THE IMPLEMENTATION OF THE RECENTLY DEVELOPED BEST PRACTICE GUIDELINES FOR WATER RESOURCE PROTECTION IN THE SOUTH AFRICAN MINING INDUSTRY

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ABSTRACT

The Department of Water Affairs and Forestry in South Africa has recently completed the development of a series of 15 Best Practice Guidelines for Water Resource Protection in the South African Mining Industry. These guidelines are based upon the water resource protection and waste management hierarchy and the concept of Integrated Water Resource Management (IWRM).

These Best Practice Guidelines are to provide guidance and are not directly enforceable on the mining industry. This paper looks at the different opportunities for the implementation of these guidelines for new and existing mining operations.

The implementation of the Hierarchy Series of Best Practice Guidelines will also assist mines to address the root cause of many of their water related problems, as it focuses on aspects such as the prevention of pollution, the reuse and recycling, and the treatment of mine water.

The existing legal framework guiding the use of water for mining and related activities in South Africa is contained in the Government Notice 704 of 4 June 1999. These regulations specify certain requirements, for example that the person in control of a mine must ensure that water used in any process at a mine is recycled as far as practicable. The regulations stipulate what is required from a mine, but provide no guidance on how it should be achieved. The implementation of the Best Practice Guidelines will assist mines to meet the requirements of the regulations, as they answer the question of how to achieve the requirements of these regulations.

The implementation of the Best Practice Guideline G4: Impact Prediction and Best Practice Guideline G5: Water Management Aspects for Mine Closure will enable mines in South Africa to follow a structured process to determine whether the impact of their mine operation or planned activity is acceptable and which water related aspects must be addressed to get mine closure and also how to address them.

The implementation of the Best Practice Guidelines for Water Resource Protection in The South African Mining Industry will greatly assist with water resource management in South Africa, as it forms a well structured, broad basis for managing water issues on any mine and gives the mines using them, the assurance that they are complying with the regulator's view of best practice.

1. BACKGROUND TO THE DEVELOPMENT OF THE BEST PRACTICE GUIDELINES

The former Department of Water Affairs and Forestry (DWAF), now known as the Department of Water Affairs (DWA) initiated a project aimed at the development of a series of Best Practice Guidelines (BPGs) for Water Resource Protection in the South African Mining Industry in 1999.

The Department appointed a lead consultant to manage the project and to facilitate the development of the guidelines in a consistent manner.

A standard approach was followed in the development of all the guidelines. For each of the BPGs the lead consultant appointed technical specialists on the subject of the guideline to assist with the review of that specific guideline. Two specialist workshops and one stakeholder workshops were held to facilitate the drafting of each guideline document and to afford the mining industry, officials from DWA and other government departments as well as other interested parties the opportunity to review and give input on the draft guideline documents.

The following three series of Best Practice Guidelines were developed:

- A Hierarchy series based upon the water resource protection and waste management hierarchy;
- A General series of guidelines for general water management strategies, techniques and tools; and
- An Activity series for specific mining related activities.

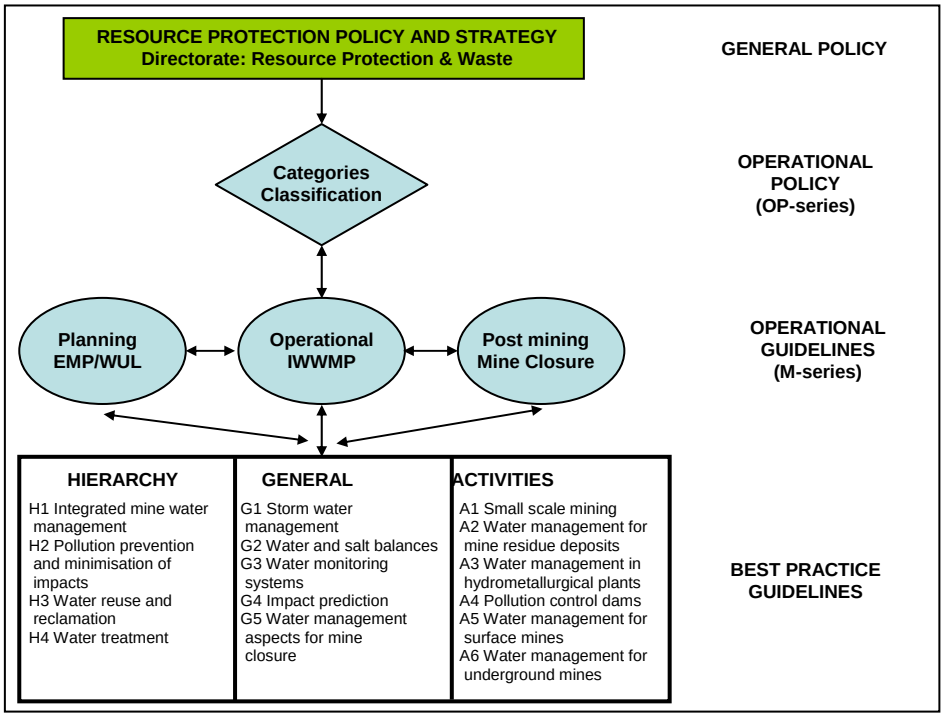
The documentation describing **Water Resource Protection and Waste Management** in South Africa is being developed at a number of different levels, as described and illustrated in the schematic diagram shown below.

The overall Resource Protection and Waste Management Policy sets out the interpretation of policy and legal principles as well as functional and organisational arrangements for resource protection and waste management in South Africa.

Operational policies describe the rules applicable to different categories and aspects relating to waste discharge and disposal activities. Such activities from the mining sector is categorised and classified based on their potential risks to the water environment.

Operational Guidelines contain the requirements for specific documents e.g. licence application reports.

Best Practice Guidelines (BPG's) define and document best practices for water and waste management.



The DWAF has developed a series of Best Practice Guidelines (BPGs) for mines in line with International Principles and Approaches towards sustainability. The series of BPGs have been grouped as outlined below:

Best Practice Guidelines dealing with aspects of DWA's water management **HIERARCHY** are prefaced with the letter **H**. The topics that are covered in these guidelines include:

- H1. Integrated mine water management
- H2. Pollution prevention and minimisation of impacts
- H3. Water reuse and reclamation
- H4. Water treatment

Best Practice Guidelines dealing with **GENERAL** water management strategies, techniques and tools, which could be applied cross-sectoral and always prefaced by the letter **G**. The topics that are covered in these guidelines include:

- G1. Storm water management
- G2. Water and salt balances
- G3. Water monitoring systems
- G4. Impact prediction
- G5. Water management aspects for mine closure

Best Practice Guidelines dealing with specific mining **ACTIVITIES** or **ASPECTS** and always prefaced by the letter **A**. These guidelines address the prevention and management of impacts from:

- A1. Small-scale mining
- A2. Water Management for Mine Residue Deposits
- A3. Water Management in Hydro-metallurgical Plants
- A4. Pollution Control Dams
- A5. Water Management for Surface Mines
- A6. Water Management for Underground Mines

The BPGs focus on the implementation of integrated water and waste management at mines and the DWA Resource Protection and Waste Management hierarchy of decision-taking. This hierarchy is based on the precautionary approach and sets the following order of priority for mine water and waste management decisions and/or actions:

Prevent or minimise pollution/contamination of water used by implementing necessary management measures or strategies

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Reuse or Reclaim contaminated water in cases where complete pollution prevention was not possible

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Treat water that cannot be reused or reclaimed

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Reuse treated water

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Discharge or Disposal of excess Water

2. LEGAL FRAMEWORK RELEVANT TO THE BEST PRACTICE GUIDELINES

South Africa has a suite of environmental related legislation. The National Environmental Management Act, 1989 (Act 107 of 1989) provides the overarching legislative framework for regulating environmental impacts. However, the legislation has been constituted in such a manner that mining activities are authorised and regulated by the Department of Mineral Resources in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA).

The DWA has a mandate to protect, use, develop, conserve, manage and control the water resources of South Africa on a sustainable basis, and therefore it also manages the water related aspects of mining activities. The legislative tools utilised by the DWA is the National Water Act, 1998 (Act 36 of 1998) (NWA) and the rregulations published in terms of the NWA.

In South Africa the only regulations relevant to the mining industry are the *Regulations on use of water for mining and related activities aimed at the protection of water resources* published in terms of the NWA in the Government Notice 704 of 4 June 1999, known as GN704. These regulations, with which any mine must comply include,inter alia, the following:

- No person in control of a mine or activity may locate any residue deposit, dam, reservoir, together with any associated structure within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary;
- No person in control of a mine or activity may place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation;
- No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource;
- Every person in control of a mine or activity must confine any unpolluted water to a clean water system, away from any dirty area;
- Every person in control of a mine must design, construct, maintain and operate any clean or dirty water system at the mine or activity so that it is not likely to spill into any dirty water system more than once in 50 years;
- Every person in control of a mine must collect the water arising within any dirty area, including water seeping from mining operations, outcrops or any other activity, into a dirty water system;
- Every person in control of a mine or activity must take reasonable measures to prevent water containing waste or any substance which causes or is likely to cause pollution of a water resource from entering any water resource, either by natural flow or by seepage, and must retain or collect such substance or water containing waste for use, re-use, evaporation or for purification and disposal in terms of the NWA; and
- Every person in control of a mine or activity must take reasonable measures to ensure that water used in any process at a mine or activity is recycled as far as practicable, and any facility, sump, pumping installation, catchment dam or other impoundment used for recycling water, is of adequate design and capacity to prevent the spillage, seepage or release of water containing waste at any time.

The regulations in GN704 stipulate specifically “what” is required from a mine, but provide no guidance on “how” it should be achieved. Due to the lack of guidance on the required measures to comply with GN704 the mining industry depended on consultants and specialists to guide them. These interpretations were subject to personal interpretation of government officials, consultants and people in the mining industry.

The newly developed series of BPGs now provide structured guidance to assist the mining industry with the implementation of the measures which will enable them to become legally compliant to GN704. The implementation of the best practice guidelines will actually assist the mines to meet the requirements of the regulations, as they answer the question of "how" to achieve the requirements set by the regulations.

The exact status and position of the BPGs in the legislative framework regulating the mining industry is very important. It must be recognised that in South Africa the Department of Minerals Resources co-ordinates environmental management within the mining industry. However, the DWA also executes its mandate to manage, conserve and protect the water resources in the country in many ways, of which the following are relevant to the mining industry, namely:

- Commenting on any application for granting of prospecting or mining rights as provided for in terms of the MPRDA within the spirit of co-operative governance
- Issuing water use licences to authorise the use of water on a mine.

3. APPROACH TOWARDS THE IMPLEMENTATION OF THE BEST PRACTICE GUIDELINES

The BPGs were primarily developed as a tool to assist DWA officials to execute their mandate. The BPGs are only guidelines with no legal enforceability. The focus of the BPG is on water management of mining activities. The most important role-player in the implementation of the BPGs is the DWA. The Department has the responsibility to train its officials on the content and the application of the guidelines.

The mining industry is regarded as the secondary user as these guidelines assist the industry in negotiations with the Department and with the compilation of Integrated Water and Waste Management Plans (IWWMPs) and Integrated Water Use Licence Applications (IWULAs).

The BPGs were developed for high impact mines associated with reactive minerals, such as the coal, gold and base metal mines in South Africa. However, the intention was that the principles and approaches documented in the BPGs would be applicable to any type of mining operation regardless of whether it is in the exploration, planning, operational, and decommissioning or closure phase. The BPGs can be most optimally applied to new mining ventures that are still in the planning phase, as the design, location of facilities and the mining plan can still be influenced by the implementation of best practice.

It is important for a mine to communicate and consult with the DWA in order to confirm the type of mining operation, as all mines should be classified by the regional office of DWA according to their potential impact on water resources. In South Africa a classification system for the mines is documented in the DWA, No. M 5.0, 1998. Operational Guideline for the DWAF to assist the DME with Environmental Management Programmes in terms of the Minerals Act.

The Department puts more effort, energy and resources into the management of the impact of mines with a higher potential impact on water resources.

The following categories have been defined:

A: Mines with a potentially significant and/or permanent impact on water quality. The following mines must always be classified as Category A mines:
- All gold and coal mines, irrespective of size.
- Any mine with any kind of extractive metallurgical process, including heap leaching. (This will include most other precious and base metal mines.)
- Any mine where pyrites occur in the mineral deposit.

B: Mines with potentially significant and/or permanent impact only on other aspects of the water environment, for example yield / availability of water, dynamics of the river, riparian rights, etc.

C: All other mines. These can be divided further into the following sub-sections:
- Big mines with no significant impact on the water environment, thus where ideal water quality and quantity objectives may be set. (Zero impact committed to.)
- Small/Low impact mines/prospecting operations

The next step for a mine would be to consider the need for the implementation of the BPGs. This need can originate from an internal driving force within a mining company, such as a specific management commitment towards the implementation of an Environmental Management System (EMS) which requires continual improvement. The BPGs would then provide guidance on the setting of the objectives and defining specific measures which will demonstrate the required continual improvement. It is very important for the management of any mine to make a decision regarding the extent to which it will implement the BPGs, as it can have significant financial implications for the company.

The need for the implementation of the BPGs at a mine can also originate from an external source. Such an external source could be in the form of a letter from the DWA, water use licence conditions, or alternatively a directive from the DWA which forces a mine to take specific action and implement a particular BPG.

Although the BPGs should be used as a complete and integrated set of documents, which are extensively cross-referenced and which together, address all aspects of integrated mine water management, not all of the guidelines will be applicable to each and every mining operation. Mines follow a very distinct life cycle from exploration, feasibility, planning, construction, operation, decommissioning through to closure and post-closure aftercare.

The different BPGs that have been produced all have particular applications to different aspects of the mining process and to different components of the water management system at the mines.

4. OPPORTUNITIES FOR THE IMPLEMENTATION OF THE BEST PRACTICE GUIDELINES

Water Use Licensing and Compilation of Integrated Water and Waste Management Plans

Mining activities are associated with water uses, such as abstraction and storage of water, disposing of waste in a manner which may detrimentally impact on a water resource, discharging water containing waste and altering the beds, banks and characteristics of a water course. A mine requires a water use authorisation for its water uses, and this may constitute a water use licence application. Such an application has to be supported by a technical supporting document, namely an IWWMP.

A mine has to demonstrate compliance with the water management decision-taking hierarchy. This is an essential requirement as the water management decision-taking hierarchy forms the foundation of DWA's approach to mine water management. It is essential to be able to demonstrate that pollution prevention, water reuse / reclamation and water treatment principles have been considered and optimally applied before mine water discharge is authorised.

An existing mine would implement and document the following in the IWWMP:

- The outcome of the pollution prevention assessment procedure stipulated in Best Practice Guideline H2: Pollution Prevention and Minimization of Impacts as part of its IWWMP.
- A mine water reuse and reclamation plan clearly indicating to DWA that water reuse and reclamation have been applied effectively using BPG H3: Water Reuse and Reclamation;
- A storm water management Plan developed in accordance with the procedure contained in the Best Practice Guideline No. G1 Storm Water Management.
- A water and salt balance developed in accordance with the procedure stipulated in Best Practice Guideline G1: Storm Water Management.
- A water monitoring programme developed in accordance with the Best Practice Guideline No. G3. Water Monitoring Systems.

BPG H4: Water Treatment clearly describes the technical methodology that should be applied by a mine to identify the constituents of concern that may require mine water to be treated to enable sustainable reuse or discharge in accordance with an approved water use licence, catchment management objectives etc. It also describes a methodology that, when applied, will enable the identification of suitable types of water treatment technology for the removal of constituents of concern and safe disposal of residues thereafter. The relevant sections of an IWWMP that deals with water treatment can be compiled in accordance with this guideline.

Impact Prediction

Government has the responsibility to consider applications for mining permits and water use licence applications, and make decisions regarding the authorisation of these mining related activities based upon the impact they have on the receiving environment. Government therefore poses a range of questions to a mining applicant such as

- How would proposed alternative mining techniques and layouts affect the potential impact on the identified receptor water resource (surface and groundwater balance and quality)?
- What is the long-term impact of all waste residue deposits on the water resource (surface and groundwater) in terms of volumes and quality of drainage over the life of mine and post-closure?
- What final rehabilitation should be undertaken for the different waste residue deposits in order to meet long-term risk management objectives for the water resource?
- Will the mine void decant after mine closure? If yes, where, when, how much and at what quality over time?
- What will the long-term impact be at the critical receptor for the contaminants of concern?
- What additional water management or treatment measures need to be instituted to reduce the contaminant loads from the various source terms or to intercept the pathways in order to ensure that the critical receptor is not adversely impacted?

If the abovementioned questions cannot be addressed satisfactorily government cannot execute its mandate to protect the water resource and then the required water use authorizations may not granted.

Best Practice Guideline G4: Impact Prediction, details a specific and very rigorous impact prediction methodology and process which a mine can follow to answer these questions and it can therefore facilitate a decision from government. This procedure allows for independent review as it is recognized that the DWA does not have the necessary skills to evaluate detailed geochemical impact prediction reports.

Mine Closure

In order for a mine to obtain a closure certificate from the Department of Mineral Resources (DMR), the DWA must confirm that the potential pollution of the water resources has been addressed satisfactorily. Due to the fact that there was no guideline to assist the authorities in making a decision, a situation developed where mine closure was perceived to be unattainable or impossible.

With the publication of Best Practice Guideline G5: Water Management Aspects for Mine Closure, a mine closure planning process was developed from a water resource management perspective. This process will guide the mine as well as the DWAF official on how mine closure application should be dealt with .

A single environmental risk assessment process, supported by DWA and DMR, was also formulated and published. It is foreseen that this BPG will facilitate the decision on the granting of mine closure certificates, as the water management aspects remains the biggest challenge in terms of mine closure.

5. CHALLENGES FACING THE IMPLEMENTATION OF THE BEST PRACTICE GUIDELINES

The current legal status of the BPGs is the biggest challenge for the effective implementation of the BPGs. These documents are merely guidelines and have no legal enforceability.

The implementation of the BPGs should be guided and informed by means of an Operational Guideline and an Operational Policy. This operational guideline would provide clear guidance to the officials in the DWA, as well as to the mining industry as to how, when and where the BPGs should be implemented. The current series of Operational Guidelines, titled the M-series, was developed in the period 1994 and 1998 need to be updated as a matter of urgency to align them with the NWA and developments in terms of integrated water resource management.

Without the required Operational Guidelines, the implementation of the BPGs by DWA officials would not be consistent throughout South Africa. A situation could arise where the water resource management requirements for mines differ between Water Management Areas. It may even vary dependant on the personal interpretation of the requirements relating to the implementation of the BPGs. This can certainly have an impact on big mining companies operating in more than one province or Water Management Area, as the “playing field” would be regarded as uneven.

In the mean time and in the absence of the required Operational Guidelines or Policy the DWA sets water use licence conditions which require the implementation of specific BPGs. This is an indirect way of enforcing the guidelines. This approach is similar to the application or implementation of the former Department of Water Affairs and Forestry, Second Edition 1998, Waste Management Series, generically referred to as the Minimum Requirements

Many of the aspects identified in the BPGs, such as modelling (e.g. hydrology, geohydrology, geochemistry) or design activities need to be undertaken by persons with the suitable technical qualifications and expertise with access to suitable resources. The use of technical personnel who are not suitable qualified poses a threat to the effective implementation of the BPGs. This risk applies to both the mine who may make decisions based upon incorrect information, as well as to the regulators.

As the BPGs have been developed for the use of water resource managers in the DWA, it is also very important that the Departmental personnel must be trained on a continuous basis on the content, and application of the BPGs. This will enable the officials in the department to evaluate the IWWMPs and IWULA submitted by the mines.

From a mining industry perspective, a total company and management commitment is fundamental to ensuring effective implementation of the BPGs and to prevent and/or minimise existing and potential environmental impacts. A mining company must clearly state its approach towards the implementation of the BPGs in the context of integrated water resource management.

6. CONCLUSIONS

There are two role-players involved in the implementation of the Best Practice Guidelines, namely the mining industry and the regulator, namely the Department of Water Affairs. The implementation of the recently developed Best Practice Guidelines poses a challenge to both parties.

The Department requires a structured approach to facilitate the effective, uniform implementation of the guidelines by all government officials. This implementation should be supported by operational guidelines or policies. Ongoing training and capacity building is also required to facilitate decision making by the regulator on the authorisation of water uses at mines.

The mining industry needs a firm management commitment, supported by adequate financial provision, for the implementation of best practice on the mines. The implementation of certain specific BPGs on water and salt balances, water reuse and reclamation and storm water management will facilitate compliance with GN704 as they provide guidance on “how” to implement the necessary measures.

The implementation of the hierarchy series of BPGs will ensure that the pollution problems are addressed at source and that through water reuse and reclamation, South Africa’s scarce water resource can be conserved.

The implementation of the general series of BPGs will facilitate the effective management of water on site through the development of proper water and salt balances, the implementation of the required storm water management measures, the accurate determination of the impact from mining activities and effective monitoring.

The implementation of the activity series of BPGs will support the mines in ensuring that development of pollution control dams, mine residue deposits as well as surface and underground mining operations take into consideration the receiving water resource, and will improve the understanding of the regulators of the impact which these activities have on the water resource.

7. REFERENCING

Government Gazette No. 20119, Vol .408, (1999) Government Notice No. 704; Regulations on use of water for mining and related activities aimed at the protection of water resources

Department of Water Affairs and Forestry, 2008. Best Practice Guideline H1: Integrated Mine Water Management.

Department of Water Affairs and Forestry, 2007. Best Practice Guideline H2: Pollution Prevention and Minimization of Impacts.

Department of Water Affairs and Forestry, 2006. Best Practice Guideline No. H3 Water Reuse and Reclamation.

Department of Water Affairs and Forestry, 2007. Best Practice Guideline No. H4: Water Treatment.

Department of Water Affairs and Forestry, 2006. Best Practice Guideline No. G1 Storm Water Management.

Department of Water Affairs and Forestry, 2006. Best Practice Guideline G2: Water and Salt Balances.

Department of Water Affairs and Forestry, 2006. Best Practice Guideline No. G3. Water Monitoring Systems.

Department of Water Affairs and Forestry, 2008. Best Practice Guideline G4: Impact Prediction.

Department of Water Affairs and Forestry, 2008. Best Practice Guideline G5: Water Management Aspects for Mine Closure.

Department of Water Affairs and Forestry, 2006. Best Practice Guideline No. A1 Small-Scale Mining – Standard Format

Department of Water Affairs and Forestry, 2006. Best Practice Guideline: A1.1 Small-Scale Mining Practices – User Format

Department: Water Affairs and Forestry, 2007. Best Practice Guideline No. A2: Water Management For Mine Residue Deposits

Department of Water Affairs and Forestry, 2006. Best Practice Guideline A3: Water Management in Hydrometallurgical Plants.

Department: Water Affairs and Forestry, 2007. Best Practice Guideline No. A4: Pollution control dams.

Department of Water Affairs and Forestry, 2008. Best Practice Guideline A6: Water Management for Underground Mines.

Department: Water Affairs and Forestry, 2007. Best Practice Guideline No. A5: Water management for surface mining

Department of Water Affairs and Forestry, 1996. Operational Guideline for control over the alteration in the course of a public stream. Operational Guideline No. M1.0.

Department of Water Affairs and Forestry, 1994. Financial Provision for the Rehabilitation of Land Disturbed by Mining Activities. Operational Guideline No. M2.0.

Department of Water Affairs and Forestry Number M3.0 1995, Policy and Strategy for Management of Water Quality Regarding the Mining Industry in the RSA.

Department of Water Affairs and Forestry, No. M4.0, 1997. Operational guideline for the application by a mine for a permit in terms of Sections 12B and 21 of the Water Act (Act 54 of 1956).

Department of Water Affairs and Forestry, No. M 5.0, 1998. Operational Guideline for the DWAF to assist the DME with Environmental Management Programmes in terms of the Minerals Act.