPN Interventions

The opportunity on the Witbank coalfields revolves around the 20 year operational timeframe before moving into a post-operational phase. This enables appropriate planning and regulation of the operations and closure process to ensure appropriate practices are adopted to mitigate AMD over at least the next half century, as well as establishing sustainable institutional, financial and technical mechanisms to promote, coordinate and manage AMD related interventions during this period. Specific intervention opportunities that may be considered include:

Coordinated regional AMD, mining and catchment planning: There is an opportunity to link a regional mining development plan with a catchment management plan in the Upper Olifants, with the focus on addressing the AMD concerns over the next five decades. This may also be motivated by the imminent establishment of statutory RQOs in this catchment, particularly if they are set at of more stringently than the current RWQOs.

Coordinated regulation: In order to effectively manage mining to mitigate AMD now and in the future, mining, environmental and water regulation needs to be better aligned and strengthened in this region. This may be done at a regional level under the existing policy regime (albeit that it will be strengthened by initiatives to integrate regulatory processes), particularly by improving monitoring, information and management system used by the regulators and establishing a cooperative mechanism for coordination of regulatory responses – the intention being to demonstrate its value on this particular critical catchment, rather than country wide. There are already proposals under the WDCS implementation to strengthen water monitoring and regulation in this catchment, but these could be expanded. This will be particularly important to address appropriate rehabilitation that reduces the AMD impact of future non-operational mines.

Promotion of Peer/Self-Regulation: Another avenue to pursue is the promotion of peer and self-regulation. This may be achieved through the partnerships with the private sector that support government or the establishment of a relevant local water management institution. The challenge with self -regulation is the varying standards of different companies. Those with greater reputational risks, due to international presence or partners will tend to have more stringent standards than those smaller companies with different governance drivers.

Mine water treatment and reuse: There are three potential scales for dewatering: onsite independent mine RO plant with discharge into local resources, a few local mines jointly treating and possibly transferring grey water to local industrial users or large regional schemes collecting, treating and distributing water to municipal potable or industrial water supply. There are a number of technical challenges in the collection and distribution infrastructure, but these are not as significant as the issues of financial viability and institutional sustainability.

Attribution and size of the liability: Addressing AMD in this catchment with neighbouring mines requires careful and credible attribution of the load contribution from different mines, both during operations and in the future post-operation. There are severe challenges around the issue of attributing the liability, especially with those mines that are ownerless. It is estimated that operational mines have a long-term liability of about R10 billion, while the state liability for defunct (abandoned) mines is about R6 billion. The owners of the mines in this instance are known, however, the financial health of the mines need to be taken into account when attributing the liability.

Financial provision for mines: The financial provisions made by mining companies are currently ineffective, because provisioning or guarantees for liability are not ring-fenced, and in many cases sale or balance sheet erosion results in a company's assets are being adequate to cover the liability at closure. A possibility is to ensure that the provision is made at the beginning or during the operational life in cash to ensure that the liability is covered in any event of mine closure.

Government provision for defunct mines: Government has the opportunity to make provision for their state-owned mines and defunct mines in order to deal with their liabilities in critical catchments. By doing this, it may also ensure that companies more effectively address their liabilities. This may be done under the waste discharge charge system or the raw water pricing strategy, which potentially allows for the consideration of mine water charges or levies, and subsidies to deal with defunct mines and state-owned mines.

Ring-fencing of finances: There is a perspective that cross-funding of a region such as the Witbank coalfields should be limited, and the financial provisions made for liabilities in the region, should be collected and used in that region. This would require a mechanism to collect the cash associated with liability and invest this in a dedicated financial vehicle that could be used to cover future AMD management costs.

Introduction of a Mining Levy: One mechanism of collecting this money would be to define a levy on mines in the area and collect this against the future liability. While the national environmental levy is being explored, this does not yet provide regional ring-fencing of the money for local management. The WDCS also provides an opportunity to collect revenue, but is more focused on current management and regulation options, than future liability.

Corporate stewardship and information sharing: With the appropriate leadership and resources from the mining companies (possibly through the Chamber or SWPN), there is an opportunity for the private sector to capture and share information about AMD responsible practices and to begin to jointly hold the Witbank mining sector responsible for compliance with at least minimum regulations.

As with the Witwatersrand, the central challenge and thus opportunity in the Witwatersrand is to develop the business model/s through which to collaboratively plan, facilitate and enable these technical, financial and institutional solutions. However, it differs from the Witwatersrand in that there is a real opportunity to ensure the remaining 20 years of mining operations provides for liabilities in the post-operational period. On the one hand, this should be focused on the ultimate catchment objectives of achieving the desired water quality outcomes (as defined by the RQOs), while ensuring that AMD water is used appropriately to augment raw or treated water supply, either locally in the Witbank area, downstream in the Olifants catchment of within the wider Vaal supply system. On the other hand, the probable suite of technical and management solutions need to be a financially viable, possibly depending on a suite of existing or new funding sources, enabled though a collaborative partnership between government (national and municipal) and the private sector (mines, industry and service providers), that limits the cost and risk to the public sector, led by an appropriate institutional vehicle that all parties can support (is credible).

3.4.5 Risks of the Response Options

While there is strong indication of growth over the next 20 years, there is some uncertainty of the long-term growth prospects of the Witbank and middle-Olifants areas as mining closes. This in turn influences the long-term sustainability of water demand (of mining, industrial or urban users) in this

region. At the same time, it is expected that the Highveld power stations will be closed over the next 30 to 40 years, which will make more water available in these systems. This excess water may either be allocated to local (agriculture or industrial) development, or more likely could be transferred to supply increasing demands in the Gauteng – through the existing inter-connected Vaal system infrastructure.

An important consideration in this is the degree to which the Witbank coalfields AMD problem will persist beyond the stabilisation period (40 years from now), or whether natural processes will result in decreased mobilisation and decant loads which bring the water quality back into acceptable RQO targets. If the latter, there may not be a need for active management beyond 40 years, so the above risk may not materialise.

However, both the AMD impacts and the reconciliation options are affected by potential climate change related shifts in precipitation and temperature in the Olifants River system (and connected Vaal system) over the next decades. There is relative certainty around increased average temperatures, but great uncertainty about the precipitation impacts (other than the expectation of greater variability). This area is similar to the Vaal in that drying future reduces ingress and thus the physical forcing function of AMD, but increases the opportunity cost of water. A wetting future increases ingress and AMD, while providing more water for supply and possible dilution with a slightly lower demand and thus opportunity cost. At this stage, either future is plausible.

There is a great opportunity to construct a management and regulation plan for the long term. In the short term, treatment of the AMD is a viable option; however, this may not be the case after 40 years. It is clear that there is no single solution going forward, and a suite of options need to be pursued. The success of implementing the suite of options is to ensure that there is a clear view going forward in terms of rehabilitation and roll-out.

3.5 Waterberg Issues, Opportunities and Constraints

The Waterberg District, which is situated in the western Limpopo, bordering Botswana, contains coal, platinum and copper mining with other metals present to a smaller extent; coal mining being the main AMD threat in the region. Although the Waterberg area consists of a number of currently operational mines (Figure 3.10), AMD has not been an urgent concern in this region due to relatively localised scale of mining, low rainfall and low ingress. In fact water shortages in this region have historically threatened to inhibit large-scale coal development of the Waterberg coalfields.[4] More recently, however, the coal reserves of the Mpumalanga Highveld, Witbank and Ermelo coalfield near the Central Basin are nearing exhaustion resulting in development plans for further coal mining in the Waterberg region, particularly to support thermal power generation expansion for South Africa.

The Waterberg district contains over 40% of the remaining domestic coal supply (~ 50bn mineable tons) and is also host to more than 70% of the Limpopo province's platinum reserves (in Mokgalakwena and Thabazimbi). Platinum mines in South Africa are largely free of AMD. Although AMD has not been an urgent concern in the past, coal mining development plans, are causing the threat of AMD in this area to rise.

[4] Eberhard, 2011, The Future of South African Coal: Market, Investment and Policy Challenges

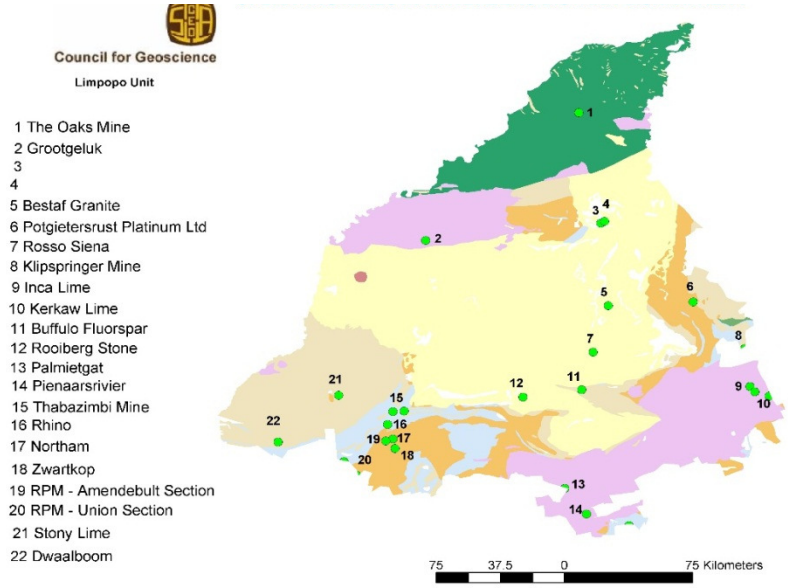


Figure 3.10: Operating Mines in the Waterberg District Municipality, 2009

3.5.1 Characterising the Waterberg AMD Problem (Definition)

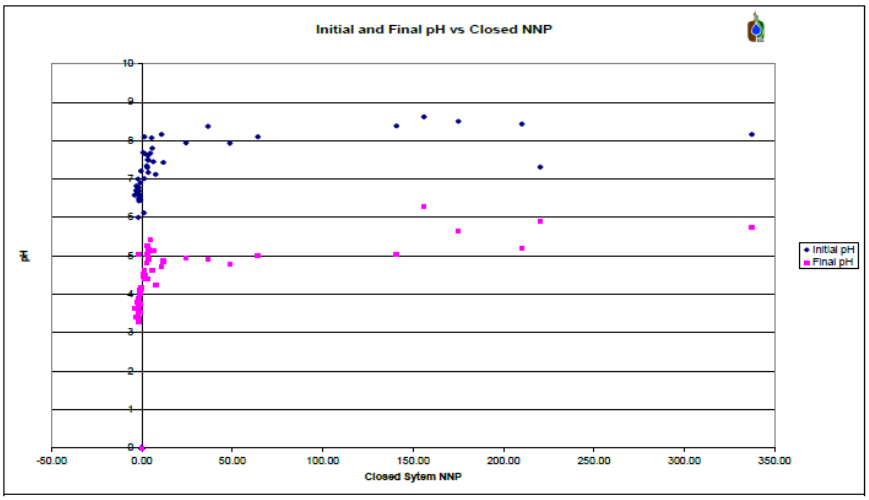
The Waterberg region is undergoing a significant growth phase as coal resources in other parts of the country diminish. Various coal-fired power plants and therefore coal mines are under construction in the region. As a result the Waterberg is largely characterized by new mines and is thereby experiencing a development phase. Pertinent issues are:

- New mines threaten to cause AMD through mining operations and poor corporate governance practices
- Inadequate licensing requirements may result in insufficient liability provisions and unnecessary destructive mining practices
- Fragmented and inconsistent legislation may result in mines being allowed to legally operate without full water considerations (separate water use and mining licenses)

A study by the University of the Free State on the Waterberg region compared the pH values of 20 acid generating rock samples at the time of the study to forecasted future pH values using a technique called acid-based accounting, and used this data to predict the potential to generate acidic drainage in areas affected by mining. The forecasts are determined by the rocks' mineralogical properties[5]. Figure 3.11 shows the initial and final pH measurements for samples in the Western Waterberg area potentially affecting parts of the Mokolo River.

The key deduction from this study is that the pH values are in most cases projected to be lower than the initial rates indicating an increase in the acidity of the sample areas. A more focussed study that tested 20 sites for acid-generating potential concluded that AMD was a growing threat in the area as nine of the 20 sites had *high* acid-generating potential. The static tests on these core samples indicate that acid mine drainage will be produced upon oxidation in some of the samples; the data also indicates that there is sufficient calcite present to serve as a buffer to limit the amount of acid generated, but not enough to completely eliminate the potential for acid generation. Preventative measures must therefore be put into place upfront to ensure AMD minimisation.

[5] See Waterberg progress report 2009.



Note: The "closed system NNP" refers to system which requires additional chemical reactions to neutralize the acidic water in comparison to an "open system".[6]

Figure 3.11: A Comparison of initial and projected pH values in the Waterberg region

It was observed that groundwater is not used for irrigation, due to the high salt content. High chloride values are found in the water along with high levels of magnesium, potassium, sodium and sulphate. The sulphate is predominant in areas with shallow coal-bearing layers or in cases where the boreholes were drilled into the coal. The sulphate values in the vicinity of the Grootegeluk Mine and Matimba Power Station are elevated relative to the surrounding area. The Limpopo River is particularly vulnerable to the impact of coal mining. The only river with overall ecological status considered "good" is the Middle Mokolo River, upstream of the Mokolo dam. All other watercourses in the Waterberg area are considered to have poor to fair overall ecological status.[7]

3.5.2 Water Management & Development Context of the Limpopo

Primarily as a result of low rainfall and a reliance on water-intensive industry, the water demand in the Waterberg area exceeds supply from both the Limpopo and Crocodile West Rivers. The water shortage is expected to continue in the Limpopo and Olifants Rivers through to 2025, resulting in a net water shortage for the Waterberg region (Tabl3 3.3).

Table 3.3: Reconciliation requirements for water in the Waterberg for the year 2025 (million m^3/a)[8]

	Water management area	Reliable local yield	Transfers in	Local requirements	Transfers out	Balance	Potential for development
1	Limpopo	281	18	347	0	(48)	8
2	Luvuvhu/Letaba	404	0	349	13	42	102
3	Crocodile West and Marico	846	727	1 438	10	125	0
4	Olifants	630	210	1 075	7	(242)	239
	Total for province	**2 161**	**955**	**3 209**	**30**	**(123)**	**349**

[6] NNP: Net neutralizing potential; NNP of a closed system is lower than the NNP of an open system
[7] Waterberg Environmental Management Draft Framework, 2010.
[8] DWAF, 2006. Limpopo Water Strategy and 5-year Workplan.

During this time, the domestic demand for coal in the country is expected to rise – for approximately 10 years – due to Eskom's growth in coal-fired power and the development of independent (coal-fired) power producers (Figure 3.12). The inclusion of future coal exports would increase this demand further. From this, it is clear that Eskom remains the major source of domestic demand and most of this increase is expected in the Waterberg, with decreases over time in the Olifants and Inkomati River basins (as existing power stations are closed).

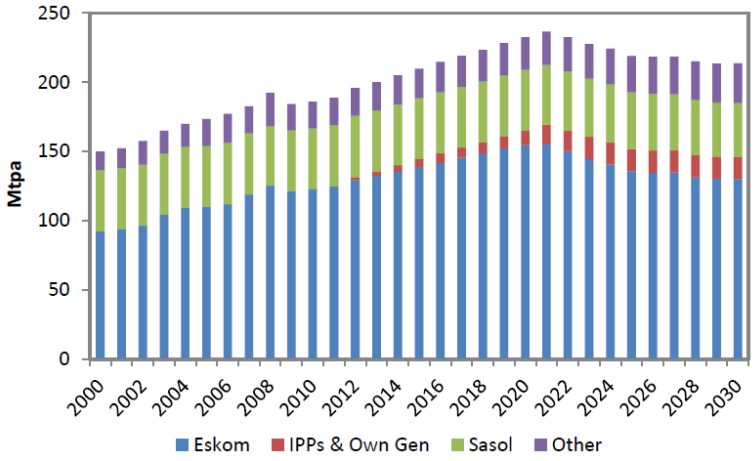


Figure 3.12: Projected domestic coal demand in South Africa[9].

The most recent Waterberg Integrated Development Plan describes official coal-related development plans including the construction of Medupi Power Station and therefore the expansion of Grootegeluk mine (Exxaro) and its beneficiation plant as well as the development of a coal liquefying plant which will require mined coal for the production of carbon chemicals from the coal. It is important to note that the future AMD impacts will depend upon the technology for energy extraction used.

3.5.3 Potential Opportunities and Constraints Requiring Attention

The benefit of being in the development phase is that an opportunity for prevention of AMD related issues exists. If the levers related to new mining facilities can be successfully used particularly regarding licensing requirements and enforcement, together with a regional planning approach, AMD can be largely mitigated. Addressing the AMD problems associated with the operations and closure of mines will add to the mitigation of the threat of AMD when new mines become operational.

Proactive planning and regulation is the most critical intervention for the Waterberg area as it allows for the avoidance of retrospectively (using treatment techniques) resolving the AMD problems in that area as is the case with the Witwatersrand and Witbank mining regions. Upfront regional coordination between the various stakeholders affected by water quality, including the DWA, DMR and mining operators, is essential in ensuring effective regional planning for the development of the Waterberg mining activity in a responsible way that protects water resources and minimizes AMD.

3.5.4 Risks of the Response Options

With the relative newness of the mining activity in the Waterberg coalfields, the risks associated with the responses relevant to the Witwatersrand and Witbank regions are less applicable if a viable regional planning process is followed. A real risk associated with a regional planning approach is non-compliance by mining operators and a lack of will or incentive to coordinate from all stakeholders.

[9] Eberhard, 2010. The future of South African coal: Market, investment and policy challenges.

Climate has a role in this area as there is low rainfall in the Waterberg region, a potential positive contribution to the AMD problem. The disadvantage of this is that any pollution or AMD that does get into the Mokolo, Lephalala, Mogalakwena Rivers and other sources of water supplying the region will place stress on not only the local water supply but other downstream resources, such as the Limpopo River, as water must be pumped to the area to supplement local short-supply of lack of fit-for-use water sources. Again, it is therefore vital to effectively plan the development of the Waterberg coalfields and use effective technology and management to minimize the contribution to AMD.

4. Scoping of Phase 2

4.1 Context to the Scoping of Phase 2

Phase 1a broadened the AMD problem analysis to address the management of mine water from coal and gold mining in South Africa, which took it beyond treatment and reuse of AMD from coal mining in the Olifants River. There is a recognition from an institutional and financing perspective, that effectively addressing mine water problems needs to distinguish post-operational mining areas (in which the majority of mines are non-operational), operational mining areas (in which there is a mix of operational and non-operational mining, but with a limited lifespan), and developing mining areas (in which new mines are being opened and most mines are operational). Furthermore, there is an understanding that the problems being faced in the gold mining areas are quite distinct from those in the coalfields.

Following this, the Witwatersrand goldfields, Witbank coalfields and Waterberg coalfields were prioritised as areas reflecting the post-operational, operational and developing phases of mining, respectively. The scoping of Phase 2 reviewed these three areas, while being cognizant of the potential trajectory of a mining area into the future. The solution needs to reflect the specific mine-related water quality concerns in the relevant catchment, and the regionally most sustainable mining practices, rehabilitation opportunities and management arrangements. This may involve a combination of appropriate mine siting (and practices), treatment & reuse, passive treatment and ingress management within the catchment, the mix of which may evolve during the development trajectory of the mining area. Furthermore, the solution needs to reflect the nature of current water supply-demand stress and the changes in future demand patterns (and sources) in the relevant catchments and its connection to the entire inter-connected Vaal supply system. All of these need to consider the changing nature of mine water from operational activities, through immediate post-operational rehabilitation-stabilisation, to long-term steady state mine water contributions, as well as the corresponding changes in climate (precipitation and temperature) and regional and spatial development.

There are likely to be a number of institutional-financial business model/s required to enable the cooperative management of mine water within an area (these may not be mutually exclusive), ranging:

- from those that focus on ensuring effective area wide planning, regulation, management and possibly financing of mine water management (to achieve water resource outcomes),
- through those required to collaboratively plan and implement specific interventions to mitigate mine water impacts at a catchment / area scale (including treatment & reuse, ingress reduction and broader local land planning opportunities),
- to those that are specifically focused on locally collecting, treating and reusing mine water from a few mines and nearby industries to a specific user.

The form of these institutional-financial business models would need to reflect the functions they are required to perform, would need to address their current viability and long-term sustainability as conditions change, and may require adjustment to the enabling policy and regulatory environment.

Phase 1b has highlighted some recurring themes that may be addressed through a SWPN intervention, each of which has been addressed in terms of the needs at a national enabling framework level, as well as at a specific mining area-catchment scale:

- Regional mining, environmental and water planning
- Collaborative mine water treatment and reuse opportunities
- Collaborative mine water management (ingress and passive treatment) opportunities
- Improved mining, environmental and water regulation and enforcement
- Improved information and corporate governance (stewardship initiatives)
- Sustainable and effective mine water financing and liability mechanisms

4.2 Priority Phase 2 Interventions for SWPN

Following the discussions and priorities agreed during the final work session of Phase 2 on 1st November 2013, it was agreed to focus on the Witbank area. The rationale for this recommendation was that Witbank has a combination of expanding, operational and non-operational mines, has a 20-year window of opportunity to address the challenge during active mining activities, has significant information, is located in an area with serious water quality and water supply concerns, and has emerging institutions and multi-lateral interest in developing a sustainable solution. However, this intervention must consider the lessons to be learned from the Witwatersrand and highlight implications for the further development of the Waterberg (and other possible new mining areas).

The outcome of Phase 2 must be a business case and implementation plan for a suite of coherent and implementable interventions to address coal mine water drainage in the Loskop Dam catchment and which may contribute to sustained water supply locally or regionally. This needs to address the current operational mine water challenges, while planning for the post-closure period (20-years) and beyond. Phase 2 also needs to concentrate on the comparative advantage (or focus) of the SWPN EWWM, which is the promotion of cooperative mechanisms between the public and private sector that enable the implementation of joint solutions that each party may not be able to leverage independently. Thus for Phase 2, there needs to be a distinction between the core collaborative intervention/s and the enabling conditions that either government or the private sector must address or fulfil in order to enable effective collaboration.

The scoping of Phase 2 is therefore done according to the required outcomes. This distinguishes the core collaborative aspects (interventions, institutions and funding), from broader pre-requisites and requirements for scaling and transfer to other areas. Importantly, these must be synthesised into a business case and implementation plan for Phase 3, but must also be developed in consultation with relevant partners and stakeholders to the process during Phase 2.

Outcome 1: Priority collaborative interventions

The primary purpose of these collaborative interventions is to contribute to the short, medium and long term management of water quality (specifically sulphate, linked to acidity and salinity) in the Loskop catchment, with a potential secondary consequence being the supply of treated water to local or regional demands. In this light, the critical issues around which there are opportunities for collaboration in the Witbank coalfields are:

- *Coherent catchment water and regional mining-environmental planning*: this should result in a joint regional mining plan (linked to a mine closure plan) in support of a catchment water resources management (and rehabilitation) plan that has formal acceptance by the mines, water managers and mineral resources regulators; this would require the establishment of these plans through existing statutory mechanisms or binding agreements.

- *Improved government and peer regulation*: consistent and coherent regulation of mine expansion, operation and rehabilitation will be required to effectively manage the mine water problem in the Witbank area, in line with the regional mining and catchment management plans, which will require strengthening of the existing capacity; this may also require the introduction of mechanisms for the mining industry to take greater responsibility for self and peer regulation.

- *Coordinated information sharing and aligned corporate governance*: new approaches and good practice in the development, operation and rehabilitation of mines to mitigate mine water impacts is being tested and implemented by different companies, but this needs to be shared and companies would jointly benefit from broad adherence to improving technologies; this would require a mechanism to disseminate information and promote good corporate governance.

- *Collective treatment and reuse or mine water*: development and operation of infrastructure to collect, treat and distribute mine water from more than one mine for reuse is potentially more cost effective than individual treatment, whether at a local or regional scale, and may provide sustainability beyond the operational period of individual mines; this requires effective mechanism/s to enable the financing and management of such schemes.

- *Collective mitigation or management of mine water*: implementation of good regional rehabilitation of mining and leveraging of land use opportunities in these areas requires collective action for passive treatment in line with a regional rehabilitation plan and provides an important option that may be financially sustainable in the long-term; this requires a mechanism to ensure adequate rehabilitation and redevelopment of land for other purposes.

- *Effective long-term liability provisioning for mine rehabilitation and water management*: the implementation of the preceding interventions requires (at least partial) funding from the mines collected during their operational period to ensure adequate rehabilitation and management after closure and this should be independently collected and invested to maintain the finance to cover liability; this requires a mechanism to collect, invest and disburse such funds.

These interventions need to be situated within the local catchment water quality management objectives, as well as the broader water supply system. The water quality goal would be to meet resource water quality objectives for the catchment, in the lowest cost, most institutionally viable, and financially sustainable manner possible. Water supply considerations need to consider local use requirements in the Witbank coalfields area, downstream catchment allocations in the Olifants River system, and regional demands in the inter-connected Upper Vaal system. This must all be assessed within the context of changing (over the next 50 years) economic and demographic conditions, water use requirements (from municipalities, mines, industry, agriculture and power stations), and climate change impacts on hydrological conditions (including mine water) and water demands.

Phase 2 needs to detail, evaluate and select the appropriate suite of interventions for the Witbank coalfields from the preceding groupings (noting that all are relevant in the long-term), possibly phasing these interventions according to priority. The specification of these interventions needs to distinguish the three periods related to operation phase, transition phase and longer-term steady-state phase of the Witbank coalfields. These interventions will be the focus of the business case, and must be compiled through active potential partner engagement.

Outcome 2: Institutional arrangements

The selected suite of interventions needs to be enabled through appropriate institutional mechanisms (and arrangements). From a SWPN EWWM perspective, a single area-catchment based coordination-implementation body should be explored. This may be supported by different internal business units, contracting of implementing agents and/or even the establishment of other collaborative bodies, as the means of actioning specific interventions. The implications for the institution between the three operational and post-operational phases of the Witbank coalfields will need to be assessed. From the preceding outcome description, this implies the regional body may have responsibility for:

- coordinating regional mine and water rehabilitation planning and ensuring cooperation between key partners, leading to the statutory or legal adoption of these plans;
- coordinating monitoring and information acquisition, together with dissemination and promotion of appropriate mining and governance practices by mines in accordance with the plans and through cooperation with the relevant regulators;
- developing and operating mine water treatment facilities and distribution to municipal, industrial or agricultural water users as water service provider through appropriate contractual arrangements;
- implementing mine rehabilitation and land redevelopment initiatives on behalf of mines in cooperation with the mines and relevant municipalities or other partners; and
- managing a dedicated mine water liability fund collected from operational mines according to an estimation of their long term water liability.

The institutional structure of such a body may include (i) a public institution, such as a water user association (depending upon the outcome of the water law review process); (ii) a special purpose vehicle established as a public-private partnership; (iii) a not for profit company or trust established by the mines; or (iv) a private company performing the relevant functions. The institutional, governance and contractual arrangements between this company and the principles (government or private sector-mines) will need to be clarified, together with the institutional, management and contractual arrangements between this institution, and other implementing agents or service providers.

For it to be effective, this entity will require all mines in the region to participate, so the legal implications and opportunities to ensure association through mining or water licenses must be explored and recommended. This highlights the importance of engagement and cooperation with Department of Mineral Resources and Department of Water Affairs, to ensure the government planning and regulatory functions are aligned to the objectives of coherent regional mining and water management. The business case needs to define the institutional and legal arrangements to enable the collaborative interventions.

Outcome 3: Funding mechanisms and arrangements

Once the extent of the liability for both state and operating mines are quantified, the funding requirements need to be fleshed out. There are a number of different aspects to funding the selected interventions and the institutional arrangements required to collaboratively implement these, including:

- funding the ongoing operating costs of the collaborative body (institution) and its core coordinating functions (planning, information, etc);

- financing the design and development of local or regional treatment and reuse infrastructure, as well as the ongoing operation and maintenance, both during the operational phase of the relevant mines and the post-operational phases;
- financing the rehabilitation and management of mining, together with the possible land redevelopment and transfer process.

The costs associated with each of these needs to be estimated, together with the appropriate sources of funding and the rules for apportioning the funding between the relevant parties. Central to this are the elements of current operational responsibility versus long-term post-operational liability, with the key consideration being the creation of a viable business model that can perform these functions as long as necessary during the three phases of operation, post-operation transition and long-term steady state. The implications for government liability around the defunct and abandoned mines must be addressed in this process. The possible sources and mechanisms for funding to be considered include:

- existing rehabilitation fund mechanisms, particularly if linked to the inclusion of mine water management in the EMP;
- additional dedicated statutory levies for mine water management (possibly including the muted environmental levy on AMD), either at a national or applied at a catchment scale, which would capture the balance sheet provisions and guarantees currently provided by some mines to cover their liabilities - requiring a Money Bill by the Minister of Finance;
- application of the waste discharge charge system to recover institutional collaboration and possibly a portion of the operational mine water mitigation or treatment costs, and possibly against the liability funds post-operation; or
- application of an association membership levy to mines as part of the established collaborative institutions, possibly distinguishing between general contributions and those associated with the treatment or mitigation of mine water.

Furthermore, the financing requirements and opportunities associated with the capital development of relevant interventions should be clarified and included in the business models. The business case should therefore outline the various options for funding, together with recommendations for funding the specific functions and interventions required for sustainable mine water management during the operational, transitional and steady-state phases of future Witbank coalfields. These funding mechanisms need to be evaluated and co-developed in consultation with the relevant mining companies, financial institutions and government departments.

Outcome 4: Enabling framework interventions

A number of broader policy and institutional issues need to be addressed to ensure the enabling framework is in place to facilitate the collaborative interventions, institutional arrangements and funding mechanisms outlined above. To be implementable, it is possible that the enabling framework focuses on the needs of this area alone, rather than attempting to restructure the entire enabling framework for South African mining and water management. The business case must clarify these requirements and propose actions required to achieve the necessary policy outcomes, including:

- ✓ any legal requirements for establishing the relevant regional collaborative institution, including possibly requiring mines in the area to join the association (through license conditions);
- ✓ the authorisation of water use and related licenses and contracts required for the treatment and reuse of mine water;

- ✓ mining, water and development authorisations required for the collaborative rehabilitation and re-development of mining areas;
- ✓ revision of the mine liability financing mechanisms (possibly for the mines in this area only), with the establishment of the appropriate legal or contractual mechanisms (possibly an endowment fund);
- ✓ linked to this may be revision of the closure requirements and liability for those mines that have made adequate provision into the liability financing mechanism; and
- ✓ strengthening of the regulatory capacity for mining and water use, through the relevant institutions operating in this region.

Detailed specification of the necessary changes would need to be included in the business case, after consultation with the relevant Departments' legal sections.

Further, five specific DWA driven processes are underway that may have bearing on the enabling framework for Phase 2, namely:

- Revision of the Raw Water Pricing Strategy and the way in which water use charges for water supply are estimated and applied;
- Implementation of the Waste Discharge Charge System and the way in which mine water discharge is levied to support improves management and mitigation of water quality impacts.
- The establishment of catchment management agencies (CMAs) as the regulator of water resources at a basin scale, in particular the Olifants CMA for Phase 2.
- The implementation of the Classification system, including the setting of Resource Quality Objectives as qualitative or quantitative water quality targets.
- The water policy and legislative review, addressing the future of water user associations amongst other issues.

This provides an opportunity to bring the mine water and partnership lens of Phase 2 to these processes, in order to ensure that possible management options or arrangements are not foreclosed.

Outcome 5: Lessons and opportunities for transfer of the approach

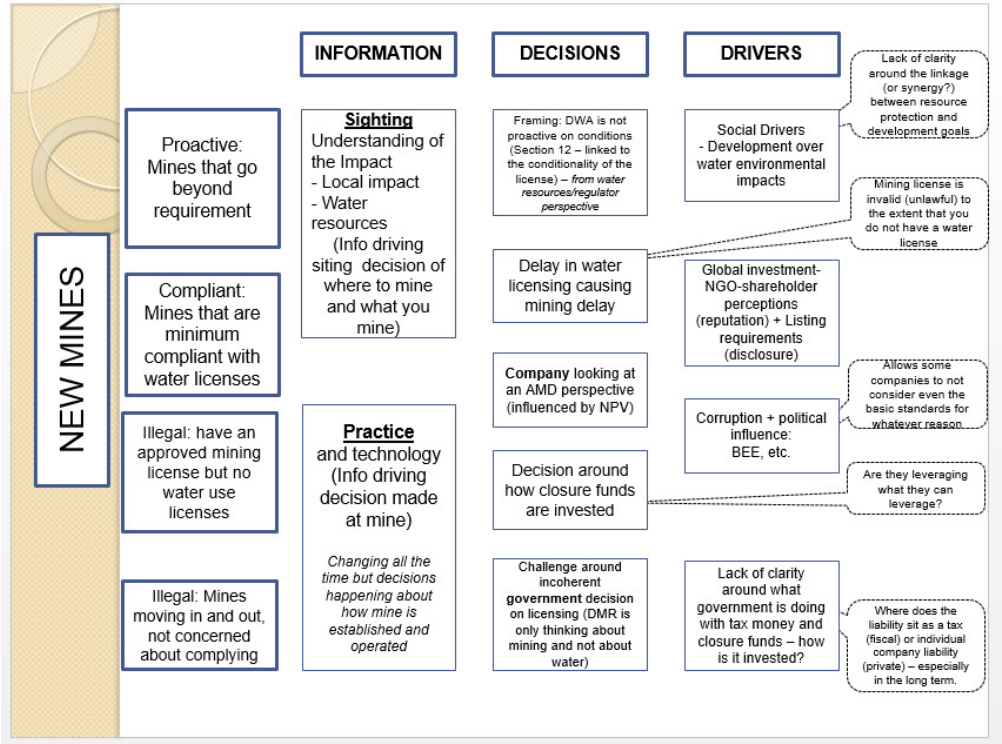
It is important that the "pilot" collaboration in the Witbank coalfields is informed by and supports the broader mining impacts on water resources in South Africa. To this end, lessons from the Witwatersrand should be captured in the definition of the interventions, institutions and funding in Phase 2, while the implications for other mining areas should be highlighted.

While not explicitly part of Phase 2, the preceding process would be significantly supported by a more national process driven by the relevant political and business leaders to engage the key broader political economic issues around the role of mining in the South African development landscape, corporate governance in the mining industry and the development of innovative partnerships between public and private sector built on trust.

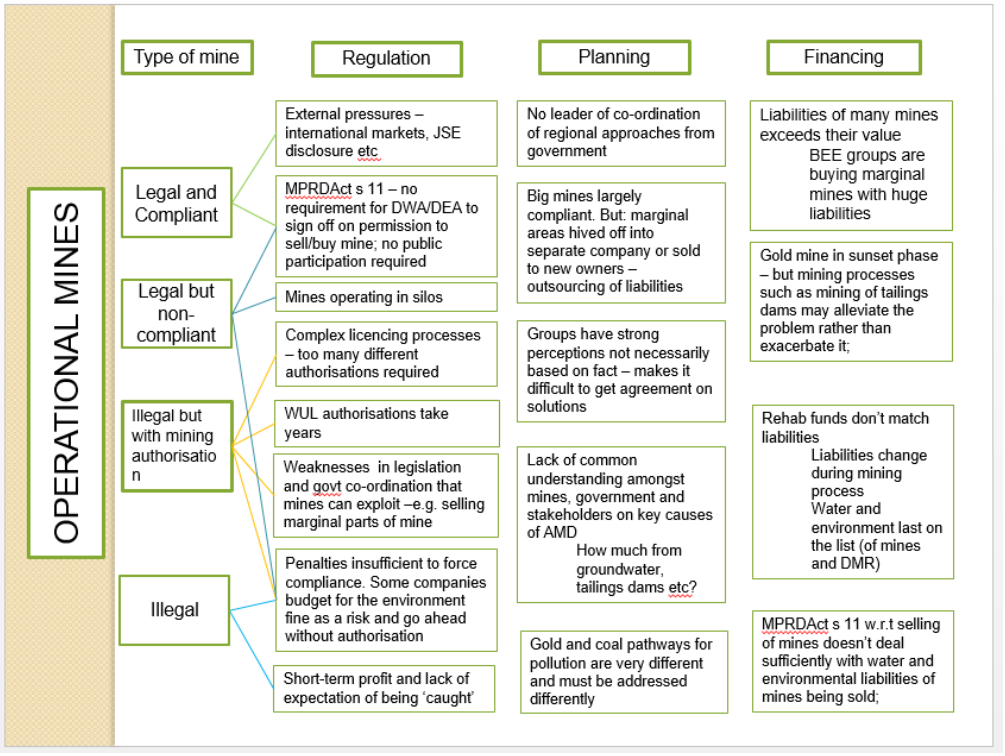
Appendices

Appendix A: Problems Trees / Causal Analysis

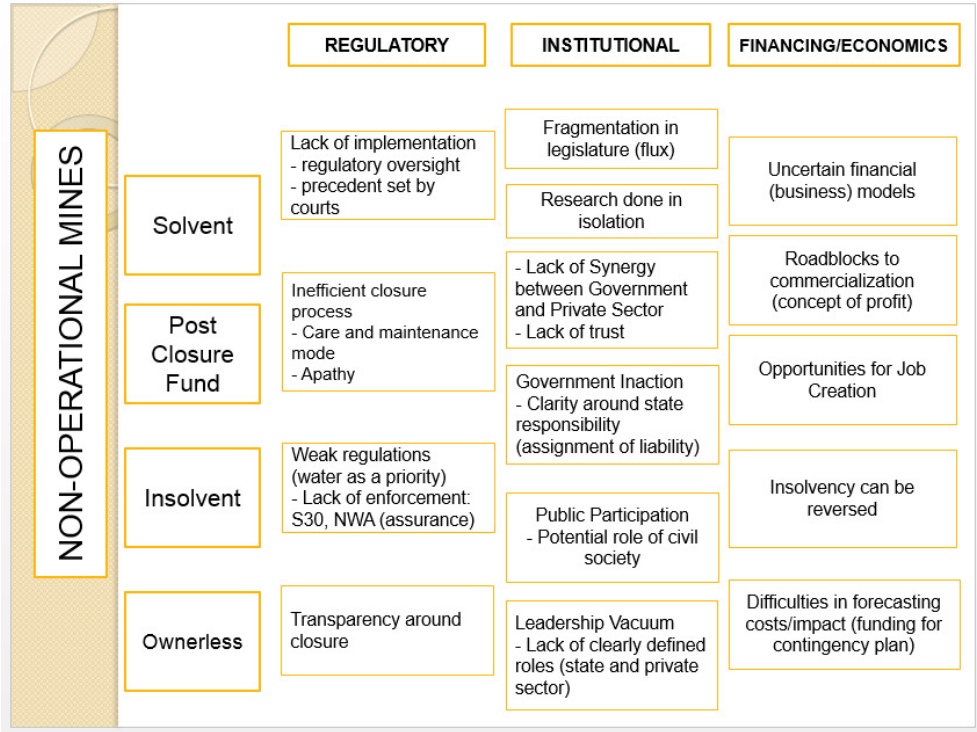
A.1 New Mines Problem Tree



A.2 Operational Mines Problem Tree



A.3 Non-operational Mines Problem Tree



Appendix B: Legal Framework for Mine Operations and Closure

B.1 Mining regulatory environment

The Constitution of the Republic of South Africa in particular the Bill of Rights, which enshrines fundamental rights to dignity, life, socioeconomic rights, the right to an environment no harmful to health and well-being and the right to sufficient water, dictates the parameters of all legislation, including legislation governing water and the environment. These rights and duties are realised, *inter alia*, through the Minerals and Petroleum Resources Development Act 28 of 2002(MPRDA), the National Water Act 36 of 1998 (NWA), and the National Environmental Management Act 107 of 1998 (NEMA). The use of water for mining and related activities is further governed through specific regulations published in terms of the NWA in terms of GN704 of 4 June 1999 (GN704).

Water management on mines and the regulation of environmental impacts is governed by the MPRDA, which is administered by the DMR. According to the MPRDA, the owner of a mine or the holder of a mining right is ultimately responsible for the negative environmental impacts arising from its mining operations. Accordingly, an applicant for a mining right is required to undertake an EIA and must compile an Environmental Management Programme (EMPr).[10] Such assessment must, where appropriate, include an analysis of the impacts relating to water management and pollution control at the proposed mining operations.[11] Similarly the MPRDA Regulations require that the acidification, salination and mineralisation of soils through seepage of polluted water and the irrigation of land with any water must take place within applicable legislative requirements *or* as approved in the EMPr (or in the case of prospecting, the environmental management plan).[12] Although this regulation suggests that there may be instances where the provisions of an EMPr could trump the requirements of other approvals or laws, the MPRDA regulations are clear that the NWA applies to water management and pollution control at all proposed or existing prospecting or mining operations and accordingly must be complied with in addition to the requirements of the EMPr.[13]

Lastly the MPRDA regulations also provide for detailed assessment of requirements and management measures for mining residue stockpiles and deposits, and prescribes certain requirements for the assessment of their impacts, characterisation, design and monitoring.[14] The extent of compliance with these requirements and considerations will thus need to be taken into account by the DMR, and other relevant commenting authorities, during the EIA and EMP approval stage. Whilst the final approval of the EMPr rests with the DMR, it may not approve an EMPr until such time as it has taken into consideration the comments of, *inter alia*, any state department charged with the administration of any law which relates to matters affecting the environment.[15] Accordingly the DWA will have a commenting role in the management of water at mines during this stage of the approval process.

In addition to the above, an applicant for a prospecting right, mining right or mining permit must, before the approval of the EMPr, make financial provision for the rehabilitation or management of

[10] Similar requirements apply to prospecting applicants who must draft an Environmental Management Plan.
[11] See Regulation 68 of GNR.527 of 23 April 2004: Mineral and Petroleum Resources Development Regulations (MPRDA Regulations)
[12] Regulation 70(6)
[13] Regulation 68(1) of the MPRDA Regulations.
[14] See Regulation 73
[15] The MPRDA Regulations provide a few limited opportunities for relevant state departments to comment on the EIA , for example by way of Regulation 49(3).

negative environmental impacts that will result from its operations.[16] This financial provision must be assessed annually. It is often the case that the assessments for the amount of financial provision required, do not make adequate provision for water treatment and management post closure, and instead nominal amounts are ascribed for "water management" without further specificity.

In order to ensure ongoing compliance with, *inter alia*, the water management undertakings and requirements of the EMPr, the holder of the mining right is required to undertake regular EMPr performance assessments (usually every 2 years), through which to evaluate the degree of compliance with the EMPr. These assessments are required to be submitted to the DMR, but there is no requirement to submit these to the DWA. Instead the water user will need to submit its own monitoring and auditing results to the DWA in terms of the conditions of its integrated water use licence. There is thus a significant degree of overlap between these monitoring and reporting requirements although in the case of reporting in terms of an integrated water use licence, this is likely to be substantially more detailed with regards to water management.

In addition to the MPRDA, the NWA requires that all identified water uses must be authorised and the list of specific water uses which must be identified is contained in Section 21. In order for an identified water use to be authorised it must either:

- fall within the thresholds of a General Authorisation,
- be listed in Schedule 1 (which lists minimal water uses);
- be a continuation of an existing lawful use; or
- be authorised by way of a water use licence.

In addition to the above, the Minister also is empowered to declare activities which have a known detrimental effect on water resources, as a controlled activity.[17] The declaration seeks to ensure that such activities are always regulated by the NWA regardless of whether the water uses associated with them trigger any other identified water uses. Once an activity has been declared as a controlled activity, it will need to be authorised by the NWA, and may be subject to specific requirements tailored to address the impacts to that controlled activity. To date, notwithstanding its known detrimental impact on water resources, mining activities and their impacts on water resources have not yet been declared a controlled activity. This may be a very useful mechanism to address AMD regulation.

In the case of a General Authorisation, the Minister has published a number of Government Notices which outline various thresholds applicable to certain water uses. If a water use falls within that threshold it may be undertaken without the need for further authorisation. It is often the case that the published General Authorisations are not applicable to Category A mines.[18] Accordingly unless the water use qualifies as a pre-existing lawful use, (i.e. a use which was lawfully undertaken two years prior to 1 October 1998), or was a minimal water use identified in Schedule 1, such use would require a water use licence in terms of the NWA.

The procedure for obtaining a water use licence usually requires the completion of an Environmental Impact Assessment (EIA), including public participation, although such a process is not mandatory in

[16] Section 41(1) of the MPRDA.
[17] In terms of section 37 of the NWA.
[18] A Category A mine includes any gold or coal mine, any mine with an extractive metallurgical process, including heap leaching or any mine where sulphate producing or acid generating material occurs.

terms of the NWA. To date there are no regulations prescribing how Integrated Water Use Licence applications should be made and mandatory requirements or procedural rules in that regard. Rather the application process is steered by a number of best practice guidelines issued by the DWA which do not have the force of law and therefore have no binding legal effect.

An application for a water use licence will also usually include the creation of an Integrated Waste and Water Management Plan (IWWMP). The IWWMP was originally designed to collate and rationalise information which was submitted as part of an Integrated Water Use Licence application, and now is also used to provide the DWA with focused and structured information to meet their general information needs and to articulate to the DWA and the water user, the measures which are necessary to ensure adequate water and waste management on an ongoing basis.[19]

It is often the case that if and when a water use licence for the mining activity is issued, that it will contain a requirement for either an IWWMP to be developed or for it to be updated in accordance with the requirements specified in the licence[20]. In addition the conditions of the licence will seek to regulate the ongoing management of water on the mine by imposing management practices, monitoring and reporting conditions and contaminant thresholds which are ideally to be tailored to the sensitivity of the water resource in question, the Resource Quality Objectives and reserve requirements, the anticipated impact of the mining activity and other considerations listed in Section 29 of the NWA. The DWA is also empowered to request security from the application for the protection of the water resource or property.[21] This empowering provision is similar to that enjoyed by the DMR when granting a mining right, but is rarely or inconsistently used by the DWA when issuing licences for mining activities.

In addition to the MPRDA and the NWA, NEMA also regulates water use impacts and management activities. There has been a longstanding legal debate as to whether the listed activities under the NEMA (as contained in GNR 544 to 546 of 18 June 2010) also apply to mining activities and accordingly whether an Environmental Authorisation in terms of section 24 NEMA is required for mining and related activities. The debate has arisen as a result of the fact that the listed activities specifically relevant to mining and prospecting have not yet come into force. That notwithstanding, commentators have argued that activities ancillary to mining, for example construction activities within 32m of a wetland, also require an Environmental Authorisation from the Department of Environmental Affairs or relevant provincial authority. This interpretation of the law provides a further avenue for regulatory oversight of water impacts and mining activities to the extent that the holder of such an authorisation will also need to comply with its conditions and report thereon to the Department of Environmental Affairs or relevant provincial authority as the case may be.

The issue of whether NEMA applies to mining and ancillary activities will soon be clarified once the provisions of Mineral and Petroleum Resources Development Amendment Act 49 of 2008[22] come into effect in December 2014. After this period, an Environmental Authorisation, will always be required for such listed activities notwithstanding the fact that they take place at mines.

[19] See Operational Guideline: Integrated Water and Waste Management Plan, DWA, February 2010.
[20] See section 29(1)(b)(iii)
[21] See Section 30 of the NWA.
[22] As read with the National Environmental Management Amendment Act 62 of 2008.

B.2 Mine closure requirements, liability and financing

Liability for water pollution caused by mining activities is regulated by a number of statutes including the NWA, NEMA and the MPRDA. The meaning and application of the statutes should be interpreted in terms of NEMA, which is the overarching environmental framework law in South Africa. Section 2(4)(p) of NEMA provides that the costs of remedying pollution, environmental degradation and its consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment. This represents the 'polluter pays' principle which is a fundamental tenet of environmental legislation in South Africa. This tenet is codified in environmental legislation along with a general statutory duty of care: every person in South Africa has a duty to protect the environment (Duty of Care). Accordingly, this principle must be considered in the context that the Duty of Care may give rise to different degrees of liability for entities or persons who are associated with or responsible for the water pollution in question.

In the context of the above, the MPRDA provides for a more limited form of liability than that of the NWA and NEMA, in that only the holder of a mineral right is held absolutely responsible for environmental liability. According to section 38, the holder of a mineral right must as far as practicable, rehabilitate the environment affected by mining operations to its natural or pre-determined state or to a land use that conforms to the generally accepted principles of sustainable development.[23] More importantly, section 38 of the MPRDA prescribes that the holder will be held liable for any environmental damage, pollution or ecological degradation as a result of his mining operations and which may occur inside and outside the boundaries of the area to which such mining right relates. Such liabilities would include water pollution arising from mining operations and would remain in extant until such time as a closure certificate is granted and all liabilities are transferred to the State.

In terms of section 41(2) of the MPRDA, if the holder of a mineral right fails to rehabilitate or manage, or is unable to undertake such rehabilitation or to manage any negative impact on the environment, then exclusion by the Minister of the financial provision made by the holder in terms of section 41(1) of the MPRDA is permitted. The Minister is also authorised, in terms of section 45 and 46 of the MPRDA, to direct the holder of a mineral right to take urgent remedial measures and if the holder fails to do so, to take the measures itself and then exercise a right of recourse against the holder. If the holder (or the holder of an old order right or the previous owner of works, as the case may be) or its successor-in-title has ceased to exist, has been liquidated or cannot be traced and the financial provision proves inadequate, then the measures have to be funded by money appropriated by Parliament for that purpose.

Section 43 of the MPRDA addresses the closure of mines and provides that the holder of a mineral right remains responsible for any environmental liability, pollution or ecological degradation, and the management thereof, until the Minister of Mineral Resources has issued a closure certificate to the holder. As part of a closure application the holder of a mining right may make application to the DMR to transfer its environmental liabilities and responsibilities to a qualified person. The Minister may not issue a closure certificate until the management of pollution to water resources, the pumping and treatment of extraneous water and compliance to the conditions of the environmental authorisation have been addressed. To date very few closure certificates have been issued. The Minister is thereafter required to return any financial provision which has been made by the mine but is entitled

[23] Section 38 of the MPRDA.

to retain any portion of the financial provision for latent and or residual environmental impacts which may become known in the future.

With regards to the NWA, the relevant section dealing with this liability and compliance with the Duty of Care is section 19. Section 19 of the NWA imposes a strict duty on owners of land, persons in control of such land or occupiers of such land, to ensure that if any activity has taken place on that land which has caused or is likely to cause water pollution, to take all reasonable measures to prevent the pollution from occurring, continuing or recurring. Primarily responsibility is thus placed upon owners, occupiers and controllers of land to take such measures. If these persons fail to take such measures, the DWA or relevant CMA may direct them to do so by way of a directive. Should the directive not be complied with the CMA or DWA may itself undertake rehabilitation measures and recover its costs from a range of responsible parties including which is not limited to owners or controllers of land. The DWA or CMA may also recover costs from a number of other parties including (but not limited to) persons responsible for the pollution and any person who may have benefited from the rehabilitation.

A failure to take reasonable measures or to comply with a directive is an offence under the NWA, which may result in a fine or imprisonment and may also result in director liability. Similarly a failure to comply with the conditions of a water use licence is an offence. The fines for such offences are significantly less than those which may be imposed for contraventions of similar environmental statutes, for example contraventions of the National Environmental Management: Waste Act 59 of 2008.[24] Instead the limit for fines in terms of the NWA is only R120 000 in a District Court or R600 000 in a Regional Court and/or imprisonment. There is thus an urgent need for the quantum of these fines to be increased to provide an adequate deterrent to potential offenders.

Furthermore, there are a number of possible legal hurdles related to the recovery of costs incurred by the DWA or relevant CMA in the remediation of water pollution, which are particularly relevant in the case of AMD. These include attributing liability in circumstances where the responsible mine is no longer in operation and has ceased to exist. Similarly proving causation and a failure to take "reasonable measures" can also be challenging, as can quantifying what are "reasonable" costs in the circumstances. Equally, existing case law provides an avenue to argue that until such time that section 19 is amended to apply retrospectively; it may only apply to water pollution which arose after the NWA came into effect in October 1998.[25] This has the potential to significantly circumscribe the effectiveness of section 19 of the NWA. That notwithstanding more recent case law suggests a judicial willingness to impose liability upon polluters of water who no longer held title to the land in question.[26] This suggests a willingness by the courts to adopt a purposive interpretation of the relevant provisions which may assist in their implementation.

Lastly, in terms of section 28(1) of NEMA, "any person" who causes, has caused or may cause significant pollution or degradation of the environment, is required to take reasonable measures to

[24] Which may attract fines as high as R10 million.

[25] *Bareki v Gencor*2006 (1) SA 432 (T). The reason for this restrictive interpretation of section 19 is because it places strict liability upon owners of land. There are counter arguments to be made, however, which would support an interpretation of section 19 so that it applies retrospectively in the context of the now retrospective section 28 of NEMA. .[25] A Schedule III offence will result in liability for the relevant company, including its employees, managers and directors if it is evident that no reasonable measures were implemented to prevent the contravention.

[26] See also *Harmony Gold Mining Company Limited v Regional Director Free State Department of Water Affairs and Forestry and Another* [2006] SCA 65 (RSA) where the court held that there was a clear causal and moral link between the directive and Harmony's pollution activities. This matter demonstrates the court's willingness to impose liability upon polluters notwithstanding the fact that the property in question had been sold by the entity which was the subject of the directive.

prevent such pollution or degradation from occurring, continuing or reoccurring, or insofar as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment. This section primarily applies to (but is not limited to) owners of land, persons in control of land or occupiers of the land. Like section 19 of the NWA, should such persons fail to comply with this duty then the Director-General of the Department of Environmental Affairs, or provincial head of department may issue a directive to them requiring them to undertake certain identified measures.

Section 28 has been amended to apply retrospectively and accordingly in the event that the land upon which water pollution occurs is sold, the previous owner may still be held liable in terms of NEMA, unless the recipient of the directive can demonstrate that at the time they owned the land they had undertaken reasonable measures to prevent, stop or minimise the pollution. Should the recipient of a directive fail to take reasonable measures the Director-General of the Department of Environmental Affairs, or provincial head of department may itself undertake such remedial measures and may also claim proportionally from any other person who benefited from the measures undertaken by the State as well as a number of identified parties who may be responsible for or who bore a legal duty in respect of the pollution. Like section 19 of the NWA this duty is not absolute and a recipient of a directive may defend it on the basis that reasonable measures were taken or that they were not wholly responsible for the pollution in question, alternatively that the pollution is not "significant".

As is evident from the above, there are a number of provisions which may be used by the State to impose liability for and seek recovery of costs in respect of water pollution and associated with mining activities. Certain of these remedies face a number of challenges in their implementation which are inherent to the nature of the pollution concerned and challenges in the implementation of environmental laws generally, or which arise from the manner in which these provisions are drafted and the duplication of functions. Similarly a lack of capacity to implement and adequate financial incentive to comply with the law, have also presented challenges in implementing these provisions. A thorough review of these laws together with the regulatory functions required for their implementation is likely to substantially assist in ameliorating some of these challenges.

B.3 Corporate accountability and information

Companies must often include provisions for rehabilitation or asset revaluation or depreciation relating to environmental issues in their annual financial statements. Many South African companies, especially the larger listed companies, also subscribe to the Global Reporting Initiative. South African Generally Accepted Accounting Principles (GAAP) incorporate international accounting standards, which also require disclosure of environmental obligations and other environmental issues. In terms of the Johannesburg Stock Exchange Listing Requirements, listed companies are contractually bound to adopt the King Code and Report on Governance in South Africa (King III). An annual integrated report is required in terms of King III that focuses on the impact of the organisation in its economic, social and environmental spheres, with an emphasis on sustainability reporting.

Appendix C: Review of Previous Options for Collaborative AMD Treatment

More than 100 years of gold mining by a succession of numerous mining companies created a region known as the (Western Basin). As the gold reserves gradually became depleted from successive mining operations, the mines started closing one by one and the focus shifted more to open-cast mining. During this time pumping of underground water only occurred from a single ventilation shaft in Randfontein. In 1998 pumping ceased and in 2002 AMD began to decant. In 2005 the DWA issued a number of directives in terms of the NWA which directed the relevant mines to undertake certain measures in respect of the AMD. Between 2005 and 2006, three section 21 companies were formed by these mines for the Central, Eastern and Western Basins in order to address AMD issues in the respective basins. Soon thereafter the Water Utilities Company ("**WUC**") was established by these three section 21 companies as a ring-fenced company to manage water on behalf of various mines in the area. The establishment of this entity was approved by the DWA and the WUC thereafter raised in excess of R60 million to execute various pilot plants, engineering designs and to undertake an EIA for a water treatment scheme to address AMD across the three basins.

In order to proceed with the proposal WUC requested the DWA to provide Rand Water with its approval to enter into an off-take agreement with WUC for the treated water. Approval from the DWA was however not forthcoming. The WUC continued with project planning, however, on the strength of the support of the Government Task Team for AMD as well as the Chamber of Mines.

In the second half of 2009, the WUC presented a detailed proposal to the DWA in respect of its intentions to develop a water treatment scheme for the AMD issues presently detected in the Witwatersrand, which included a proposal for an interim and a long term solution. This proposal was updated and resubmitted in 2010 in order to address certain concerns harboured by the DWA.

In 2010, however, the DWA then made a public statement that "One of the main reasons why we are not getting the WUC project off the ground is related to an off-take agreement with Rand Water. WUC has asked for support from the department to finalise an off-take agreement with Rand Water. However, the department cannot force Rand Water to buy water from WUC, because we would be expected to subsidise such an agreement. We cannot take taxpayers money, subsidise the agreement and then make a profit from it..." The DWA then advised WUC in 2011 that it did not support the Industry Proposal, and that it intended to implement the recommendations for treatment and action which were contained in the Report drafted by the Inter Ministerial Committee on AMD. The state has since pursued the implementation of this report and the measures proposed are currently being implemented by the Trans Caledon Tunnel Authority.

The delay in the approval of and ultimately the rejection of the WUC proposal is unfortunate in view of the considerable delays, expenses and increase in environmental risk it precipitated. Furthermore, there is good reason to suggest that a public and private partnership would have been beneficial and appropriate in a South African context given the WUC's willingness to address the challenge. Current international practice and the success thereof demonstrates that collaborative plans and state and private partnerships are considered as good industry practice with regards the treatment of AMD. Similarly it suggests that there is good precedent for the State to assume liabilities for AMD in instances where mines have been abandoned or are "ownerless". Examples of such partnerships or collaborative efforts are outlined below:

Canada

The legacy of abandoned mines and the rehabilitation of the environmental impacts of such mines, remains a complex challenge in Canada for governments, the mining industry and communities.[27] To address this issue the State has pursued partnerships with local industries, similar to that proposed in the Industry Proposal.

In Canada, orphaned or abandoned mine sites are generally defined as closed mines whose ownership has reverted to the Crown, either because the owner has retired from business or, as is the case with some historic properties, because no owner can be found. [28] They are also described as mine sites where the owner has ceased or indefinitely suspended advanced exploration, mining, or mine production without rehabilitating the site. In order to address abandoned mines as well as new mining operations which have taken place upon such mines, or mines where the mine is still in existence but unable to fund the full cost of remediation, the State has pursued the following four types of collaborative measures:

- First, there are federal-provincial collaborations. One example is the Canada-Ontario agreement respecting abandoned uranium mine and mill tailings, under which each government agreed to cover 50% of perpetual care costs where a producer or owner is unable to pay for clean-up due to bankruptcy, insolvency, or emergency circumstances.[29]
- Second, there are federal-territorial collaborations. An example is the Canada-Yukon DTA, under which the State is responsible for the remediation of environmental impacts associated with activities that occurred on an abandoned mine site prior to 1 April 2003. In turn, the Yukon is responsible for the remediation of impacts associated with permits or authorizations issued by that government to mining operations after this date.
- Third, there are federal-industry collaborations. One example is the federal mine site reclamation policy for the Northwest Territories (and Nunavut). In terms of this policy if a mine became insolvent and the trustee abandoned the mine because of high unsecured environmental liabilities, the federal government will enter into transactions with a purchaser of such an abandoned mine under certain conditions.[30]
- Fourth, there are provincial-industry collaborations.

The first two types of collaborations noted above (federal-provincial, federal-territorial) are arrangements wherein the full cost of environmental remediation measures is paid for with public funds. The third and fourth types of collaboration noted above (federal-industry, provincial-industry) have the potential to alleviate some of the government's financial burden. The public purse will fund only part of the clean-up costs and the availability of a broader base of funds can accelerate the response to the problem.

---

[27] Government of Canada, *Sustainable Development: A Canadian Perspective* (Ottawa: Canada, 2002) at 72-73, 78 (national assessment report prepared for World Summit in Johannesburg, South Africa).

[28] See generally Castrilli "Wanted: A Legal Regime to Clean Up Orphaned /Abandoned Mines in Canada" JSDLP – RDPDD Volume 6: Issue 2 (2007) 111 .

[29] This example and those following are all *directly* drawn from Castrilli (supra).

[30] These conditions include the following: the purchaser would have limited liability for the existing environmental condition of the property; a portion of the economic value of the production from the mine would be attributed to a fund for the remediation of the existing liabilities at the site; and the purchaser would remain fully liable for the remediation costs of any environmental impact resulting from its own operations at the site.

These examples thus demonstrate common practice in the face of extensive, diffuse, co-mingled and "ownerless" pollution, and the State's role in respect thereto.

*The United States of America (**USA**)*

In the USA, whilst partnerships with industry are less common, the State's role in accepting the costs for ownerless or abandoned pollution is well developed. In this regard the Comprehensive Environmental Response Compensation and Liability Act 42 U.S.C. § 9601 1980 (CERCLA) serves as perhaps the most powerful legal mechanism that federal and state regulators can use to clean up releases to the environment from past mining activities.[31] CERCLA, amongst other things, makes the current property owner liable for such releases, whether or not the property owner caused the release. It relates only to "hazardous substances "found on such properties. It uses funds from the State SuperFund (as funded by a tax) to pay for such remedial activities. Once a site is placed on the National Priority List, it then is eligible to be remediated through SuperFund taxes. The SuperFund may then reclaim such costs from "Potentially Responsible Persons" who are possible polluters who may eventually be held liable for the contamination or misuse of a particular property or resource. Examples of the State instituting action under CERCLA include the Iron Mountain Rehabilitation where both the State and Potentially Responsible Persons were contributing towards the costs of remedial measures.

In addition to CERCLA, the Surface Mining Control and Reclamation Act of 1977 (SMRCA) established the national Abandoned Mine Land Reclamation Programme under the Office of Surface Mining Reclamation and Enforcement (OSMRE) U.S. Department of the Interior. The programme was initially developed to reclaim land and water resources adversely affected by past coal mining and left abandoned or inadequately restored, but now also includes abandoned hard-rock mines in certain instances. The SMCRA established a trust to pay for the reclamation of abandoned coal mines, funded from a fee on active coal mines on each tonne of coal produced in the US.[32] Once the national program had been established, Congress authorized states and tribes to implement their own programs. The programs are funded through grants from OSMRE, which receives funding from the AML Fund.

The practice in the USA suggests that the State plays an important role in funding related rehabilitation where mines are "ownerless" or abandoned. Whilst CERCLA provides for the opportunity to seek the repayment of costs from Potentially Responsible Parties, the State's capital contribution is nevertheless still significant and it is implemented in a manner which recognises that liability needs to be apportioned between the relevant parties responsible for causing it.

Australia

In Australia, historic mining sites which were closed without adequate rehabilitation present a potentially large liability for governments.[33] Governments have accepted responsibility for historic sites where mining ceased before current environmental regulations came into force. They also can become responsible for remediation of sites where it is not possible to assign costs to the original site owner, for example, because of lack of financial resources, or that company no longer exists.[34]

[31] See generally Wernstedt and Hersh "Abandoned Hardrock mines in the United States: Escape from a Regulatory Impasse?" *William and Mary Policy Review* Vol 1:25.
[32] State Department of the Interior, Office of Surface Mining Reclamation and Enforcement Annual Report 20081415 (2008)).
[33] Harris at 39
[34] Ibid at 39-40.

In December 2010 a *Strategic Framework for managing Abandoned Mines in the Minerals Industry'* (MCMPR/MCA) was finalised. This framework highlights the need for partnerships in the management of abandoned mines, as they enhance the "value for money" on such projects. The proposed funding mechanism for such remedial activities is suggested to be through direct government funding, offset arrangements and partnerships. The MCMPR/MCA emphasises the benefits of partnership which in the Australian context have proven to be successful in improving the quality of rehabilitation projects, whilst allowing interested stakeholders to be directly involved in the rehabilitation.

One example of such success is the Savage River Rehabilitation Project. This project concerned the rehabilitation activities related to the Savage River Mine which originally operated as an open cut magnetite mine from 1966 until 1996, resulting in sizeable AMD impacts. Before the mine was re-opened in November 1997, the Tasmanian Government developed and implemented an agreement with the new owners. Funds for the remediation were provided by both the purchase money and the closure funds left by the original owners. Because these funds were significantly less than what was required to remediate, the Tasmanian Government and the new owners initiated and implemented a cooperative management and remediation regime that allowed for mutual benefit.[35] The agreement permitted the mine owners to undertake remediation contracts for the Crown to "work off' the purchase price. The statute which was enacted by the government to allow for the remediation provided the mine owners with indemnity against pollution caused by previous operations both existing and that which may occur in the future.[36] The partnership is producing long term dividends and aquatic life has improved significantly. This agreement and several others of its kind have proven to be successful in cases where mining takes place on previously mined areas with existing pollution.

[35] MCMPR/MCA, 2010

[36] Where pollution is caused or might be caused by previous operations and this may be impacting on Grange's operations or discharges, Grange is indemnified against that emission and the state cannot set emission limits. Grange is however required to operate to best practice environmental management.