

**AN IMPLEMENTATION PROGRAMME FOR THE  
SOUTH AFRICAN GOLD MINING INDUSTRY TO  
ACHIEVE ENVIRONMENTAL COMPLIANCE**

**BY**

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## LIST OF ABBREVIATIONS

<i>Abbreviation</i>	<i>Title</i>
APPA	Atmospheric Pollution Prevention Act
AQA	National Environmental Management Air Quality Act
AQMP	Air Quality Management Plan
CARA	Conservation of Agricultural Resources Act
COP	Code of Practice
COR	Certificate of Registration
DACEL	Department of Agriculture, Conservation, Environment and Land Affairs
DEAT	Department of Environmental Affairs and Tourism
DH	Department of Health
DME	Department of Minerals and Energy
DWAF	Department of Water Affairs and Forestry
ECA	Environment Conservation Act
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
EMS	Environmental Management System
GIS	Geographical Information System
GRI	Global Reporting Initiative
I & APs	Interested and affected parties
IAEA	International Atomic Energy Association
IEM	Integrated Environmental Management
ISO	International Organisation for Standardisation
KPI	Key Performance Indicator
MHSA	Mine Health and Safety Act
MOSA	Machinery and Occupational Safety Act
MPRDA	Mineral and Petroleum Resources Development Act
NEA	National Energy Act
NEMA	National Environmental Management Act
NNR	National Nuclear Regulator
NNRA	National Nuclear Regulator Act
NWA	National Water Act (Number 36 of 1998)
SHERQ	Safety, Health, Environment, Risk and Quality
SOP	System Operating Procedure
WDCS	Waste Discharge Charge System

## **ABSTRACT**

The gold mining industry in South Africa is exposed to various legal issues due to the nature of its operations. Furthermore, there has been a renewed focus on environmental management in South Africa over the past decade, as well as an international focus on sustainable development. Environmental management in the gold mining industry must incorporate sustainable development, as well as the ‘cradle to grave’ concept.

The gold mining industry has to ensure that its activities are compliant with environmental legislation and best practice requirements, as the increase in environmental awareness and legislated principles has escalated gold mines’ exposure to demands for the remediation and reparations of pollution and environmental degradation.

No single document exists that provides the gold mining industry with detail on the environmental legislation and best practice requirements that gold mines are able to refer to in order ensure effective environmental management. Furthermore, there is no implementation plan for gold mines to implement in order to achieve compliance with environmental legislation and best practice requirements. This study has presented such a document, as it has provided the reader with detail concerning the responsibilities of the regulatory authorities, the current and new legislation, best practices, codes of practices, and offences and liabilities that gold mines will become exposed to should they not adhere to environmental legislative requirements. This detail has been used to compile an implementation programme (Chapter 4), which when implemented will ensure environmental compliance for the gold mining industry in South Africa.

This mini-dissertation has thus provided the gold mining industry with an overview from which to work in order to become legally compliant with issues pertaining to environmental management in South Africa.

## OPSOMMING

Die goudmynbedryf in Suid-Afrika word aan verskeie regsgekke blootgestel weens die aard van die bedryf. Hierbenewens is daar tydens die afgelope dekade hernieude fokus op omgewingsbestuur in Suid-Afrika sowel as 'n internasionale fokus op volhoubare ontwikkeling. Omgewingsbestuur in die goudmynbedryf moet volhoubare ontwikkeling, sowel as die “van-die-wieg-tot-die graf” konsep insluit.

Die goudmynbedryf moet verseker dat dit aan die omgewingswetgewing en beste-praktyk vereistes voldoen, aangesien 'n toenemende omgewingsbewustheid en wetgewende beginsels die bedryf blootstel aan eise vir herstelling en vergoeding van besoedeling en omgewingsdegradasie.

Daar bestaan geen enkele dokument vir die goudmynbedryf wat besonderhede aangaande die wetgewende vereistes en beste-praktyk beginsels vir goudmyne bevat, waarna verwys kan word om effektiewe omgewingsbestuur toe te pas nie. Daar bestaan ook geen implementeringsplan vir goudmyne om toe te pas sodat hulle aan al die wetgewing sal voldoen nie. Hierdie studie bied juis so 'n dokument sowel as volledige inligting aan die leser aangaande die verantwoordelikhede van die regulerende instansies, die huidige en nuwe wetgewing; beste-praktyk beginsels, oortredings en aanspreeklikheid waaraan goudmyne blootgestel word indien hulle nie aan die omgewingswetgewing sou voldoen nie. Hierdie besonderhede is gebruik om 'n implementeringsprogram (Hoofstuk 4) saam te stel wat sal verseker dat die goudmynbedryf in Suid-Afrika aan die omgewingswetgewing sal voldoen.

Hierdie skripsie verskaf 'n oorsig aan die goudmynbedryf wat gebruik kan word om aan die wetgewing met betrekking tot omgewingsbestuur in Suid-Afrika te voldoen.



## CHAPTER 1 INTRODUCTION

South Africa's gold resources are important assets, and significant contributors to the country's economy. The South African gold mining industry has provided for the creation of valuable jobs and infrastructures, and has contributed to the improvement of the quality of life of millions of people. However, due to the economic conditions in South Africa, the continued success of this industry will be largely dependent on its ability to access international money and commodity markets. The gold mining industry cannot, therefore, afford to be impeded by criticism that may flow from matters such as doubts concerning its environmental philosophies and responsibilities. It is also of importance that the gold mining industry must have a clear indication of what its responsibilities in this regard are (DME, 1999).

There has been a renewed focus on environmental management in South Africa over the past decade, as well as an international focus on sustainable development. It is for these reasons that there have been changes in the administration and practice of environmental legislation, as well as the introduction of best practices to ensure holistic environmental management in the gold mining industry.

Integrated environmental management (IEM) will enable a gold mine to identify, predict, and evaluate all advantageous and detrimental effects on the environment, socio-economic conditions, and cultural heritage. This, in turn, will lead to the minimisation of detrimental impacts and the maximisation of advantageous impacts. Environmental management must incorporate sustainable development, as well as the 'cradle to grave' concept. This will be achieved by a gold mine if all legislative and best practice requirements are adhered to.

The increase in environmental awareness and legislated principles has escalated gold mines' exposure to demands for the remediation and reparations of pollution and environmental degradation. There is thus increasing pressure from governmental departments, the community (both local and international) and non-governmental organisations for mines to ensure (and maintain) holistic environmental management. This has led to an onus on the mines to address and mitigate any potential impacts that their activities may have on the environment.

The 'polluter pays' principle is prominent in South Africa's environmental legislation. It is thus important for a gold mine to ensure that all employees are aware of the effects of pollution, the ramifications of their behaviour, and the steps that should be put into place to either remedy the effects of pollution or prevent pollution. This will be achieved by training the employees, and instituting reporting structures and systems operating procedures.

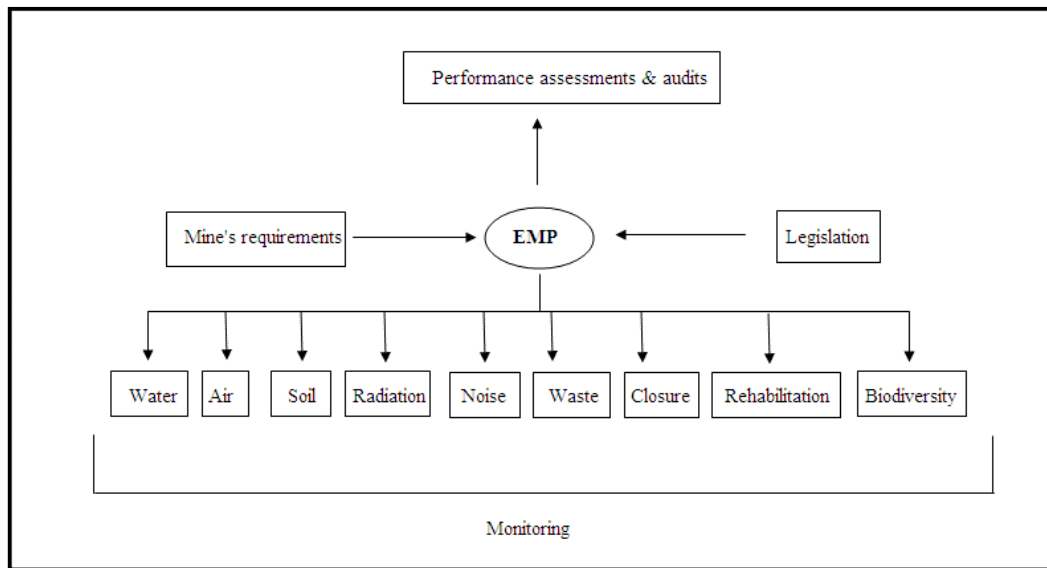
Formal environmental legislation has been in enforcement in South Africa since 1989, with the promulgation of the Environment Conservation Act. The National Environmental Management Act was promulgated in 1998. Prior to the 1990s, environmental control and management in the mining industry was administrated under mining legislation, in that the environmental requirements for dealt with in the mining acts.

Environmental legislation in South Africa was promulgated because environmental degradation must at the very least be minimised and at the most prevented. The South African Constitution gives the people of South Africa the right 'to an environment that is not harmful to their health or well-being' (Bill of Rights, Chapter 24). The current environmental laws in South Africa concentrate on protecting, promoting, and fulfilling the nation's social, economic and environmental rights; while encouraging public participation, implementing cultural and traditional knowledge and benefiting previously disadvantaged communities.

Reporting by a gold mine on a regular basis will build stakeholder relationships, align the business strategy with stakeholder values and interests, and highlight the 'full cost and benefit' of the mine's performance (Kapelus, 2003). A good reporting structure is pivotal to good corporate governance, and will enable the mine to adhere to triple bottom line reporting. Reporting also adds a value for society and the immediate surrounding community in that the gold mine will be seen to be open and transparent. The reporting structure detailed in this document will be centred on the Global Reporting Initiative.

An Environmental Management Programme (EMP) is used by a gold mine to ensure compliance to all legal requirements. This document was formally termed 'Environmental Management Programme Report' under the auspices of the Minerals Act of 1991 (this act was subsequently replaced by the Mineral and Petroleum Resources Development Act in 2002). EMPs are specific to individual gold mines, and should be audited on a regular basis. The EMP will detail the measures a mine will implement in order to adhere to the legislative and best practice requirements concerning water, air, waste, soil, radiation, noise, biodiversity, and alien and invasive species; and can only be compiled once a mine is aware of all the legislative requirements it needs to take into account and adhered to. Furthermore, the

monitoring, rehabilitation, environmental awareness training and closure programmes are also detailed in this document. A schematic layout of an EMP is demonstrated in Figure 1 below.



**Figure 1: The structure of an EMP**

Best practice requirements are not legislative requirements. That is, their implementation is optional. Best practices lend credibility within the industry as the gold mine(s) will be seen to be complying with international norms and standards with regards to environmental management, and thus their implementation is important.

Environmental management encompasses a wide variety of issues, and can be very much compartmentalised. There are many Acts, Bills and Policies that the gold mining industry needs to adhere to, but these sometimes deal with specific issues and not environmental management as a whole. No single document details the requirements (both legislative and best practice) that gold mines are able to refer to in order to achieve the prevention and mitigation of environmental pollution and degradation exists in the gold mining industry.

The aim of this study, therefore, is to present a document pertaining to environmental legislation and best practice requirements in order for it to effectively implement environmental management.

Environmental legislation establishes a duty and onus on mines to prevent and rectify (or otherwise minimise) environmental pollution and degradation that arises as a result of their activities. Although it is important to address each issue/aspect individually, environmental

management must be based on a holistic approach. Holistic environmental management in the gold mining industry will only be achieved if ‘buy-in’ from management is achieved. Many of the people who will have to co-operate and work together with the environmental department may have very little knowledge pertaining to environmental issues. This dissertation will be able to provide such individuals with a platform from which to work by providing a detailed summary of environmental legislation and best practice requirements, and an implementation plan. This will allow gold mines to approach environmental management in a holistic manner by fulfilling the legal responsibilities pertaining to their activities.

Although legislation and best practices are in place in the gold mining industry, there is no step-by-step guideline to implement these requirements. It is in a mine’s best interests to implement these requirements. Firstly, it will lead to conformance to relevant environmental legislation. Secondly, it will encourage a good public image (transparency is essential for the mine to create a positive relationship with society and the immediate surrounding community). Thirdly, a centralised database will allow for effective environmental management. The implementation of a monitoring programme will allow the mine to measure its conformance and improvement. If the gold mine shows willingness to comply with requirements, it will show transparency and openness from the mine’s side. It will also illustrate that the mine is willing to commit to effective environmental management that will benefit not only the mine, but the community and society as a whole. In order to achieve integrated environmental management, a mine has to implement a step-by-step programme that addresses all the requirements at hand. The implementation plan provided in the document will aid in this fulfilment of responsibilities.

This dissertation will, furthermore, provide a broad outline on best practice requirements that the mine can comply with. These best practice requirements will include corporate governance, risk management, sustainable development, triple bottom line reporting, accountability, International Organisation for Standardisation (ISO) systems and reporting, the Global Reporting Initiative’s reporting structure, environmental management systems, and stakeholder engagement.

To meet this aim of the study will focus on achieving the following objectives:

- ❖ To detail the regulatory authorities the mine will report to;
- ❖ To summarise national current and future legislative requirements pertaining to the gold mining industry;

- ❖ To detail the offences and penalties the mine can incur if it does not comply with legislation;
- ❖ To summarise the best practice requirements pertaining to the gold mining industry;
- ❖ To provide details of the codes of practices that are to be implemented;
- ❖ To provide details concerning rehabilitation requirements;
- ❖ To detail closure requirements;
- ❖ To summarise the financial provision;
- ❖ To provide an implementation plan. This plan, when followed, will ensure that the mine is compliant with environmental legislation and best practices.

Each of these objectives will be dealt with in the chapters that follow. Chapter 2 will outline the current legislation and best practices, while chapter 3 will provide the reader with an outline of legislation that is still to come into effect (new legislation). Chapter 4 will provide the reader with a generic implementation plan of environmental legislative and best practice requirements.



## **CHAPTER 2 CURRENT LEGISLATION AND BEST PRACTICES**

This chapter will provide the reader with detail on the current legislation and best practices pertaining to the South African gold mining industry. The detail contained herein will give the reader an understanding of what is currently required of the gold mining industry to achieve environmental compliance. The detail will list the regulatory agencies, provide a description of the ‘umbrella’ legislation and legislation pertinent to the various aspects of the EMP (for example, water), and provide detail on the best practices pertinent to the gold mining industry.

Legislative requirements include Acts, Bills, Standards, Regulations, Environmental Management Programmes (EMPs) and Closure Plans. Best practice requirements include Policies, Guidelines (including ISO), and the Global Reporting Initiative (GRI). There are two Codes of Practices (COPs) that gold mines have to comply with (Section 2.5) pertaining to residue deposit and cyanide management. These are specific to each gold mine, and will therefore each have their own specifications. Mandatory requirements include Scoping Reports, and Environmental Impact Assessments.

The Constitution of the Republic of South Africa is South Africa’s highest authority of law. The National Environmental Management Act is the overarching and enforceable body of legislation. Thereafter follows the Mineral and Petroleum Resources Development Act, and other environmental legislation. There are acts that are concerned with overall environmental management, and then other acts that are have specific components. For example, the National Environmental Management Act (NEMA) is concerned with ‘general’ environmental management while the National Water Act (NWA) is specifically concerned with the regulation of water use and management.

This chapter will provide the reader with an outline of the ‘umbrella’ legislation (2.1) pertaining to environmental management, as well as the legislation that must be included and adhered to pertaining to the specific aspects contained in an Environmental Management Programme (2.2). Section 2.3 of this chapter will detail the various offences and liabilities that a gold mine will expose itself to if it does not adhere to environmental legislation. Section 2.4 will provide the reader with an outline of best practices that can be implemented. An outline of the Codes of Practices that a gold mine needs to compile and adhere to is provided in Section 2.5 of this chapter.

The various government agencies responsible for ‘policing’ the different aspects of environmental legislation, and the various Acts and Bills fall under these government departments. Table 1 indicates the responsibilities the various regulatory agencies hold.

**Table 1: The regulatory agencies and the legislation mandated by them**

<i>Regulatory agency(ies)</i>	<i>Legislation</i>
All	Constitution (Section 24)
DME	Mineral Petroleum Resources Development Act
DEAT	Environment Conservation Act: Sections 2,21,22,26
DEAT	National Environmental Management Act: Sections 24(1),23(2)
DLA	Development Facilitation Act
DHS	Hazardous Substances Act
DWAF	National Water Act
DEAT, DH	Atmospheric Pollution Prevention Act
DME	Nuclear Energy Act
DME	Mineral Development Bill
DME	National Nuclear Regulator Act
DME	Mine Health & Safety Act
DME	Mines & Works Act: sect
DEAT	South African Weather Services Act
DEAT	White Paper on Integrated Pollution and Waste Management for South Africa
DEAT	Environmental Laws Rationalisation Act

## 2.1 ‘UMBRELLA’ LEGISLATION

‘Umbrella’ legislation pertains to the general aspects of environmental legislation – these aspects being central and relevant to all aspects of environmental management. The Sections contained in 2.1 will provide detail on the following acts:

- ❖ The Constitution (2.1.1);
- ❖ Common law (2.1.2);
- ❖ National Environmental Management Act (NEMA) (2.1.3);
- ❖ Mineral and Petroleum Resources Development Act (MPRDA) (2.1.4);
- ❖ Environment Conservation Act (ECA) (2.1.5);
- ❖ Mine Health and Safety Act (MHSA) (2.1.6);

- ❖ Promotion of Access to Information Act (2.1.7);
- ❖ National Heritage Resources Act (2.1.8);
- ❖ National Monuments Act (2.1.9).

### ***2.1.1 The Constitution***

South Africa's Constitution makes allowance for the protection of the environment (this is unique to South Africa's Constitution). Section 24 of the Bill of Rights states that:

‘Everyone has the right:

1. To an environment that is not harmful to their health or well-being; and
2. To have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that -
  - a) Prevent pollution and ecological degradation
  - b) Promote conservation; and
  - c) Secure ecologically sustainable development while promoting justifiable economic and social development.’

The Constitution is the overarching piece of legislation in South Africa's legislative framework. This implies that the Constitution overrules any other piece of legislation. The State, under the direction of the Department of Environmental Affairs and Tourism, is responsible for enforcing the constitution.

Section 41 of the Constitution makes allowance for co-operative governance, in that all spheres of government are required to co-operate with ‘mutual trust and good faith’. Government departments are further required to foster friendly relations, assist and support one another, inform and consult with one another, co-ordinate their actions, co-ordinate their legislation, adhere to procedures and agreements between the various departments, and lastly avoid legal action against one another. There is currently a difficulty in the application of this co-operative governance, in that there is an overlap in the regulation and approvals of Environmental Impact Assessments (EIAs) between DEAT and DME. The DME is mandated to approve EIAs in terms of the MPRDA, while DEAT is mandated in terms of NEMA and ECA.



### **2.1.2 Common law**

Common law obliges the owner of a gold mine to ensure that the operations of the mine and the consequences thereof do not create a nuisance or otherwise infringe upon the rights of others. Common law is provided for in terms of the Constitution, and takes natural justice into account.

### **2.1.3 National Environmental Management Act**

The ‘polluter pays’ principle is deeply entrenched in the National Environmental Management Act (NEMA). This principle is centred on the fact that the party/ies responsible for causing the pollution be responsible for mitigating the effects of this pollution. It must be noted that this is not just limited to the mine lease area(s), as the mine is responsible for environmental damage, pollution or ecological degradation that may occur outside the boundaries of the lease area.

The NEMA is the overarching and enforceable body of environmental legislation. This body of legislation echoes Section 24 of the Constitution, in stressing that environmental management must make the community (and its needs) its first priority. Adherence to this body of legislation will ensure that the gold mining industry inter-links all elements and issues pertinent to environmental management. It will also ensure that all health and safety consequences of decisions will be realised.

Section 2 of Chapter 1 of this act states the holder of a mining permit has to, at all times, give effect to the national environmental management principles. The consideration of various factors must be brought into focus:

- ❖ Avoidance/minimisation of the loss of biodiversity;
- ❖ Avoidance/minimisation of the disturbance of ecosystems;
- ❖ Avoidance/minimisation of pollution;
- ❖ Avoidance/minimisation of cultural and heritage sites;
- ❖ Avoidance/minimisation/recycling of waste;
- ❖ Responsible and equitable use of renewable and non-renewable resources;
- ❖ Avoidance/minimisation/mitigation of adverse impacts.

Section 2 is also concerned with the participation of the community, as well as sustainable development. The participation of interested and affected parties (I & APs) is mandatory, thus

making the community a priority. The Act also states that all forms of knowledge – including traditional and cultural – be taken into account during the decision making process. Although this is a legal requirement, the mine should not view it as a negative occurrence, as it will demonstrate openness, and transparency. Furthermore, the participation of I & APs will ensure the well-being of the community. Stakeholder engagement does not begin and end with running public participation meetings when required to by legislative means, but must form part of the total life of the project. An emphasis is placed on sustainable development by ensuring that development encompasses social, economic and environmental sustainability, environmental justice is pursued, and equitable access to environmental resources is given.

Chapter 3 of this act details the requirements for environmental implementation and management plans. The reader is referred to Sections 11-16 of this particular chapter for further information on these requirements.

The general objectives of integrated environmental management (IEM) are dealt with in Sections 23 and 24 of Chapter 5 of the act. The gold mine has to consider, investigate, assess and communicate the impact of the mining operation on the environment and have procedures for the investigation, assessment and communication of the potential impact in place. These procedures will ensure the investigation of the environment, impacts, and mitigatory measures, the participation of the community, the access of information to the general public, reporting on gaps in knowledge, the investigation and formulation of arrangements for the monitoring and management of impacts, the measure of the efficiency of the measures employed for the efficiency of the management practices, and the co-ordination and co-operation between organs of state in the consideration of assessments (the MPRDA also makes allowances for this). The general objectives of IEM can be listed as follows:

- ❖ Identification, prediction and evaluation the actual and potential impact on the environment, socio-economic conditions and cultural heritage, the risks and consequences and alternatives and options for mitigation of activities, with a view to minimising negative impacts, maximising benefits, and promoting compliance with the principles of environmental management;
- ❖ Adequate consideration of the effects of activities on the environment (before actions are taken in connection with them);
- ❖ Adequate and appropriate opportunities for public participation in decisions that may affect the environment;
- ❖ Consideration of environmental attributes in management and decision-making which may have a significant effect on the environment;

- ❖ Identification and employment of the modes of environmental management best suited to ensuring that a particular activity is pursued in accordance with the principles of environmental management.

Section 28 of Chapter 7 of this act details the actions and requirements that need to be taken to prevent/minimize/ mitigate the effects of pollution. The following measures will need to be implemented by the mine in order to avoid or minimise pollution:

- ❖ Investigate, assess and evaluate the impact on the environment;
- ❖ Inform and educate its employees about the environmental risks of their work and the manner in which their tasks must be performed;
- ❖ Cease, modify or control any act, activity or process causing the pollution or degradation;
- ❖ Contain or prevent the movement of pollutants or the causant of degradation;
- ❖ Eliminate any source of the pollution or degradation;
- ❖ Remedy the effects of the pollution or degradation.

#### ***2.1.4 Mineral and Petroleum Resources Development Act***

The Mineral and Petroleum Resources Development Act (MPRDA) was promulgated in 2002, and replaced the Minerals Act (No 50) of 1991.

This Act is primarily concerned with the allocation of rights and expansion of opportunities for historically disadvantaged persons. It does have a significant effect on environmental management and its associated responsibilities (Section 38, Chapter 4) due to the fact that it encompasses the principles contained in Chapter 1 of the NEMA. Furthermore, this act states that ‘Any prospecting or mining operation must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into the planning and implementation of prospecting and mining projects in order to ensure that exploitation of mineral resources serves present and future generations’ (MPRDA, 2002).

Compliance with this Act will aid in implementing IEM. Gold mines will need to institute the ‘cradle to grave’ principle, adopt the ‘polluter pays’ principle, implement a rehabilitation programme, and adhere to the ‘precautionary’ principle. The ‘precautionary’ principle implies that alternatives need to be considered for each project a mine wishes to carry out. The reader is referred to the afore-mentioned Section 38 for further detail.

This act makes allowance for intergovernmental governance, in that all reports submitted for approval need to be circulated to all relevant departments. The Department of Minerals and Energy (DME) will remain the regulating mining authority, but will have to consult with the various governmental departments before it may issue any approvals. The governmental departments have strict timelines that need to be adhered to during this approval process. These timelines must be taken into consideration during project planning processes.

The MPRDA imposes obligations upon a gold mine regarding the management of residue deposits and stockpiles. This management must include residue characterisation, classification, site selection, construction, operation, monitoring, decommissioning, closure, post-closure monitoring, and the design of the disposal facility. The manner in which they must be managed will be incorporated in the EMP. The Act also states that the mine may not deposit tailings (albeit permanently or temporarily) on any site that is not registered under the EMP.

Section 39 and Regulations 51 and 52 of this act detail the information that must be included in an EMP. The DME will undertake annual audits and performance assessments to determine the successfulness of the implementation of the EMP, and thus Regulation 55 must also be taken into account. This particular regulation is also concerned with the monitoring programmes that need to be instituted. Existing and approved EMPs need only be amended, while all new EMPs must include scoping reports, environmental impact assessment (EIA) reports, and risk assessments. These reports are dealt with under Regulations 49 and 50. Regulation 61 lists the Sections that need to be included in the EMP. Regulation 56 provides the principles that need to be adhered to for mine closure, while Regulation 62 details the components of a closure plan. A gold mine will need to incorporate these principles and components into its closure plan, in order to obtain approval from the DME. The reader is referred to these Sections for further detail.

Section 45 of the Act is concerned with emergency incidents and their remedial actions. The Act states that, should environmental damage ecological degradation or pollution occur, the Minister of Minerals and Energy is permitted to issue a directive to the mine to rectify this. If the gold mine does not comply with the directive the Minister is permitted to take the relevant and necessary steps in order to mitigate the situation. The funds for mitigation and rehabilitation may be recovered from the mine.

### **2.1.5 Environment Conservation Act**

The Environment Conservation Act (ECA) makes provision for ‘the effective protection and controlled utilisation of the environment’ (Fuggle and Rabie, 2000). The Act makes allowance for public participation in subordinate legislation, as well as administrative decision making (the reader is referred to Sections 32(1) and 32(2) of this act for further information). This Act thus, like the NEMA, makes the the community a priority. Gold mines will therefore have to adhere to the requirements (for the prevention of pollution) of this act in their pollution management programmes.

The ECA has two sets of provisions that will ultimately govern the control of gold mining’s activities that will have a detrimental effect on the environment (Fuggle and Rabie, 2000). These provisions take the form of limited development areas, and identified activities. The mine will have to conduct impact reports (in terms of this piece of legislation) if it intends to develop/implement projects that entail controlled activities.

### **2.1.6 Mine Health and Safety Act**

Although a gold mine’s environmental department may not strictly be involved in health and safety, there may be a Safety, Health, Environment, Risk and Quality (SHERQ) committee where the environmental department is represented. It is for this reason that the Mine Health and Safety Act (MHSA) - No 29 of 1996 - is relevant.

Sections 2 and 5 contained in Chapter 2 of this act are concerned with the maintenance of a health and safe working environment for the employees of the mine: ‘Owner to ensure safety..... Manager to maintain healthy and safe mine environment’ (MHSA, 1996). Section 5 states that the employer is to maintain a ‘healthy and safe mine environment’. This includes eliminating or minimising risk and hazards from the working environment, assessing the risk that employees (and contractors) are exposed to, and ensuring that people who may be directly affected by activities at the mine are not exposed to any hazards.

Chapter 2 is concerned with promoting health and safety on the gold mine. Sections 6, 10 and 11 (Chapter 2) state that the employer must supply adequate equipment and training to the mining employees. The employer has to be able to respond to any risk, or hazard, that the employees may be exposed to. Furthermore, the chapter makes provision for a health and

safety policy, and code of practice (Sections 8 and 9). The gold mine must ensure that the employees and contractors are fully briefed in health and safety training (Section 10).

### ***2.1.7 Promotion of Access to Information Act***

Part 3 of this Act is concerned with the ‘access to records of private bodies’, and states that a requester has the right of access to records of private bodies. The following conditions, however, need to be met:

- ❖ Procedural requirements for the request have been complied to;
- ❖ The record is required for the protection of human rights;
- ❖ Access to the record is not refused in terms of any ground for refusal contemplated in Chapter 4 of this act.

### ***2.1.8 National Heritage Resources Act***

The National Heritage Resources Act (1999) has various objectives that could be relevant to the gold mining industry:

- ❖ The introduction of an integrated and interactive system for the management of the national heritage resources;
- ❖ The promotion of good governance at all levels;
- ❖ The empowerment of civil society in order to nurture and conserve their heritage resources;
- ❖ The implementation of general principles for governing heritage resources management;
- ❖ The establishment of norms and the maintenance of essential national standards for the management of heritage resources.

If the mine has any declared national heritage sites within its lease area it must oblige to the requirements contained in this Act. The Act also makes provision for demolition of Natural Heritage Resources, in that ‘no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority’ (NHRA, 1999).

### ***2.1.9 National Monuments Act***

The National Monuments Act (No 28 of 1969) is concerned with the preservation of both immovable and moveable property. Thus, national monuments and conservation areas are protected by this Act.

If the gold mine's lease area encompasses any declared national monuments and/or conservation areas, it must oblige to the requirements contained in this Act.

### ***2.1.10 Protected Areas Act***

The Protected Areas Act - No 57 of 2003 - does not permit the commercial prospecting or mining in protected areas or special nature reserves without the written permission of the Minister and the Cabinet member representing the DME. The protected areas referred to include World Heritage Sites, specially protected forestry areas, specially protected forest nature reserves, and specially protected wilderness areas (the reader is referred to Section 9 for further information).

This Act also mandates the Minister to monitor mining activities conducted in areas not historically defined by this act.

Mining must be done in consultation with the local community, and the principles contained in Chapter 2 of NEMA must be incorporated into the gold mining process.

## **2.2 LEGISLATION PERTAINING TO SPECIFIC ASPECTS CONTAINED IN AN EMP**

Section 2.1 was compiled to give the reader a general understanding of what is required for successful environmental management on a gold mine in terms of the current legislative practices in South Africa. However, there are various other Acts and Regulations that pertain to more specific aspects of an EMP on a mine. For example, while NEMA addresses environmental management in general, the National Water Act (NWA) addresses environmental management in terms of water.

The aspects that need to be addressed on an individual level in the EMP include water, air, waste, soil, radiation, noise, biodiversity, alien and invasive plant species, rehabilitation,

closure and financial provision. Therefore, in order to gain an understanding of what is required in terms of all aspects on a gold mine, the reader is referred to the Sections below.

### **2.2.1 Water use and management**

The provision of water in South Africa is divided into public water and private water, and its use is regulated by the NWA (under the directorship of the Department of Water Affairs and Forestry). Various other acts also make provision for the management of water: the MPRDA regulations have general requirements for water management, the Conservation of Agricultural Resources Act (CARA) - No 43 of 1983 - contains water management guidelines, and the Health Act (No 63 of 1977) is concerned with effective water management (Barnard, 1999).

It must be noted that, in terms of the NWA, it is an offence to pollute public and/or private water to render it unfit for the propagation of fish and aquatic life, including rainwater, seawater, and subterranean water. All water in South Africa is under the trusteeship of the national government.

It is imperative that a gold mine establishes a water quality management programme in order to manage its water use. This will contribute towards responsible and sustainable mining, as well as the reduction of costs. There are general principles of integrated mine water management that should be included in this management programme (Wood, et al, 2003):

- ❖ Compliance with DWAF's water management hierarchy;
- ❖ Compliance with all legislation;
- ❖ Compliance with provincial ordinances and requirements of the local authority(ies);
- ❖ A life-cycle approach (that includes the 'cradle-to-grave' approach);
- ❖ The precautionary principle;
- ❖ The temporal variability of water quality and quantity;
- ❖ A risk-based approach;
- ❖ The identification of incremental and declining water demands over the life of the mine;
- ❖ Liaison with process design engineers;
- ❖ The identification of the various water quality requirements of the different operation activities;
- ❖ The confirmation of design losses versus recorded losses for existing process;
- ❖ The collation of information, in order to provide a time-line indicating the progressive increments in water demand of the life of the mine.



The National Water Resources Strategy was designed for the protection of both surface and ground water by implementing resource directed measures and source directed controls. This will be achieved by limiting/restricting the purpose, manner and extent of water uses. The implementation of this strategy will replace Regulation 991 (waste discharge standards, Regulation 1560 and the regulations in terms of Section 9(6) (Dam safety), and Regulation 2834 (water and sewage treatment).

#### **a. Surface Water management**

There are various aspects to surface water management pertaining to gold mines, namely pollution prevention measures, emergency incidents, water use licensing, safety risks, catchment management agencies, and Government Notice 704. These aspects will be elaborated upon in the sub-Sections that follow.

##### *(i). Pollution prevention measures*

Section 19 of the NWA is concerned with pollution prevention measures, and states that the owner of the land, the person occupying the land, or the person in control of the land has to 'take all reasonable measures to prevent any such pollution from occurring, continuing or recurring'. Various measures can be implemented: those that prevent pollution, those that ameliorate the effects of the pollution, those that contain the pollution, those that remedy the effects on the watercourse, and those that comply with management practices and waste standards. It is imperative to realize that in order to eliminate/manage pollution, the mine must investigate the source - and not just the symptoms. Pollution management must include aspects such as public participation, education, and training. A gold mine must ensure that there are adequate programmes in place for pollution management, and that funds are made available for the implementation of these programmes.

Pollution prevention has added economic benefits for the gold mining industry, for example costly enforcement and clean-up practices will be reduced; a competitive economy will be promoted, and energy, materials, and resources will be used more efficiently.

There are regulations (issued in terms of the NWA) that deal with pollution control. These regulations are contained under R287 of 1976. Regulation 5 states that the manager of a mine is responsible for the compilation of a plan depicting all works constructed for the control of water on the surface of a mine. This plan must contain a list of prescribed details. Regulation 6.1 states that a mine manager must employ effective measures in order to prevent effluent

(this includes water that is pumped from underground) flowing, or seeping, beyond the boundaries of the mine property. Regulations 7, 8, 11.1, 12, 14, 16, and 21 are concerned with the measures to be taken with respect to tailings, slimes, waste rock dumps, and various other sources of pollution. Regulations 9, 13, and 19, on the other hand, are concerned with measures to be taken with respect to stormwater drains, waterways and dams. Regulation 18 is concerned with measures that need to be taken with respect to domestic effluent in water (Fuggle & Rabie, 2000).

*(ii) Emergency incidents*

Emergency incidents are dealt with in Section 20 of the NWA. The Section states that the responsible person must report an incident to the following authorities: DWAF, the South African Police Service or the relevant fire department, and the catchment management agency.

The responsible person must ensure that measures are taken to contain and minimise the effects of an incident, clean-up procedures are instituted, the effects of the incident are ameliorated, and any directives are followed. A gold mine must therefore ensure that there is an emergency plan in place.

*(iii) Water use licensing*

The Department of Water Affairs and Forestry (DWAF) has identified various water uses:

- ❖ Schedule 1 use: no profit is made through the use of water. DWAF is of the opinion that this use is under minimal risk, and requires no registration;
- ❖ Existing lawful use: this use occurred 2 years prior to the promulgation of the NWA;
- ❖ General authorisation: these are for conditional use; and are limited and specific to a use. DWAF is of the opinion that the use is of low risk, and requires a registration.

All water that a gold mine uses and/or discharges that falls outside the scope of a Schedule 1 use or general authorisation will require individual and compulsory licensing.

Gold mines are only permitted to use water if the water use has been authorised by a licence. Should water be abstracted from a nearby farm, this permission will be granted provided the person who is authorised to use water for irrigation under the act is given such permission from a water institution. The responsible authority – DWAF - will only issue a licence to a gold mine once all relevant factors have been taken into account. Any activity that uses water that is not licensed will be viewed as an illegal activity. The mine will be legally bound to

comply with all conditions issued under its licence. These conditions can include objectives that need to be complied with, management practices, monitoring, the payment of charges, and the preparation of a water management plan.

Any gold mine that wishes to dewater has to comply with the conditions of this act. Application will have to be made for a license for the use of this water as detailed in Sections 21 and 26 of the NWA.

Water use licenses are issued under Section 21 of the NWA. There is some confusion between Sections 21(c) and (i), in that the mine does not have to apply for a license if the flow was diverted prior to the mining activity, but will have to apply for an approval for this use by DWAF.

The reader is referred to Section 41 of the NWA for the procedure for licence applications.

*(iv) Dam safety risks*

Section 118 of the NWA is concerned with control measures for dams with safety risks. Should the gold mine own or manage a dam, it is to submit information, drawings, specifications, design assumptions, calculations, documents and test results as requested to the DWAF. The Minister of Water Affairs will then be able to classify any dams that may have a safety risk. Any repairs or alterations that need to be undertaken will be done at the mine's expense. Section 120 states that the owner must register the dam.

Regulations 5.9.1 and 5.9.2 (issued in terms of the Mines and Works Act, and applicable by virtue of the transitional clause of the Minerals Act) state that water that contains poisonous/injurious matter in solution/suspension must be fenced off, and notices be erected warning the general public. This is also dealt with in Government Notice R992. This water may not be permitted to escape without previously having been rendered innocuous (Fuggle & Rabie, 2000).

*(v) Catchment management agencies*

The NWA allows for the establishment of catchment management agencies. These agencies will be concerned with the management of water resources. Catchment management agencies may issue directives to the mine, apportion liability (if more than one mine is found liable), and recover remediation costs from the mine.

*(vi) Government Notice 704*

Regulation 4 of this government notice states that no residue deposit, reservoir or dam may be located within the 1:100 year floodline, or less than a horizontal distance of 100m from the nearest watercourse. Furthermore, person(s) may not dispose of any substance that may cause water pollution.

Regulation 5 states that no person(s) may use substances for the construction of a dam or impoundment if that substance will cause water pollution.

Regulation 6 is concerned with the capacity requirements of clean and dirty water systems, while regulation 7 details the requirements necessary for the protection of water resources.

The reader is referred to the various regulations of this notice for specific detail.

### **b. Groundwater**

The NWA allows the owner of a gold mine to pump extraneous water if it is necessary for the continuation of mining operations, or if it is beneficial for the safety of the mine employees (Fuggle & Rabie, 2000). Section 12B of this Act states that water that is pumped may be used for operations, or for domestic use, provided that a permit has been issued.

#### ***2.2.2 Air pollution***

The main statute currently controlling air pollution in South Africa is the National Environmental Management Air Quality Act (AQA), No 163 of 2005. In addition, the Kyoto Protocol and its contents are also applicable to South Africa. However, it must be noted that the trading of emissions (as made allowance for in the Kyoto Protocol) will not overrule local acts. The MPRDA also has regulations that have general requirements for air pollution, as well as noise control and blasting.

The preamble to the AQA states that the objective of this Act is to restore, protect and enhance the quality of air in South Africa, in a sustainable manner. The aim of this act is to establish norms and standards, and provide a regulatory framework for air quality management planning and reporting.

The structure of this act will be a framework act, in that the regulations pertaining to the act will be promulgated at various stages after the Act itself has been promulgated. The AQA has repealed the Atmospheric Pollution Prevention Act (APPA), No 45 of 1965, and will address its shortcomings. Furthermore, this AQA will also allow a gold mine to comply with international best practice, and provide an environment conducive to proactive air pollution prevention, consistent environmental reporting, responsible environmental reporting, continuous improvement, environmental benchmarking, and effective I&AP consultation (Scorgie, et al, 2003).

Bell, Dewar and Hall (2004) have listed the following objectives of the AQA:

- ❖ To protect, restore and enhance South Africa's air quality, in line with sustainable development;
- ❖ To provide increased opportunities for public involvement, and participation in the protection of the nation's air quality;
- ❖ To ensure public access to all relevant information pertaining to air pollution;
- ❖ To reduce the risks to human health;
- ❖ To prevent the degradation of air quality by implementing the necessary measures.

The following requirements are listed in the AQA (as summarised by Scorgie, et al, 2003):

- ❖ Compliance with emission standards;
- ❖ Compliance with air quality standards;
- ❖ Compliance with control requirements & abatement system availabilities;
- ❖ Point source emission monitoring;
- ❖ Ambient air quality measurement;
- ❖ Greenhouse gas emission measurement;
- ❖ Reporting on monitoring information;
- ❖ Audits;
- ❖ Audit reporting (proof of compliance/routine reporting of non-compliance);
- ❖ Pollution prevention plans;
- ❖ Environmental management co-operation agreements;
- ❖ Economic instruments (for example, pollution charges);
- ❖ The regulation of diffuse sources.

The sub-Sections below will detail the various Sections contained in the AQA.

### **a. Listed activities and priority areas**

The AQA will focus on the control and regulation of both point and non-point sources of air pollution, and ambient air quality (Sections 9, 10, and 11 of Schedule 2).

The Act calls for the listing of certain activities, and the establishment of priority areas (this will be on a national basis). Gold mining is expected to be classified as a listed activity. These listed activities are transferable on the sale of assets, and not the sale of shares. The regulating authorities will be the various municipalities.

### **b. Ambient Air Quality Standards**

Ambient air quality standards will be set for this Act, and SANS 69 will provide the framework for these standards. SANS 1929 will provide the limits for common pollutants.

These common pollutants can be listed as follows:

- ❖ Particulate matter;
- ❖ Carbon monoxide;
- ❖ Sulphur dioxide;
- ❖ Ozone;
- ❖ Nitrogen dioxide;
- ❖ Benzene;
- ❖ Lead.



Dustfall regulations have been proposed, and are classified into 4 band categories. The reader is referred to the act for further detail. Please refer to Table 4 for further information concerning the band categories.

**Table 4: Dustfallout categorisation**

<b><i>Band number/category</i></b>	<b><i>Band description</i></b>	<b><i>Dustfall rate (mg/m<sup>2</sup>/day)</i></b>
1	Residential	D<600
2	Industrial	600<D>1 200
3	Action	1 200<D>2 400
4	Alert	2 400<D

*The action level is for two consecutive months, or three non-consecutive months*

Target, action and alert levels have been proposed for dustfall rates. The promulgation of these levels will allow a more effective management of air pollution. Refer to Table 5 for more detail.

**Table 5: Dustfallout action levels**

<i>Level</i>	<i>Averaging period</i>	<i>Dustfall rate (mg/m<sup>2</sup>/day)</i>
Target	Annual	300
Residential action	30 days	400
Industrial action	30 days	1 200
Alert threshold	30 days	2 400

### **c. Air Quality Management Plan**

The Act stipulates that an Air Quality Management Plan (AQMP) is implemented by the mine. The following components must be included in the plan (Scorgie, et al, 2003):

- ❖ Operational and functional structure requirements;
- ❖ System component requirements;
- ❖ Emission reduction measures;
- ❖ Human resource development requirements;
- ❖ Research requirements;
- ❖ Information dissemination;
- ❖ Public participation process.



### **d. Licensing**

Licensing is dealt with in Chapter 5 of the AQA. Metropolitan and district municipalities have been mandated with implementing the licensing system referred to in Section 22 of the act. A gold mine must apply for a license if it undertakes any listed activities (as defined in the AQA) during its life-of-mine phases.

It is important to note that the licensing application also has to be made in terms Section 24 of the National Environmental Management Act and section 21 of the Environment Conservation Act. This means that the gold mine applicant and the licensing authority must comply with the requirements as detailed in those sections.

### **2.2.3 Waste**

Gold mining wastes have been excluded from the jurisdiction of the Environment Conservation Act (Fuggle & Rabie, 2000), while urban solid wastes do fall under the jurisdiction of the act. Solid mine wastes are regulated by the Mines and Works Act.

Whilst there is no national policy on overall waste management, there is a Radioactive Waste Management Policy for South Africa. There are regulations that pertain to waste management: Regulations 63-73 of the MPRDA are concerned with waste management and pollution control, as are the regulations as set out in Section 20 and 24 of the ECA. A gold mine's waste management system must comply with the regulations as set out in Section 20 and 24 of the ECA, and be in line with the White Paper on Integrated Pollution and Waste Management for South Africa. This management system must include the classification of the different types of waste; the handling of waste (from source, through storage, till collection); the storage of waste; the transport of waste; the disposal of waste (citing and management of waste disposal sites); the reduction of waste; the utilisation of waste; the location, planning and design of sites used for waste disposal; control over the management of sites; and the dissemination the information regarding effective waste disposal to the general public. This system must be implemented at strategic areas on the mine.

Waste generated on a gold mine include and can be classified as follows: urban solid waste, litter, medical waste, and radioactive waste.

#### **a. Urban solid wastes**

Urban solid wastes can be classified as inert wastes (builders' rubble, tyres, cover and spoil), general wastes (household, commercial and garden refuse), and special wastes (cause ill-health or increased mortality or may affect the environment in an adverse manner) (Fuggle & Rabie, 2000).

The RSA code classes and categorises special wastes. These wastes must be handled according to their classification and sub-classification, risk characteristics, aquatic toxicity ratings, threshold limit values, biodegradability ratings, and disposal criteria (Fuggle & Rabie, 2000). Hazardous wastes must also be handled according to the severity of the potential impact.



## **b. Litter**

The White Paper on a National Policy regarding Environmental Conservation has various objectives for the reduction of litter (Fuggle & Rabie, 2000). These objectives include:

- ❖ The co-ordination of activities with the control of solid waste and littering;
- ❖ Anti-littering and anti-pollution campaigns;
- ❖ Measures and incentives to promote re-use, recycling, and reclamation of materials;
- ❖ Measures and processes to regulate the production, decrease, utilisation and disposal of solid waste;
- ❖ Procedures for the profitable use/re-use of urban solid waste;
- ❖ Installations, facilities, and machinery to make the recovery, recycling, and re-use of waste;
- ❖ Guidelines for the evaluation of packaging material and containers.

## **c. Medical waste**

Section 23 and 35(1) of the Medicines and Related Substances Control Act (No 101 of 1965) is concerned with the disposal of medicines and related substances. These substances must be handled, stored, and disposed of separately to general and hazardous waste.

## **d. Radioactive waste**

Radioactive waste is controlled under the provision of various acts (DME, 2000). These acts can be listed as follows:

- ❖ Constitution of the Republic of South Africa;
- ❖ Nuclear Energy Act;
- ❖ National Nuclear Regulator Act;
- ❖ Hazardous Substances Act;
- ❖ Mine Health and Safety Act;
- ❖ Minerals Act;
- ❖ National Water Act;
- ❖ National Environmental Management Act.

Gold mines must dispose of solid radioactive waste in accordance with Table 2.

**Table 2: Classification and disposal of solid radioactive waste**

<i>Specific alpha activity (Bq/g)</i>	<i>Disposal option</i>
< 0.2	Off-site
0.2-100	Tailings dam
100-1000	Tailings dam after dilution
>1000	Approved repository

Gold mines must dispose of liquid radioactive waste in accordance with Table 3.

**Table 3: Classification and disposal of liquid radioactive waste**

<i>Classification</i>	<i>Disposal option</i>
Low activity	Dilution into process stream
	Evaporation dams
	Filtered & passed through ion exchange column, collection in sample tanks
	Passed through concentrator, collection in sample tanks
High activity	Passed through concentrator, mixed with concrete, disposed-of as solid waste

The Radioactive Waste Management Policy for South Africa states that the generators of radioactive waste are responsible for the technical, financial and administrative management of the waste.



#### **2.2.4 Soil**

The Conservation of Agricultural Resources Act, No 43 of 1983, (CARA) is concerned with the management of soil. Section 3 of this Act states that the purpose of the Act is 'to provide for the conservation of natural agricultural resources of the Republic by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water resources, and by the protection of the vegetation and the combating of weeds and invader plants'.

Soil is subject to degradation through the various gold mining activities. Physical degradation will be brought about by the loss of soil from a land surface, chemical deterioration occurs when plant nutrients are lost from the material, and biological degradation is brought about by the introduction of alien and invasive plant species (these render the soil unsuitable for grazing and/or cultivation).

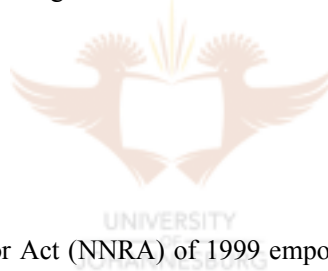
This Act will look upon a gold mine as a land user if the mine:

- ❖ Owns the land;
- ❖ Has a fiduciary right to the land;
- ❖ Is a servitude holder;
- ❖ Occupies the land;
- ❖ Possesses the land;
- ❖ Leases the land.

There are various measures in CARA to achieve its objectives. Those relative to the mining industry can be listed as follows:

- ❖ The prevention (or control) of the salinisation of land;
- ❖ The prevention (or control) of water logging;
- ❖ The restoration or reclamation of eroded land;
- ❖ The construction, maintenance, alteration or removal of soil conservation works.

Gold mines must include soil management in EMPs in order to achieve the afore-mentioned measures.



### **2.2.5 Radiation**

The National Nuclear Regulator Act (NNRA) of 1999 empowers the regulation of activities, safety standards, and the regulation of practices, and the Nuclear Energy Act (NEA) is concerned with the regulation of the acquisition and possession of certain nuclear and related material. This Act makes it mandatory for a gold mine to have a Certificate of Registration (COR) - previously a nuclear license - before it may use, possess, produce, store, process, re-process, convey or dispose of any radioactive material.

The health and safety of employees is addressed in Section 5 of the MHSA. The NNRA further adds to this by stating that the holder of a COR is liable for any nuclear damage that may occur.

#### **a. The Certificate of Registration**

The COR is a legally binding document, and a gold mine has to put measures in place to comply with this document and its specifications. The mine will have to pay the National Nuclear Regulator (NRR) an annual licence fee for the administration of the COR. Section 57

of the NNRA states that the mine has to display the COR in prominent places, as determined by the NNR. It is important to note that the COR is a controlled document, and thus the mine may not duplicate this document. The mine will have to submit a Licence Change Request if it wishes to make changes to the COR.

The following basic conditions will be contained in the COR:

- ❖ Condition 1 states that the mine must carry out both a radiation survey and a hazard assessment;
- ❖ Condition 2 specifies that radiation control programmes must be compiled. These programmes will be determined by the findings of the survey and hazard assessment, and must be specific to the workforce, the public and waste management;
- ❖ Condition 3 is concerned with the schedule for compliance to the programme;
- ❖ Condition 4 is concerned with the transport of radioactive materials.

There are various studies that have to be undertaken in order to comply with the COR conditions. These include, but are not limited to, surveillance, a hazard assessment, a radiation protection programme for the workforce, a public radiation protection programme, a waste management programme, and a programme for the transportation of radioactive items. The plans for these documents must be submitted to the NNR for approval before they are compiled. Licence Documents and Guides are available on request from the NNR for the compilation of the necessary documents.

Surveillance must involve the measurement of radioactivity within all areas within the mine's lease boundary. The gold mine must make certain that the direct dose rate, the surface contamination levels and the airborne contamination levels are quantified during this surveillance process. The mine must use this programme to specify the type and frequency of all measurements, the procedures for taking measurements, the reference levels employed, the degree of exposure of the workers, the method(s) of data handling, interpretation of data, and the recording of data.

Hazard assessments must be conducted in respect of all the operations and activities on the mine. These assessments must be used to identify and quantify all the potential radiation hazards that exist on the gold mine that will result from the mining process. It must be noted that hazard assessments must not only be carried out for normal operations, but also for maintenance activities, waste management, and demolition.

The radiation protection programmes for the workforce and the public, as well as the waste management programme, must be conducted in respect of all the operations and activities on a gold mine. The mine must establish its dose limits in these reports and the procedures to stay within these dose limits must be defined. The programme for the workforce must encompass the control of radiation hazards and the medical surveillance programme. The programme for the public is concerned with the control of radiation hazards that the public may be exposed to. The mine must submit an annual return detailing its waste management.

The programme pertaining to the transport of radioactive materials must be conducted in respect of all the operations and activities on the gold mine. Items with a specific activity of  $>70\text{kBq/kg}$  will fall under the jurisdiction of this programme, and surface contamination of  $0.04\text{ Bq/cm}^2$  for alpha emitters and  $0.4\text{ Bq/cm}^2$ . The implementation of this programme must be such that the mine will transport radioactive materials in accordance with the International Atomic Energy Association (IAEA) regulations. The mine must submit an annual return over and above the submission of this programme.

#### **b. Dose limits**

Ionising radiation is capable of inducing genetic and carcinogenic effects at low levels that will adversely affect the workers and community members. There is no threshold level below which these effects will not be realised. It is therefore imperative that radiation protection is introduced on a gold mine. The purpose of a radiation protection programme is to limit exposure from anthropogenic sources, thus providing an acceptably low mortality risk. It must be ensured that, although there are limits set, exposure must be kept at a bare minimum. Exposure limit values are the upper threshold values.

Although there are general dose restrictions (as previously mentioned), the NNR will provide the mine with legal restrictions pertinent to that specific mine. The mine's radiation protection programme will only be concerned with the workers' and public's absorbed doses. The International Council for Radiation Protection has set a public dose limit of  $1\text{ mSv/year}$ . However, it must be noted that the NNR limit for public exposure is  $0.25\text{ mSv/year}$ , and this is what the mine must adhere to.

The personal dose limit is  $50\text{mSv}$  per annum or  $100\text{mSv}$  per annum over a 5 year consecutive period. The gold mine must ensure (and put controls in place) that its workers do not receive a dose that exceeds this. If a worker exceeds his/her annual dose, his/her working hours must be

reduced or an alternate workplace must be allocated. It is important to note that the dose limit is representative of all possible sources of radiation.

### **2.2.6 Noise**

It must be noted that noise is measured in both an environmental capacity and an occupational hygiene capacity. However, strictly speaking, noise in the workplace is generally not considered to be an environmental problem (Fuggle and Rabie, 2000) as it has a detrimental affect on the workers and not the environment. This noise section is included in this document for the sake of completeness.

The ECA regulates noise control, and enforces noise prohibition of certain activities. These regulations are only administered by the local authorities, and thus form the basis of by-laws.

The Road Traffic Act (No 29 of 1989) is concerned with the regulation of noise by motor vehicles on public roads. This will apply to mine vehicles that leave the lease area, and those that drive on public roads within the lease area. A gold mine will not be allowed to operate a vehicle if it is in excess of the prescribed noise level, or if the noise emanates from the use of methods, accessories and appliances.

The Machinery and Occupational Safety Act (MOSA) (No 6 of 1983), the Mine Health and Safety Act, and the MPRDA are concerned with occupational exposure to noise. The MOSA can be applied in the following circumstances:

- ❖ Employee safety while operating machinery;
- ❖ Employee safety in the workplace;
- ❖ Employee safety during the course of his/her employment.

### **2.2.7 Biodiversity**

The Minister, or MEC, for DEAT is responsible for issuing biodiversity plans for South Africa in terms of the Biodiversity Act. A gold mine will be expected to comply with the provisions therein if the lease area falls within the plan(s).

The establishment of (indigenous) biodiversity will form an integral part of the mine's rehabilitation plan. A gold mine will have to submit a biodiversity management plan that will

provide a means for the establishment of the ecosystem and its long-term survival as part of its rehabilitation programme in the EMP.

### ***2.2.8 Alien and invasive plant species***

CARA is concerned with the eradication of alien and invasive plant species. Weeds and invader plants fall under the jurisdiction of this Act because they undergo asexual reproduction. The Mountain Catchment Areas Act (No 63 of 1970) is also concerned with the eradication of alien and invasive plant species. This Act will come into effect if the mine is situated in a mountain catchment area, or within a 5km radius of such an area (Fuggle and Rabie, 2000). The Biodiversity Act (2004) states that alien and invasive plant species pose a potential threat to South Africa's biodiversity. Therefore, a gold mine will require a permit (once an assessment of potential impacts and risk has been carried out) if it wishes to keep any alien and invasive plant species on its lease area. However, it must be noted that the onus is on the mine to protect the threatened endemic biodiversity, and prevent the permitted species from spreading should the permit be awarded (Biodiversity Act, 2004). The permit will only be awarded under the following conditions: a risk assessment has been carried out, the species has no/negligible invasive potential, the benefits of the restricted activity involving the species are greater than the effect on the biodiversity, and the applicant has undertaken significant measures to prevent the spread of the species.

These plant species have been prioritised, and have been classified accordingly in Notice 2485 (1999). Category 1 species have been classified as weeds, and serve no useful economic purpose. Category 2 species are useful for commercial plant production purposes, but are proven plant invaders under uncontrolled conditions outside demarcated areas. Category 3 species are mainly used for ornamental purposes in demarcated areas but are proven plant invaders under uncontrolled conditions outside demarcated areas. Category 2 and 3 plants may be established in controlled areas provided that: the plantings are confined to the area, cultivation is controlled, precautionary measures are in place to control the spread of seeds, and the plants and products that are derived serve beneficial purposes.

Although the Biodiversity Act states that all organs of state must prepare an invasive species monitoring, control and eradication plan for land under their control, a gold mine must include its own plan in its EMP. The reader is referred to the Biodiversity Act for the detail to be included in the plan. The mine must undertake a survey of the species within its lease area before it compiles the eradication plan. All species must be identified, and classified

according to the three categories. Category 1 species must be the first to be eradicated. Category 2 and 3 species can be eradicated in the same manner as Category 1 species.

### **2.2.9 Rehabilitation**

There are various rehabilitation objectives that gold mines have to comply with in order to have a successful rehabilitation programme and closure programme. The rehabilitation of tailings dams will perhaps form the biggest part of a gold mine's environmental rehabilitation programme, as this is where the residue from the operations is deposited. The prevention/minimisation of pollution during the mining process will not only have a positive effect during the life of the mine, but will also aid the rehabilitation process.

A gold mine is directly responsible for the rehabilitation of the environmental impacts resulting from its operations. Although there is an onus on the owner of the mine to ensure that reasonable mitigatory measures are taken, the holder of the freehold must be satisfied with the mitigation/rehabilitation before the surface right permit can be cancelled. The surface right holder will be considered to be the polluter if the freehold owner is not satisfied with the rehabilitation that has been carried out.

Rehabilitation can be divided into two different streams, namely concurrent rehabilitation and final rehabilitation. Concurrent rehabilitation must be carried out along with the operations on the gold mine, and will decrease the final liability that the mine will carry at the time of closure. This concurrent rehabilitation will be carried out within the context of the EMP. Final rehabilitation will be carried out once the mine goes into its closure phase. This final rehabilitation will be carried out within the context of the closure plan.

The institution of a rehabilitation programme will allow a gold mine to remedy negative impacts on the environment, reduce its financial liability, and make land available for other uses. It is important to realise that rehabilitation does not begin and end with the planting of vegetation; rather it involves returning the whole of the receiving environment to an acceptable state. The environment must be left with a fully functional ecosystem, and this will only be achieved if the following aspects and impacts are addressed:

- ❖ Spills;
- ❖ Radioactivity;
- ❖ Waste rock dumps;
- ❖ Water quality;



- ❖ Tailings;
- ❖ Soil pollution;
- ❖ Alien and invader plant species;
- ❖ Dust.

Rehabilitation needs to be initiated at all operations in order to ensure that it is carried out in a comprehensive manner. Programmes need to be developed, legislation enforced, and harmful impacts need to be identified and analysed before rehabilitation can take place. This will enable gold mines to institute rehabilitation programmes with the certainty that all impacts and aspects have been addressed.

The rehabilitation of tailings dams will enable the mine to establish vegetation, which will have numerous benefits. Some of these benefits include the reduction of dust pollution, leaching and erosion; the establishment of plant material; sustainable land management; water and gas partitioning; and the establishment of wildlife habitats, aesthetic retreats and a biodiversity reservoir (Van Deventer, n/d). The Chamber of Mines has issued guidelines for the engineering rehabilitation of slimes dams. The reader is referred to the guidelines for further detail.

It is not acceptable to merely vegetate tailings dam(s), and expect the receiving environment to be rehabilitated. The following parameters need to be investigated and addressed for effective rehabilitation:

- ❖ Slimes chemistry;
- ❖ Slope angles and preparation;
- ❖ Plant nutrients;
- ❖ Moisture availability for growth;
- ❖ Soil type;
- ❖ Plant species.

A rehabilitated tailings dam will form a new ecosystem. There are thus no guidelines and standards available to evaluate the wellbeing of this new ecosystem. It is for this reason that monitoring records of the rehabilitated areas need to be kept. Not only will these records allow for an objective review of the new ecosystem, but will be submitted to the DME when applying for closure to prove that the rehabilitation is sustainable.

A gold mine will not receive a closure certificate if the residual pollutant impacts on its tailings complex(es) are not addressed and eliminated. Studies need to be carried out on parameters such as water (and its associated pollution aspects), soil and radiation. These

studies will enable the mine to compile a comprehensive tailings rehabilitation programme that will ensure sustainable land management.

A strict quality management and monitoring system must be instituted in order to ensure and demonstrate legislative compliance. This system will ensure that residue quality is evaluated on a regular basis and scientific manner, and that sustainable land management is realised.

### **2.2.10 Closure**

The directors of a gold mine will be held liable for all environmental impacts (both positive and negative) caused by the operations until a closure certificate is obtained. The reader is referred to Section 2.3 of this document for further detail.

The DME has established a closure policy. This policy is to be used in order to establish principles that are applicable to environmental management in mine closure, identify the objectives of mine closure, delineate the process of closure and facilitate cost effective closure (Cornelissen, 2003).

The detail provided herein is generic to the gold mining industry. It should be noted that closure will be site specific and this detail should be adapted accordingly. The detail in the sub-sections below will be concerned with the closure certificate(s), the closure plan and associated risk assessments, the transfer of environmental liability to a third party, water management, landfill sites, tailings dams, waste rock dumps, and buildings, structures and roads.

Cornelissen (2003) has identified the following as principles of closure:

- ❖ Closure of a life-of-mine process;
- ❖ The quantification of risk;
- ❖ The proactive management of risk;
- ❖ The co-ordination of the various requirements of the authorities by the DME;
- ❖ A structured approach to the consultative process;
- ❖ The closure of a business.

The objectives of closure can be listed as:

- ❖ Safeguarding the health and safety of all humans and animals from hazards that may result from terminated mining operations;

- ❖ The minimisation of environmental damage or residual impacts to an extent that it is acceptable by all parties;
- ❖ The rehabilitation of land to, as far as is practicable, its natural state, or to a predetermined and agreed standard or land use which conforms with the concept of sustainable development;
- ❖ The physical and chemical stability of the remaining structures must be such that risk to the environment is not increased by naturally occurring forces to the extent that such increased risk cannot be contended with by the installed measures;
- ❖ The optimal exploitation and utilization of South Africa's mineral resources are not adversely affected;
- ❖ Efficient and cost-effective closure;
- ❖ Closure in accordance with a policy.

The closure of a gold mine is a relatively complicated process that involves consultation with and participation of stakeholders, government departments and I & APs. Due to the volatility of the economy and the gold mining industry, it is advisable that a gold mine has two plans in place: one for planned closure and one for unplanned closure. Planned closure pertains to closure at the end-of-life of the mine. This closure is in accordance with the mining work programme, and therefore the closure costs are included. Unplanned closure pertains to closure before the end-of-life of the gold mine is reached. These closure costs will be higher than planned closure costs, as they will not have been budgeted for. The rehabilitation liability is reflective of planned closure.

If a gold mine's EMP was approved under the Minerals Act of 1991 (and not the MPRDA), a closure plan detailing schedules, programmes and costs must be submitted to the DME. If the mine's EMP has been approved under the MPRDA, the DME will require a closure plan (with a risk assessment) before the project begins. In other words, the closure plan (and the means of funding of the closure of the project) must be submitted together with the EMP.

#### **a. Closure certificate**

The Minerals Act of 1991 allowed for gold mines to be granted partial closure certificates. It is important to note that the MPRDA does not make allowances for partial closure certificates. Therefore, a gold mine has to complete the closure of its entire lease area before it can apply for a closure certificate.

Section 43 of the MPRDA is concerned with closure. The Act states that the holder shall remain liable until a closure certificate has been issued. The Act makes provision for consultation with governmental departments prior to the issuance of the closure certificate, and states that an environmental risk assessment process needs to be followed for mine closure. Section 43 (1) states that the holder is responsible for environmental liability, pollution and ecological degradation (and the management thereof) until the Minister of Minerals and Energy has issued a closure certificate.

A gold mine will obtain a closure certificate only once it can prove that rehabilitation is satisfactory, and there are no residual pollution effects. It is recommended that, whatever form of rehabilitation is used, a post-closure monitoring programme is implemented before the mine applies for closure (this should be for a period of 5 years). The institution of this monitoring programme will enable the mine to identify and rectify any residual pollution impacts.

Regulation 56 of the MPRDA details the principles that need to be adhered to before a closure certificate is granted. The reader is referred to this regulation for further information.

#### **b. Closure plan and risk assessment**

Regulation 57 of the MPRDA states that a closure plan and an environmental risk report need to be compiled and adhered to before a closure certificate is granted. The environmental risk report must include financial provision for rehabilitation, maintenance and monitoring programmes. Furthermore, Regulation 61 states that the closure objectives listed in this closure plan must include the end-use of the land, the key objectives for mine closure, and the proposed closure costs.

Regulations 60 and 62 of the MPRDA are concerned with the contents of the environmental risk report and closure plan. The reader is referred to these regulations for further information.

#### **c. Transfer of environmental liabilities to a third party**

A gold mine may apply for the transfer of its environmental liabilities if the directors wish to give up ownership of the mine before closure is received. This will allow the directors to give up their liability, and walk away from the closure process.

The mine will be able to transfer its liabilities to a third party once the Minister of Minerals and Energy has approved the transfer. The third party must show competence in accepting and managing the environmental liabilities associated with the transfer.

### ***2.2.11 Financial provision***

This Section will detail the financial provision that a gold mine must provide for as part of its environmental rehabilitation programme. The MPRDA details financial provision in Section 41, and states that financial provision has to be made for the remediation and rehabilitation of environmental damage; and that the holder has to make provision before the Minister of Minerals and Energy approves the EMP. Financial provision must also be made for monitoring and performance assessment. The calculation of this provision must be undertaken in accordance with the DME's financial quantum, and should be updated on an annual basis.

The Minister of Minerals and Energy may use the rehabilitation fund if the holder of the mining permit fails to rehabilitate the affected environment. The requirements to maintain and retain financial provision will remain in place until the Minister issues an exoneration certificate. The exoneration certificate will be issued once the Minister is satisfied rehabilitation (and thus closure) has been undertaken in a satisfactory and sustainable manner.

Regulation 53 lists the following methods available to gold mines to make financial provision available:

- ❖ A financial guarantee;
- ❖ A cash deposit;
- ❖ An approved contribution;
- ❖ Any other method deemed satisfactory by the directorate.

## **2.3 OFFENCES AND LIABILITIES**

A gold mine will expose itself to offences and liabilities if it does not comply with environmental legislation, as discussed in Section 2.2 of this document. Each Act has its own means of apportioning liabilities and determining the extent of the offence(s) committed. These offences and liabilities have been detailed in terms of the various Acts in the sub-Sections below.

### ***2.3.1 National Environmental Management Act***

Section 28 states that there is an obligation on the person(s) causing pollution to remedy the situation, while Section 32 states that criminal and civil liability can arise if the principles, statutes and laws are not abided to. Government departments (more specifically DEAT) are entitled to litigate individuals in their private capacity.

The ‘polluter pays’ principle can be applied to a gold mine, although the corporate veil does apply. The mine may be found liable, but not summarily strict.

Section 33 is concerned with private prosecution, and states that ‘Any person may—

(a) In the public interest; or

(b) In the interest of the protection of the environment,

institute and conduct a prosecution in respect of any breach or threatened breach of any duty, other than a public duty resting on an organ of state, in any national or provincial legislation or municipal bylaw, or any regulation, licence, permission or authorisation issued in terms of such legislation, where that duty is concerned with the protection of the environment and the breach of that duty is an offence’.

The government departments are empowered to recover any costs that may be incurred during mitigation, rehabilitation and prosecution. Personal liability may be proved in terms of this Act if the absence of reasonable measures and the presence of negligence can be proved. Section 34 is concerned with criminal proceedings, should any person be convicted of an offence.

The NEMA Amendment Act, No 12 of 2005, states that a gold mine may have to submit an environmental audit if the regulatory authority is suspicious of non-conformance. The reader is referred to Section 29 of this Act for further detail.

### ***2.3.2 Mineral and Petroleum Resources Development Act***

Directors’ liability is dealt with Section 38 of this Act. This Section states that: ‘... (2) Notwithstanding the Companies Act, 1973 (Act No. 61 of 1973), or the Close Corporations Act, 1984 (Act No. 69 of 1984), the directors of a company or members of a close corporation are jointly and severally liable for any unacceptable negative impact on the environment, including damage, degradation or pollution advertently or inadvertently caused by the company or close corporation which they represent or represented.’ (MPRDA, 2002).

### **2.3.3 National Water Act**

There are various Sections within this Act that deal with offences and liabilities. The rectification of water contraventions is dealt with in Sections 53 and 54. The responsible authority may issue a directive, should the gold mine contravene applicable legislation, license requirements, directives or conditions. If the mine does not comply with the directive, the responsible authority is permitted to withdraw licences and permits, carry out any works and take any other action necessary to rectify the contravention (and then recover costs from the mine), and apply to a competent court for relief.

The gold mine carries the liability for water use charges, and these charges will still be applicable under a restriction or suspension. The Act states that any person registered in terms of a regulation or a license under Section 26 to use water is liable for paying all charges imposed under Section 57 in respect of that water use.

Section 151 lists factors that if not adhered to, will constitute an offence. Should the responsible person be found guilty of an offence, the responsible person will be responsible for the costs and implementation of remediation measures.

Section 154 is concerned with offences in relation to employer and employee relationships:

‘Whenever an act or omission by an employee or agent -

- (a) Constitutes an offence in terms of this Act, and takes place with the express or implied permission of the employer or principal, as the case may be, the employer or principal, as the case may be, is, in addition to the employee or agent, liable to conviction for that offence; or
  - (b) Would constitute an offence by the employer or principal, as the case may be, in terms of this Act, that employee or agent will in addition to that employer or principal be liable to conviction for that offence’.
- Section 155 states that a high court may grant an interdict, or another appropriate order, against any person who has contravened any provision of the NWA.

Regulation 14 states that any person(s) failing to comply with regulations 2, 3, 4, 5, 6, 7,8 ,9, 10,11 ,12 and 13 are guilty of an offence. Once convicted, the person(s) will be liable to a fine or imprisonment (for a period not exceeding 5 years).

### **2.3.4 Air Quality Act**

Should a person be found guilty of non-compliance – in terms of Section 48 of this Act – Section 49 will be used to determine the penalty. The offender is liable to fine, imprisonment or both. The fine will be determined according to the severity of the offence, the monetary benefits gained by the offence, and the extent of the contribution of the guilty party's pollution load in the area. Imprisonment will not exceed a period of 10 years.

### **2.3.5 Environment Conservation Act**

This Act relies upon criminal sanction to impress its penalties. The maximum penalty for contravention is 10 years imprisonment, or R100 000, combined with a maximum fine of three times the commercial value of anything in respect of which the offence was committed. If the offender is found to have committed an offence, the court is allowed to impose further charges, e.g. clean-up costs.

### **2.3.6 Biodiversity Act**

The maximum penalty for contravention is 5 years imprisonment, or a fine, or the issuance of both. Section 101 of this Act states that a person will be found guilty of an offence if he fails to comply with Sections 57(1), 65(1), 67(2), 71(1) or 81(1); contravenes or fails to comply with the provisions of Sections 69(1) or 73(1); performs an activity other than that as detailed in the permit; allows another person to commit an offence; alters the permit; and makes a false statement in order to obtain a permit.

## **2.4 BEST PRACTICE REQUIREMENTS**

As previously stated, best practice requirements for effective environmental management are not legislative requirements and their implementation is optional. These best practices lend credibility within the industry as gold mine(s) will be seen to be complying with international norms and standards.

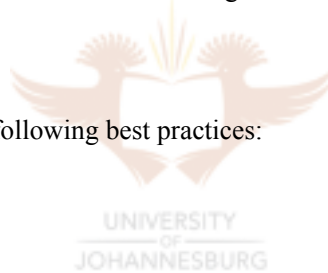
Best practices are therefore not legally binding, but their institution will enable a gold mine to institute a holistic environmental management programme. This implies that the adherence to best practices cannot be seen as a legal defence because negligence will be measured within



the South African legal framework. Many of the best practices, such as the International Organisation for Standardisation's (ISO) policies, are internationally recognised and accredited. Thus, the institution of best practices will also enable the mine to comply with international trends.

This section will give the reader a broad outline of the various best practice systems and requirements that a gold mine can institute, in order to ensure that the mine covers all issues surrounding sustainable development and sustainability pertaining to environmental management. The mine should – at the discretion of management, board of directors, and shareholder requirements – implement a system that best suits the needs of the mine.

Although there are legal means in place, the implementation of best practice requirements will ensure that the gold mining industry has a good public image, and builds trust with the community. Both the gold mine and the community will benefit from this relationship of trust. The mine will be able to demonstrate its national competitiveness and corporate governance. Society and the immediate surrounding community will be able to measure the mine's accountability.



This section will deal with the following best practices:

- ❖ Corporate governance;
- ❖ Risk management;
- ❖ Sustainable development;
- ❖ Accountability
- ❖ ISO systems and reporting;
- ❖ GRI reporting;
- ❖ Environmental Management Systems;
- ❖ Stakeholder engagement.

#### ***2.4.1 Corporate governance***

The Corporate Governance Network ([www.ocgn.com](http://www.ocgn.com)) defines corporate governance as 'enhancing the return on capital through increased accountability'. The institution of corporate governance in the gold mining industry will ensure that the mines honour practices and processes in line with company ethics. This will ensure that the mines abide by the concept of transparency.

Corporate governance is managed by the King II report in South Africa. If a gold mine is owned by an international company, it must ensure that it not only satisfies the requirements of the King II report (such as triple-bottom line reporting and integrated sustainability reporting) , but the host country's requirements.

The Institute of Directors ([www.iod.com](http://www.iod.com)) has identified the factors to be included any corporate governance model. A gold mine must include the following in its corporate governance policy:

- ❖ Clarify and confirm the environment as a stakeholder;
- ❖ Environmental corporate governance must reflect current South African law;
- ❖ 'Reasonable measures' must embody 'Best Environmental Option' standards;
- ❖ Environmental Corporate Governance principles must be integrated with the business of the company;
- ❖ Disclose the environmental ethos, policies, values and beliefs;
- ❖ The mine and Directors must bear responsibility for environmental performance and furthermore must ensure that their activities do no cause environmental harm;
- ❖ Incorporate environmental issues into all aspects of their auditing and reporting;
- ❖ Occupational health and safety must be incorporated into environmental issues;
- ❖ Internal Auditors to be used in monitoring;
- ❖ A person, usually the Company Secretary, must perform statutory duties to ensure environmental compliance;
- ❖ Assist in the formulation of changes in environmental legislation.

(K. Babich, n/d)

#### ***2.4.2 Risk management***

A gold mine needs to define and manage its risks. The directors of the mine now carry a liability in terms of Section 38(2) of the MPRDA. This implies that the directors are now legally responsible for risks, so it is important that they are made aware of, and made to understand, the risks involved. The mine must institute a risk reporting framework. The establishment of a risk management committee will enable the mine to manage its risks effectively.

### ***2.4.3 Sustainable development***

One of the intentions of South Africa's environmental legislation is to achieve an ideal balance between ecological processes and a sustainable economy, while enforcing sustainable development. This enforcement of sustainable development has three tiers: economic, environment and social. The sustainable development concept is deeply entrenched in the MPRDA.

Sustainable development can be defined from the Brundtland Commission as development that must satisfy the present generation without doing harm to the future generations. Furthermore, if a gold mining project is not viable or profitable at a current economic environment, then the project will not be approved by the DME and the resources will be preserved for the future generations. Sustainable development will be achieved when health and safety are not compromised and our natural and cultural resources are not endangered.

Sustainable development has both an environmental and social context, and needs to satisfy three sub-systems: economic development and growth, ecological balance and social development. Whilst environmental sustainability is achieved by reducing resource consumption and deleterious effects on the natural environment, sustainability also has a social dimension in that the costs and benefits of mining become more equitable.

The implementation of sustainable development has numerous positive effects. The White Paper of the Environmental Management Policy for South Africa lists these effects as follows:

- ❖ The betterment of working and living conditions,
- ❖ Equitable access to land and natural resources,
- ❖ Integration of economic development,
- ❖ Social justice and environmental sustainability,
- ❖ Efficient use of energy resources,
- ❖ Interaction between population dynamics and sustainable development,
- ❖ Sustainable use of social, cultural and natural resources,
- ❖ Public participation in environmental governance,
- ❖ The custodianship of our environment.

Agenda 21 (UNCED, 1992) is a sustainable development action plan – a result of the Rio Declaration on Environment and Development. This agenda contains several principles,

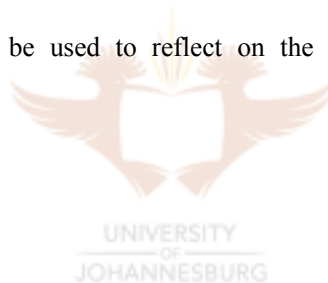
which, if followed, will ensure sustainable development and improved development and well-being.

The only manner through which gold mining can become sustainable is to implement measures that ensure the mine is incorporating sustainable development through its projects and operations. However, sustainable development will only be realised when both mine and government departments are jointly able to achieve their respective objectives with regard to sustainable development (Swart, 2003). A gold mine has a profit objective and the expertise to extract mineral resources, while the government departments have a local socio-economic development objective (Swart, 2003).

It must be noted that unless the gold mining industry, labour, community-based organisations, and NGOs all co-operate with and obey the environmental laws, sustainable development will fail and ecosystem deterioration, illiteracy, poverty, hunger and sickness will continue to prevail.

The following indicators can be used to reflect on the effectiveness of a gold mine's sustainability (Kapelus, n/d):

- ❖ Environmental pollution;
- ❖ HIV/Aids;
- ❖ Limited resources;
- ❖ Conflict;
- ❖ Migration;
- ❖ Retrenchment;
- ❖ Resettlement.



These indicators need to be revised on a regular basis. The gold mining industry is an ever-changing environment, and these indicators need to be adapted on needs-be basis.

Reporting on indicators involves a triple bottom line approach incorporating environmental, social and economic responsibility. The implementation of the triple bottom line will allow for the mine to account for its actions in terms of environmental aspects, social aspects, governance, and economic aspects (Kapelus, 2003).

#### **2.4.4 Accountability**

Accountability is a crucial element of sustainable development (Kapelus, 2003). Materiality, responsiveness and completeness are the three principles that encompass accountability (Kapelus, 2003). A gold mine needs to identify all material issues that face the business and society, be responsive to all issues that the stakeholders have identified as being important, and tackle all issues to the full extent in order to ensure completeness (Kapelus, 2003).

A gold mine carries accountability for the following issues (Kapelus, 2003):

- ❖ Planning;
- ❖ Project development;
- ❖ Exploration;
- ❖ Construction;
- ❖ Operation & maintenance;
- ❖ Abandonment;
- ❖ Decommissioning;
- ❖ Post-closure.

These issues can have an adverse effect on the environment, and thus the mine will be held accountable for them until the Minister of Minerals and Energy can satisfactorily establish that there is no long-term damage to the environment. The MPRDA also ensures that these aspects are addressed so that the mine has to take accountability. For example, the EMP is a mandated document and is legally binding.

#### **2.4.5 ISO systems & reporting**

The implementation of ISO standards will offer a gold mine a wide-ranging portfolio of standards for sampling and test methods to deal with specific environmental challenges. These include the standards for the monitoring of the quality of air, water and soil, as well as noise and radiation; and standards that will aid the mine in taking a more pro-active approach to managing environmental issues.

The ISO system for environmental management is ISO 14000. There are several standards that must be taken into consideration:

- ❖ ISO 14001 – Environmental management systems – specification with guidance for use;
- ❖ ISO 14004 – Environmental management systems – general guidelines on principles, systems and supporting techniques;

- ❖ ISO 14010 – General principles of environmental auditing;
- ❖ ISO 14010/1 – Auditing of environmental management systems;
- ❖ ISO 14012 – Qualification requirements for environmental auditors;
- ❖ ISO 14020/5 – Guidelines and principles for environmental auditing;
- ❖ ISO 14030/1 – Guidelines and principles for environmental performance evaluation;
- ❖ ISO 14040/3 – Guidelines and principles for life cycle assessment;
- ❖ ISO 14050 – Terms and definitions;
- ❖ ISO 14062 – Design for environment;
- ❖ ISO 14063 – Environmental communication.

The codes of specification must be implemented in the following order (ISO 14001):

- ❖ Commitment and policy;
- ❖ Planning;
- ❖ Implementation;
- ❖ Measurement and evaluation;
- ❖ Review and improvement.

There are numerous benefits that a gold mine will experience by implementing the ISO 14001 model. These include:

- ❖ An improved corporate image (demonstration of sound business management that includes concern for the environment);
- ❖ The maintenance of regulatory compliance to a position of improved productivity and enhanced competitive advantage;
- ❖ Improved environmental performance;
- ❖ Superior performance;
- ❖ An increased state of preparedness;
- ❖ Compliance with legislative and other requirements (including the Mining Charter);
- ❖ Industry-wide standardisation;
- ❖ A reference framework to international standards;
- ❖ The implementation of an Environmental Management System;
- ❖ The standards are viewed as technical agreements;
- ❖ Reduced raw material/resource use;
- ❖ Reduced energy consumption;
- ❖ Improved process efficiency;
- ❖ Reduced waste generation and disposal costs;
- ❖ Utilization of recoverable resources;

- ❖ The minimisation of harmful effects on the environment that are caused by the mine's activities.

#### **2.4.6 Global Reporting Initiative**

The Global Reporting Initiative (GRI) is a multi-stakeholder process and independent institution whose mission is to develop and disseminate globally applicable sustainability reporting guidelines (Global Reporting Initiative, n/d). The implementation of this reporting framework will thus guide a gold mine on sustainability reporting.

By implementing the GRI Principles, a gold mine will realise the following benefits:

- ❖ The reports will present a balanced and reasonable account of economic, environmental and social performance;
- ❖ The reports will reflect the mine's contribution to sustainable development;
- ❖ The reports will facilitate comparison over time;
- ❖ The reports will facilitate comparisons across organisations;
- ❖ The reports will allow management to credibly address issues of concern to the stakeholders.

(GRI, 2002)

The GRI recommends the inclusion of water indicators for the effective management of water. These indicators include:

- ❖ Total water use;
- ❖ Significant discharges to water by type;
- ❖ Water sources and related ecosystems/habitats significantly affected by use of water;
- ❖ Annual withdrawals of ground and surface water as a percent of annual renewable quantity of water available from the sources;
- ❖ Total recycling and re-use of water;
- ❖ Water sources and related ecosystems/habitats significantly affected by discharges of water and runoff.

(GRI, 2002)

#### **2.4.7 Environmental management system**

An Environmental Management System (EMS) is typically used to comply with the ISO 14000 standards. However, it is an excellent management tool to use even if a gold mine does

not have ISO accreditation, and has thus been dealt with separately to ISO. The establishment of an EMS will allow the mine to collate its information in an orderly manner, and also ensure the correct dissemination of information. The generation of electronic reports and specifications will ensure that all relevant parties are kept abreast of issues and developments. An EMS will allow the gold mine to monitor its conformance, and deal with 'red-flagged' issues immediately.

Smuts (et al) list the following requirements of an EMS:

- ❖ Baseline information;
- ❖ Monitoring information;
- ❖ Operational targets;
- ❖ Incident tracking;
- ❖ Management review;
- ❖ Access to the system.

#### **2.4.8 Stakeholder engagement**

Stakeholder engagement will not only ensure that society and the immediate environment are trusting of the gold mine, but also assists with identifying issues that are of concern to the public. Stakeholder engagement allows the mine to be pro-active, encourages preventive engagement, and encourages the scoping of solutions (Reichardt, 2003).

Stakeholder engagement does not begin and end with running public participation meetings when required to by legislative means, but must form part of the total life of the project. Stakeholder engagement also involves building relationships with the public, and informing all relevant parties of the 'state of the environment' of the gold mine. The mine must attend public forums, participate in action groups, and have regular meetings with the various community groups. Articles pertaining to projects and environmental progress on the mine published in newspaper will also facilitate with stakeholder engagement.

Stakeholder engagement is a two-way process (Reichardt, 2003). Whilst the gold mine is able to educate the stakeholders as to the goings-on of the mine, the stakeholders themselves are able to inform the mine as to what their specific needs are. It is excellent public relations for the mine to be seen as proactive, transparent, and open to sharing information and ideas with the community. The public needs to know that it enjoys open channels with the mine. However, it must be made clear that stakeholder engagement must not be public relations



driven exercise. The gold mine has a responsibility towards society, and this definitely involves stakeholder engagement.

There are several requirements for constructive stakeholder relationships between a gold mine and the community. These can be listed as follows (Reichardt, 2003):

- ❖ Company structures require a reporting and decision making hierarchy, that ends at a dedicated function at the executive level;
- ❖ Acceptance that this is a core function;
- ❖ Protection from arbitrary changes by other functions;
- ❖ Ability to attract and retain specialists;
- ❖ Long-terms investment in relationship building;
- ❖ Engagement to include the appropriate transfer of sustainable and relevant skills;
- ❖ Key stakeholders begin outside of the comfort zone;
- ❖ Stakeholders must be made to understand the limits to the mine's capabilities.

## **2.5 CODES OF PRACTICES**

Codes of Practices (COPs) are documents that need to be implemented on a gold mine as a means of instruction for the management of residue deposits and cyanide. The COPs are indicative of a gold mine's management philosophy, and should be compiled so that employees are versed in the management of the issues under question. There are two COPs relevant to the mining industry in terms of environmental management: residue deposits and cyanide.

Whilst COPs are not approved by the DME, they must be submitted to the relevant department(s) of the DME. These COPs are mandatory, that is, if they are not adhered to, the DME may take legal action against the mine.

### ***2.5.1 Residue deposits***

The COP for residue deposits is based on the Chamber of Mines guideline and SANS 10286. The reader is referred to these for further information about the factors that need to be addressed and included in this COP.

Although the management of residue deposits does not strictly fall under environmental management, the mismanagement of residue deposits will have an adverse impact on the environment. It is therefore important for this COP to be taken into consideration.

### **2.5.2 Cyanide**

The COP for cyanide management is based on the Chamber of Mines guideline. The reader is referred to these for further information about the factors that need to be addressed and included in this COP.

## **2.6 CONCLUSION**

In order for a gold mine to effectively implement its environmental management practice and philosophies, it is important that all statutory requirements are met. This chapter has provided the reader with an outline of the environmental legislative requirements and best practices for this implementation. Thus, the reader has been familiarised with the requirements and documents necessary for effective environmental management on a gold mine.

The contents of this chapter will feature in the implementation programme contained in Chapter 4.

## **CHAPTER 3 NEW LEGISLATION**

This chapter details new legislation that is due to come into effect. The inclusion of these legislative requirements will save the gold mine both time and money by not having to revise the implementation plan once the new laws are promulgated. It is thus important to take note of the various changes pending in South Africa's environmental legislation, as these changes will have an effect on the legislative requirements that the gold mining industry has to comply with.

### **3.1 THE NATIONAL ENVIRONMENTAL MANAGEMENT SECOND AMENDMENT ACT**

The proposed National Environmental Management Second Amendment Act is concerned with amendments to Chapter 5 of NEMA. This Act was assented to on the 9 July 2004, but has not been allocated with an effective implementation date.

It is important to note that any permits and authorisations that have been granted in terms of other legislation, will not absolve the company from obtaining authorisation under this Act.

#### **3.1.1 EIAs**

The Bill repeals Section 24(1) of NEMA, and indicates that EIAs will only be required for listed activities. The EIA regulations, compiled under NEMA, are expected to include mining activities as listed activities. Thus, an EIA will have to be undertaken when a mining project is undertaken. This is of major significance for the gold mining industry in South Africa. Whilst mining activities are indeed conducted in terms of a mining authorisation (issued under the Minerals Act 50 of 1991), they also fall within the ambit of listed activities in terms of the Environmental Conservation Act (ECA). This implies that EIAs must have been undertaken.

The Minister of Minerals and Energy (or MEC) will have the authorisation to direct a company (in this case, a gold mine) to compile an EIA. The Minister (or MEC) will have the power to either grant an environmental authorisation or issue a directive for the company to

cease the activity (this may be in its entirety or partly). If the company is directed to cease the activity, it will be responsible for the rehabilitation of the environment.

### ***3.1.2 Offences & liabilities***

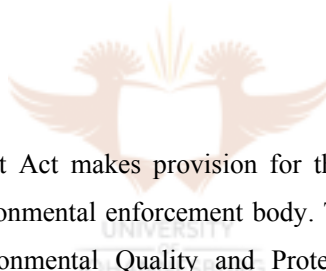
Gold mines that undertake listed activities in contravention of the ECA will face the risk of a fine (to the amount of R5 000 000.00 per activity). It is important to note that this contravention of the ECA can result in the imprisonment of the chief executive (up to a period of 10 years).

### ***3.1.3 Environmental practitioners***

This Amendment Act calls for the registration of environmental practitioners. This will ensure that standards are set, and maintained by these environmental practitioners.

### ***3.1.4 Green scorpions***

Section 34 of this Amendment Act makes provision for the Green Scorpions. The Green Scorpions will act as the environmental enforcement body. This enforcement body has been formed under DEAT's Environmental Quality and Protection Directorate, and will be concerned with authorisation, compliance, monitoring, enforcement and prosecution.



## **3.2 WASTE DISCHARGE CHARGE SYSTEM**

The waste discharge charge system (WDCS) is a proposed charge system that relates to water pollution. Gold mines will be expected to pay a certain charge according to the quality of the water that they discharge – mines will pay a charge per volume of adverse quality discharged and will receive a rebate for water that complies with discharge standards. The charge system will be based upon several key objectives:

- ❖ The internalisation of the costs of pollution imposed on society by the discharger (mine);
- ❖ The recovery of costs;
- ❖ An incentive for the prevention/reduction of pollution;
- ❖ The promotion of sustainable water use.

This system was promulgated in September/October 2005, but has not been allocated with an effective implementation date.

### **3.3 ENVIRONMENT CONSERVATION ACT AMENDMENT ACT**

This amendment act was assented to on the 10 February 2004, and has not been allocated with an effective implementation date, and will replace Section 20 of the original Act. It is anticipated that the promulgation of this amended Act will allow for effective waste management on a national scale, and will for the transfer of administration of Section 20 to the DEAT. Section 20 is currently administered by the DWAF, and is concerned with waste management (and the associated permits). The Minister for Environmental Affairs and Tourism will be granted to set regulation with regard to financial provision.

### **3.4 NATIONAL WASTE MANAGEMENT ACT**

This Act will be responsible for the promotion of inter alia cleaner gold mining production; the prevention of pollution; a volume decrease of waste at its source; and the recovery, re-use and recycling of waste..



### **3.5 NATIONAL WATER PRICING STRATEGY FOR WATER USE CHARGES**

This pricing strategy will be concerned with pricing of raw water, and will thus only deal with the abstraction and storage of water and stream flow reduction activities by a gold mine. It is important to note that this strategy does not deal with waste discharges. Waste discharges will be handled separately, under the WDCS.

### **3.6 CONCLUSION**

This chapter has familiarised the reader with the new environmental legislation that is due to come into effect in South Africa. This new legislation needs to be taken into consideration, as it will repeal existing legislation, or introduce new aspects that a gold mine has to take into

consideration (for example the WDCS) for its implementation programme contained in Chapter 4.

The contents of this chapter will feature in the implementation plan contained in Chapter 4.



## **CHAPTER 4 IMPLEMENTATION PROGRAMME**

This chapter details the general implementation plan that can be used by a gold mine in order to ensure legislative compliance, as well as adherence with best practices in order to achieve effective environmental management. As was stated in the introduction, gold mines should implement a step-by-step programme that addresses all the requirements at hand in order to achieve integrated environmental management. Thus, if a gold mine was to follow this implementation plan (consisting of five phases), it would become compliant with all legislative and best practice requirements.

The various phases are arranged according to priority. That is, the highest priority issues are implemented in Phase 1, whilst those issues with the lower priorities are dealt with in the phases that follow. For example, the first point of departure is to institute an EMP. Once the EMP is compiled, programmes such as the monitoring programme can be instituted. Each phase has been divided into various steps, in order to facilitate the implementation. It should be noted that this is a generic plan, and can be adapted according to a gold mine's operations, specifications and requirements.

Figure 2 below represents the Phases 1-5 that need to be implemented by a gold mine in order to achieve compliance. The roll-out process of the five phases is described in detail in the sections that follow.

### **4.1 PHASE 1**

This phase addresses the necessary detail for the compilation and submission of various documents for the institution of an EMP. The following documents need to be compiled by the gold mine and submitted to the relevant government departments for approval:

- ❖ EMP;
- ❖ Air Quality Management Plan;
- ❖ Water Management Plan;
- ❖ Water treatment;
- ❖ Code of Practices;
- ❖ Rehabilitation Trust Fund.

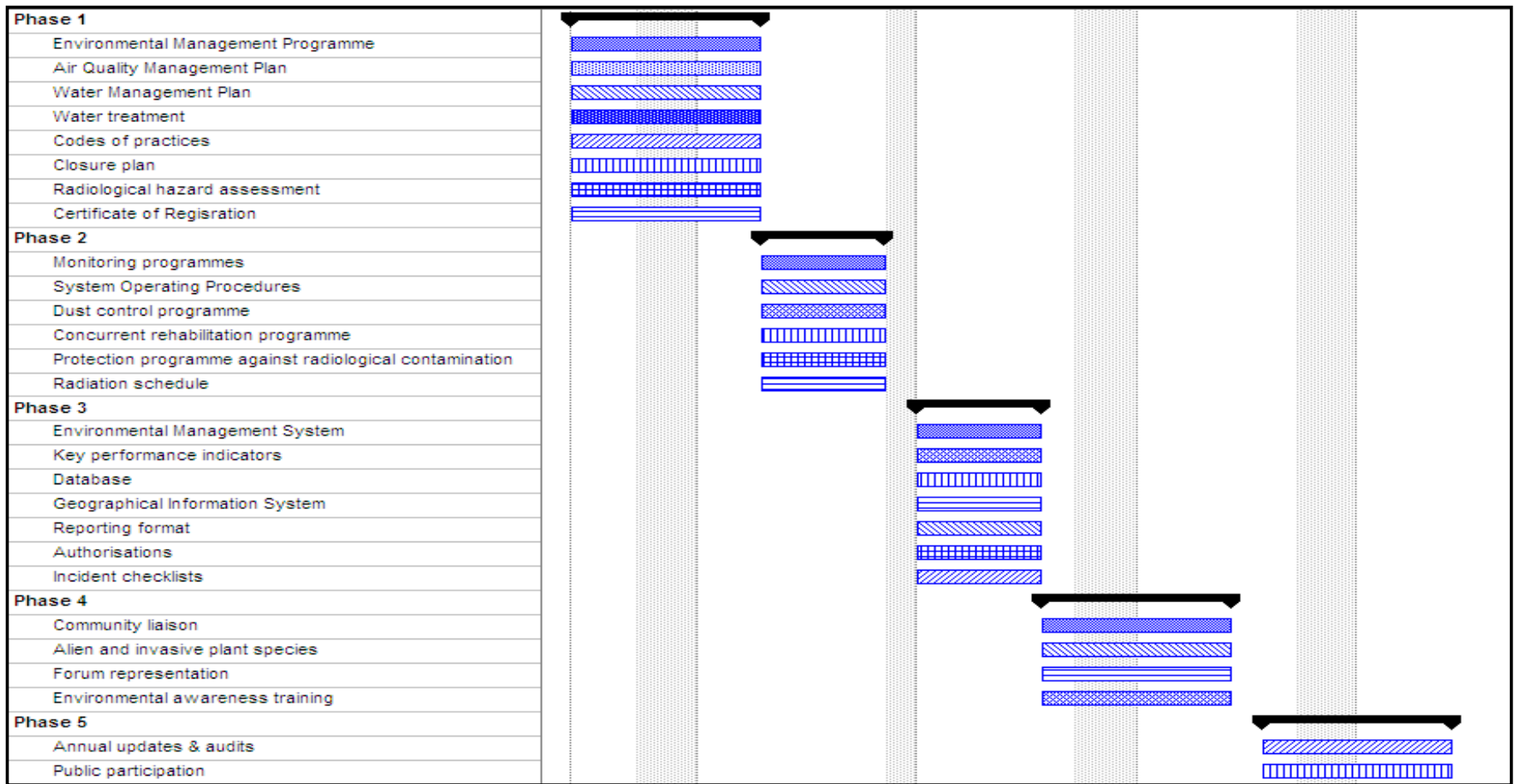


Figure 2: The various phases and tasks of the implementation plan



#### ***4.1.1 Environmental Management Programme***

EMPs for new operations/projects must be compiled according to the requirements of the MPRDA. If the gold mine has an existing and approved EMP, then an amendment to the document needs to be carried out in order to bring the existing EMP in line with the requirements of the MPRDA. The gold mine must ensure that the amendment contains a closure plan and risk assessment.

#### ***4.1.2 Air Quality Management Plan***

This AQMP must detail the measures to be taken with regard to dust, noise and stack emissions. Measures for the prevention and minimisation of dust must be instituted. The measures employed will be dependent on cost, future plans for the tailings dam(s), activity on the dam(s), and the time period needed for dust inhibition. For example, if a tailings dam is to be reworked shortly after the implementation of the dust suppressant system, the use of a chemical dust suppressant might prove to be economical than planting vegetation. Chemical dust suppressant is not a recommended method for any surface area that will have activity on it.

Long-term measures that can be employed for dust suppressant include vegetation and rock armouring. It is important to note that, whatever dust suppressant method is employed, maintenance is an integral part of any dust suppressant programme. This includes maintenance post-closure of the mine. Stack emissions must be reduced to acceptable levels that are in line with the air quality standards. Vehicular emissions must be brought in line with statutory requirements, as per the air quality standards.

#### ***4.1.3 Water Management Plan***

The gold mine must ensure that all its activities are listed in its water license. Should the mine not have a water use license, a Water Use License Application must be completed, and submitted to DWAF. This application must contain the following:

- ❖ Water balance;
- ❖ Salt balance;
- ❖ Integrated Water Management Plan;

- ❖ Any other documents requested by DWAF;
- ❖ Emergency incident procedure.

The water management plan will not only ensure compliance to legislation, but also allow for the effective management of water. This plan must be designed according to DWAF's water management hierarchy: reduce, reuse, and recycle, and must comply with the requirements as instituted by the Department of Water Affairs and Forestry (DWAF).

This water management plan must include options that will ensure that as much of the water as possible that the mine discharges is used internally (this will decrease the volume of water that is discharged into the natural water system, as well as the volume of water from Rand Water that is utilised). The plan must also conform to DWAF's mission, which is that the flexible national water management strategy is related to supply, demand and quality. A water management plan will not only ensure compliance to legislation, but also allow for the effective management of water.

#### ***4.1.4 Water treatment***

Any water that is discharged by the gold mine will need to be treated before it is discharged. The treatment plant/process must be adjusted so that the water that is discharged from this plant complies with the relevant water quality objectives (as determined by DWAF). Allowance must be made for this in the planning stage if the operation is new. If it is an existing mine, this must be looked at as a matter of urgency.

#### ***4.1.5 Codes of Practices***

The following COPs must be compiled if not already instituted on the gold mine:

- ❖ Residue deposits;
- ❖ Cyanide.

Should the mine have these documents in place, they should be revised and updated as per the DME requirements.

#### **4.1.6 Closure plan**

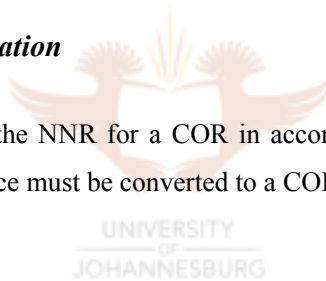
A closure plan must be tabled, and must include the rehabilitation schedule for the gold mine. The rehabilitation schedule must be inclusive of both concurrent and final rehabilitation, as well as any monitoring and maintenance problems that may need to be instituted. A Rehabilitation Trust Fund must be established in accordance with the MPRDA.

#### **4.1.7 Radiological Hazard Assessment**

A hazard assessment must be carried out in order to determine what radiation exposure workers and the public will experience as a result of the mine's operations. This assessment must also determine what the major sources of radiation are, as well as the greatest exposure pathways. This assessment must be used to set-up and implement the worker and public monitoring schedules.

#### **4.1.8 Certificate of Registration**

The gold mine must apply to the NNR for a COR in accordance with the NEA. If it is an existing mine, the nuclear licence must be converted to a COR.



## **4.2 PHASE 2**

This phase addresses the various steps that will provide the necessary information for the implementation of the following:

- ❖ Monitoring programmes;
- ❖ System operating procedures;
- ❖ Dust control programme;
- ❖ Concurrent rehabilitation programme;
- ❖ Protection programme against radiological contamination;
- ❖ Radiation schedule.

#### **4.2.1 Monitoring programmes**

The gold mine must implement monitoring programmes in order to monitor the impacts its operations have on the environment. These programmes will also enable the mine to track

pollution plumes, identify new sources of pollution and establish pollution trends. The mitigation of adverse impacts and the success of rehabilitation will also be reflected in the monitoring data and trends.

Monitoring forms an essential part of any environmental management system. Santren lists the following features of a monitoring programme:

- ❖ Definition of the objectives,
- ❖ Baseline studies prior to the activity,
- ❖ Assessment of any damage/impact, prediction of future sources of pollutants under study and their effects,
- ❖ Selection of parameters to be studied.

The various monitoring programmes detailed in the EMP must be implemented. It is assumed that trends were identified and analysed before monitoring programmes were compiled. If this was not the case, the gold mine must establish baseline trends before the monitoring programme is implemented. A monitoring programme must concentrate on 'problem' areas, as well as serve to identify any developing 'problem' areas. It is impossible to identify the 'problem' areas if trends have not been established.

#### **a. Water**

A water monitoring system (inclusive of both surface and ground waters) must be instituted. Not only will this ensure compliance to legislation, it will enable the gold mine to constantly track the quality of the water, and ensure adherence to the requirements of the EMP. This monitoring programme must integrate the analysis of chemical, physical, toxicological and biological parameters.

It is suggested that sites of potential pollution are identified. The monitoring points chosen must include these identified points of pollution, as wells as sites upstream and downstream of the pollution. Additional sites must be established on a needs be basis. These sites must be entered into a GIS system. The monitoring points must be registered with DWAF.

## **b. Air**

### *(i) Dust*

Dust monitoring sites must be identified, and be incorporated into a dust monitoring programme. The establishment of the programme will enable the gold mine to identify the sites that need to be addressed. The dust fallout results will also enable the mine to monitor the effectiveness of the dust suppression measures that are employed.

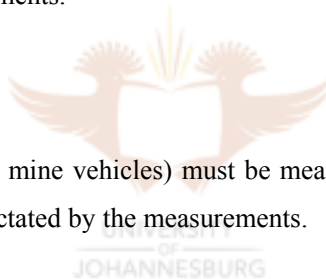
The guidelines to be used for this monitoring programme must be the air quality standards of the AQA. The use of these guidelines will enable the gold mine to classify different points/sites of dust fallout, and thus institute appropriate corrective action.

### *(ii) Stack emissions*

The implementation of a stack emission monitoring programme will enable the gold mine to comply with legislative requirements.

### *(iii) Vehicles*

The vehicular emissions (of all mine vehicles) must be measured and monitored. Mitigatory measures must be taken if so dictated by the measurements.



## **c. Radiation**

This monitoring programme must encompass both underground (if applicable) and surface monitoring, as well as the monitoring of any scrap metal that is to be sold for either non-restricted or restricted release.

Underground monitoring will be used to compile the radiation protection programme, and will provide data for the medical surveillance programme. This data can also be used to highlight the areas where protection against contamination is necessary.

The surface monitoring data must be used in the medical surveillance programme, the radiation protection programme, and the public hazard assessment. This data can also be used to highlight the areas where protection against contamination is necessary.

Radon, long-live alpha and gamma must be monitored underground. Gamma, beta and alpha must be monitored on surface. This monitoring must not only focus on employees, but also the public and working areas.

The following areas must be monitored during the operational and closure stages:

- ❖ Tailings dams;
- ❖ Sand dumps;
- ❖ Plant;
- ❖ Water treatment plants;
- ❖ Shafts;
- ❖ Salvage yards;
- ❖ Workshops;
- ❖ Undisturbed areas;
- ❖ Sludge dumps;
- ❖ Rock dumps;
- ❖ Slag dumps;
- ❖ Land nearby ventilation shafts;
- ❖ Storage dams and pans;
- ❖ Seepage from tailings and sand dumps;
- ❖ Areas where spills have occurred;
- ❖ Points where the watercourse(s) cross the mining lease area (if any).

#### **d. Soil**

Soil samples must be taken and analysed in order to determine if any chemical degradation/pollution has taken place. This can be done on an annual basis.

A visual inspection programme must be instituted, so that any physical degradation (erosion) can be spotted and dealt with immediately. This inspection programme must form part of the programme for concurrent rehabilitation, as well as be included in the post-closure monitoring programme.

#### **e. Noise**

It must be noted that noise is measured in both an environmental capacity (noise is viewed as a source of pollution), and an occupational hygiene capacity. It is recommended that synergy exists between the environmental and occupational hygiene noise monitoring programmes.

#### **4.2.2 System Operating Procedures**

The institution of System Operating Procedures (SOPs) will ensure uniform methods and programmes mine-wide. These methods and programmes need to be uniform in their implementation so that they can be standardised, and thus provide accurate information on the aspects listed below. It will also allow for the comparison of data obtained on various sites within the lease area of the gold mine. SOPs are a best practice requirement.

SOPs to be compiled and implemented include:

- ❖ Water monitoring;
- ❖ Dust monitoring;
- ❖ Stack emission monitoring;
- ❖ Incident reporting;
- ❖ Noise monitoring;
- ❖ Soil monitoring;
- ❖ Emergency procedure;
- ❖ Radiation monitoring of scrap metal;
- ❖ Risk assessment;
- ❖ Risk communication;
- ❖ Protective measures for radioactive sources;
- ❖ Operational control (to ensure legal compliance);
- ❖ Public participation;
- ❖ Rehabilitation;
- ❖ Waste management;
- ❖ Recycling;
- ❖ Transportation of radioactive materials.



#### **4.2.3 Dust control programme**

Dust suppression methods must be put in place in order to mitigate dust pollution, emanating from sources such as waste rock dumps and slimes dams. Various dust suppression methods can be used on areas that contribute to dust pollution:

- ❖ Vegetation;
- ❖ Rock armouring;
- ❖ Irrigation;

- ❖ Dust suppression agents.

The method(s) that are chosen must be in line with the mining work programme, as well as the rehabilitation and closure programmes. For example, if a mine dump that contributes to dust pollution is due to be reclaimed, then a temporary (yet effective) dust suppression method must be implemented as opposed to a more expensive permanent option.

#### ***4.2.4 Concurrent rehabilitation programme***

This rehabilitation programme must be carried out along with the operations on the gold mine, and will involve the rehabilitation of selected areas/sites. This programme must include, but not be limited to, the following:

- ❖ Vegetation of tailings;
- ❖ Clean-up of all spillages;
- ❖ Sealing and capping of derelict shafts;
- ❖ Rehabilitation of reclamation sites as mining ceases.

The end-use of all land on the mine must be identified. This will allow for more effective rehabilitation, as the land, tailings and areas can be rehabilitated to exact requirements.

A sampling procedure of the soils contained in all areas that require vegetation must first be undertaken. This will allow the gold mine to determine the extent of amelioration, and the types of grass/shrubs/trees that must be planted. The types of grass/shrubs/trees that are planted will also be determined by the location of the area(s). Vegetation must be of an indigenous nature as far as is practicably possible.

The residue from spillages that occur in the reduction plant must be recirculated through the plant, and then disposed of on the tailings facility. Spillages occurring outside the plant (for example, from pipeline bursts) must be thoroughly cleaned up and disposed of in an environmentally friendly manner.

Firebreaks must be established, and maintained during the winter months in areas that are vegetated. The National Veld and Forest Fire Act state that the gold mine has a duty to prepare and maintain firebreaks. The fire protection association must be informed of the date the mine wishes to burn these firebreaks, as well as the owner of any adjacent land.



It must be noted that the programme implemented to eradicate alien and invasive plant species can also be incorporated herein.

#### ***4.2.5 Protection programme against radiological contamination***

The gold mine must compile, and implement, a programme that will decrease contamination of the receiving environment due to radiation.

#### ***4.2.6 Radiation schedule***

The NNR will issue the gold mine with a schedule for all reports that must be compiled or reviewed. This schedule must be detailed in Part 2 of the mine's COR. The mine must liaise with the NNR in order to determine timeframes for the submission of these reports. Monitoring data from the radiation monitoring programme can be used to provide the information necessary for the compilation of these reports.

### **4.3 PHASE 3**

This phase addresses the detail that will provide the necessary information for the implementation of the following:

- ❖ Environmental management system;
- ❖ Key performance indicators;
- ❖ Database;
- ❖ Geographical information system;
- ❖ Reporting format;
- ❖ Authorisations;
- ❖ Incident checklists.

#### ***4.3.1 Environmental Management System***

An EMS must be instituted by the gold mine. The EMS must be specific to the gold mine's requirements, and must receive buy-in from senior management in order for the implementation to be successful. The detail contained within the EMS will depend on what

data the gold mine wishes to have available, and the aspects of the operation the mine wishes to include.

#### ***4.3.2 Key performance indicators***

Key performance indicators (KPIs) need to be established for each environmental consideration. The delineation of KPIs will allow for compliance to all legislative and best practice requirements. It is suggested that the KPIs are incorporated into the environmental management system, so that deviations from the KPIs can be red-flagged and follow-up can be instituted accordingly.

#### ***4.3.3 Database***

The institution of a database will ensure that the gold mine is able to monitor measurable parameters concerning environmental impacts and mitigation at all times. A database can also be used to monitor trends and anomalies, and should be linked to an environmental management system. This is an excellent method to ensure that environmental compliance is regulated. The results obtained from all the monitoring programmes should be entered into the database, in order for the gold mine to monitor how successful the implementation of the mitigatory measures has been.



#### ***4.3.4 Geographical Information System***

The installation of a Geographical Information System (GIS) will enable the gold mine to investigate different scenarios quickly and efficiently (Hugo, et. al., 1997). The GIS system has the ability to store and access large data sets, and will allow more effective management of the issues and aspects that it currently manages. It can also be used as a tool for problem identification.

#### ***4.3.5 Reporting format***

A reporting framework must contain or encompass the principles and guidelines of ISO and GRI. The institution of a framework will allow for the standardisation of reporting on the gold mine. The standardisation of reporting will allow for all data to be comparable.

#### **4.3.6 Authorisations**

The Radiation Protection Officer must check radiation authorisations of all dealers to who restricted release items are sold to.

#### **4.3.7 Incident checklists**

The environmental department on the gold mine ought to compile incident checklists that must be distributed to various levels of employ. The incident checklists must be used to note any adverse impacts on the receiving environment. It is suggested that distribution takes place from foreman level upwards. These employees must be encouraged to use the checklists and submit them to the environmental department. This will allow the environmental department to monitor impacts on a greater scale on the gold mine. The more employees there are involved in identifying incidents, the more adverse impacts will be noted (and thus mitigated).

### **4.4 PHASE 4**

This phase provides the reader with information for the implementation of the following:

- ❖ Community liaison;
- ❖ Alien and invasive plant species;
- ❖ Forum representation;
- ❖ Environmental awareness training.



#### **4.4.1 Community liaison**

The gold mine must establish communication channels with the community, as well as stakeholders. These members of the community must be made aware of what the mine's contribution is to environmental management in the area. The mine must task an employee (or a committee) with community liaison. This will establish trust within the community, as the members will know whom to contact if they have grievance. A hot line can also be established. This must be manned by a mine employee, and available on a 24-hour basis.

#### ***4.4.2 Alien and invasive plant species***

A programme for the eradication of alien and invasive plant species on the gold mine's lease area must be compiled and implemented. This eradication programme can be carried out by the mine itself, or the mine can partner with various companies and organisations, for example the Department of Water Affairs and Forestry's Working for Water Programme. The mine can use this as an opportunity to create a beneficiation project.

The reader must note that the eradication of alien and invasive species is a long-term project. Many plants will have seeds in the soil that will germinate at a later stage, for example eucalyptus seeds can lie dormant in soil for 50 years before re-germinating.

#### ***4.4.3 Forum representation***

Care must be taken to ensure that the mine is represented on all relevant forums. This forum representation must include representation on a water forum that is representative of the applicable catchment management agency. Catchment management agencies are bodies that are empowered by the NWA, and are concerned with the management of water resources. The gold mine will be able to have input in the management of the water resources that affect it, if it is represented on the relevant water forum(s).



#### ***4.4.4 Environmental awareness training***

The gold mine must ensure that its employees receive environmental awareness training, in order for them to realise the harmful effect of pollution on the environment, the value of resources, the potential hazard of radiation, and understand the system operating procedures. These training sessions must be held on a regular basis, and must also form part of the induction programme.

### **4.5 PHASE 5**

This last phase will provide the reader with information regarding annual updates and audits, as well as public participation.

#### ***4.5.1 Annual updates and audits***

The gold mine must ensure that the following is carried out on an annual basis:

- ❖ EMP audit;
- ❖ Review COR Schedule;
- ❖ Review water license conditions;
- ❖ Review the AQAP;
- ❖ Review the RTF status, and contributions that have been made;
- ❖ Review closure costs;
- ❖ Assess the status of rehabilitation;
- ❖ Review trends, and modify monitoring programmes accordingly;
- ❖ Assess compliance to COPs.

#### ***4.5.2 Public participation***

The gold mine must hold public participation meetings each time it implements a new project or environmental programme.

It is clear from the discussion of these five phases, that the various issues pertaining to legislative and best practice requirements can be implemented by a gold mine by using a step-by-step process. A gold mine will become compliant with legislative requirements and will be able to implement best practice requirements if it follows this particular implementation plan. This process must be implemented according to priority, that is, issues with high priorities should be dealt with before issues with lower priorities.

## **CHAPTER 5 CONCLUSION**

This study has been undertaken, as it is important to have a single document containing the necessary information on legislative and best practice requirements, as well as an implementation plan involving a step-by-step process for a gold mine's compliance to the various requirements for holistic environmental management.

Due to the nature of its operations, a gold mine is exposed to various legal issues. Chapters 2 and 3 of this document provide the reader with the necessary information on the various aspects that a gold mine needs to have in order so that it can decrease its exposure.

Chapter 2 provides the reader with detail concerning the responsibilities of the various regulatory authorities, the current legislative and best practice requirements pertaining to the gold mining industry, codes of practices, and offences and liabilities that the mine can become exposed to that are currently in place. The legislative requirements have been divided into 'umbrella' legislation and legislation pertaining to specific aspects contained in a gold mine's EMP. 'Umbrella' legislation is general legislation that pertains to the general aspects of environmental legislation and management. The aspects that need to be included in an EMP have been classified under water, air, waste, soil, radiation, noise, biodiversity, alien and invasive plant species, rehabilitation, closure and financial provision.

Chapter 3 details information on new legislation that is due to come into effect. Although this legislation has not come into effect yet, it is important for gold mines to be aware of it so that it can be included in planning for future implementation programmes.

The implementation plan that can be used by a gold mine in order to ensure legislative compliance, and adherence with best practices in order to achieve effective environmental management is detailed in Chapter 4. A gold mine will be able to institute all legislative requirements and best practices if it adopts the implementation plan. This implementation plan is a step-by-step process, making it easy to follow and implement.

This dissertation has thus provided the gold mining industry with an overview from which to work in order to become legally compliant with issues pertaining to environmental management in South Africa, so that it can achieve effective environmental management.

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