DEPARTMENT OF ENVIRONMENTAL AFFAIRS

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NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998
(ACT NO. 107 OF 1998)

NATIONAL GUIDELINE ON MINIMUM INFORMATION REQUIREMENTS FOR PREPARING ENVIRONMENTAL IMPACT ASSESSMENTS FOR MINING ACTIVITIES THAT REQUIRE ENVIRONMENTAL AUTHORISATION

I, Bomo Edith Edna Molewa, Minister of Environmental Affairs, hereby give notice of my intention to publish the National Guideline on Minimum Information Requirements for Preparing Environmental Impact Assessments for Mining Activities that Require Environmental Authorisation, in terms of section 24J of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as set out in the Schedule hereto.

Members of the public are invited to submit to the Minister, within 30 days after the publication of this Notice in the Gazette, written comments or inputs to the following addresses:

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Any inquiries can be directed to Mr Alfred Mocheko on (012) 399 9315 or Ms Sujata Carlyle at 012 399 9314.

The National Guideline can also be accessed on the departmental website: www.environment.gov.za.

Comments received after the closing date may not be considered.

BOMO EDITH EDNA MOLEWA
MINISTER OF ENVIRONMENTAL AFFAIRS

SCHEDULE

Disclaimer: *Any Errors or omissions found in this guideline will be corrected will be available as an online version at* www.environment.gov.za. Any additions to the guideline in the form of appendices will also be made available online.

Citation: Department of Environmental Affairs. 2017. National Minimum Information Requirements Guideline for preparing EIAs for mining activities that require environmental authorisations. Pretoria.

PREFACE

The Environmental Impact Assessment (EIA) Regulations make it clear that an Environmental Assessment Practitioner (EAP) appointed to manage an EIA process must, amongst other requirements, have knowledge of all guidelines that have relevance to the proposed activity and the EIA process, and must throughout the EIA process take into account all relevant guidelines.

This guideline contains information that provide guidance in terms of best practice in terms of EIA aspects that is related to mining and specifically mineral processing. While the best practice guidance must to be taken into account, this document does not take the place of legal advice in a specific situation governed by legislation. This guideline must be read together with all relevant legislation including the National Environmental Management Act, Act No. 107 of 1998 (NEMA) and the EIA Regulations and is not intended to be a substitute for the provisions of any legislation in any way.

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Abbreviations

BA	Basic Assessment
BAR	Basic Assessment Report
CA	Competent Authority
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIA Regulations	Environmental Impact Assessment Regulations published in terms of the NEMA under GNR 982 on 4 December 2014, as may be amended or replaced
EIAR	Environmental Impact Assessment Report
EMPr	Environmental Management Programme
GIS	Geographic Information System
GDP	Gross Domestic Product
RI&AP	Registered Interested and Affected Parties
LOM	Life of Mine
MIR	Minimum Information Requirements
MPRDA	Minerals and Petroleum Resources Development Act, Act No. 28 of 2002
NEMA	National Environmental Management Act, Act No. 107 of 1998
SANBI	South African National Biodiversity Institute
SD	Sustainable Development
S&EIR	Scoping and Environmental Impact Report
PP	Public Participation
PPP	Public Participation Process

Definitions

In this Guideline any word or expression to which a meaning has been assigned in the NEMA or the EIA Regulations has that meaning, and unless the context requires otherwise -

"Area of Influence" refers to the area likely to be affected by the project, including all its ancillary aspects and its associated activities, as well as unplanned direct/indirect impacts caused by the project;

"Closure Certificate" refers to a closure certificate issued in terms of section 43 of the MPRDA; and

"Life of Mine" refers to the number of years that an operation is planning to mine and process ore.

1 Background

Overall regulation of the mining industry is outlined in the Mineral and Petroleum Resources Development Act, Act No. 28 of 2002 (MPRDA) which falls within the mandate of the Department of Mineral Resources (DMR). Prior to 8 December 2014, the MPRDA included provisions pertaining to the management and protection of the environment. Since 8 December 2014, all provisions pertaining to the management and protection of the environment as contained in the MPRDA were repealed and the management and protection of the environment in respect of the mining industry falls within the ambit of the NEMA. Environmental concerns in the mining industry are therefore now governed through the NEMA and the DMR is now the competent authority (CA) responsible for the processing of EIA applications for activities related to mining.

1.1 Purpose

The purpose of this document is to allow for a more standardised and robust approach during the compilation of EIAs by considering best practise scenarios.

1.2 Aim and objective

The aim of the Minimum Information Requirements (MIR) guideline is to equip EAPs to undertake comprehensive and detailed EIAs that will ultimately encourage the submission of high quality information which will ensure that the DMR during the processing of applications, has the best quality information available for decision making.

The MIR guideline sets out how to achieve the following core objective:

- To identify key aspects that need to be considered and assessed during the EIA process and most importantly, also highlight environmental outcomes to be achieved.

1.3 Guideline Limitations

- The MIR guideline details information required for an EIA application for an EA in respect of mining and prospecting activities in terms of the NEMA and does not address operational requirements.
- This guideline only provides guidance for mineral prospecting and extraction and not petroleum.
- The MIR guideline is by no means a checklist of information required to be granted an EA, and additional site, mineral and project specific information must be included in an application to ensure completeness.
- This MIR guideline does not currently provide guidance on financial provision.

2 Environmental Instruments and Tools

2.1 Screening Tool Application

The EIA Regulations indicates that an EIA application for an EA must be accompanied by a screening report generated by the national screening tool, once this tool is operational. This on-line application is a database of currently available spatial data that is used to help EAPs identify and consider environmental issues in the area where development is being proposed.

2.2 Environmental decision making instruments

The EIA Regulations provide that an application for an EA must take into account government policies and plans, guidelines, in particular any guidelines published in terms of section 24J of the NEMA, environmental management instruments and other decision making instruments as adopted by relevant government departments and institutions.

It is important to note that even if the EAP is not required to include a guidelines section for an application for an EA, the EAP must still ensure that the application indicates how it takes into account any government guidelines, in particular those published in terms of section 24J of the NEMA, environmental management instruments and other decision making instruments that have been adopted by the CA.

3 Requirements for Project Details

This chapter of the MIR guideline provides guidance on key concepts and sections that are critical in the development of a comprehensive EIA.

3.1 Project introduction

A project introduction should be a short and concise overview of the project and its major activities. Refer to Figure 1 for a summary of this information. Figure 1 presents an example of a few requirements. Others may include a description of Ecological Support Areas and Critical Biodiversity Areas under Property Description or the inclusion of Protected Areas and rural villages under Locality Plan. All maps should use the latest published information or databases.

1. General Overview	2. Contact Details	3.Property Description	4. Locality Plan
•Major project aspects or infrastructure •Commodity type •Expected life of the operation	•Contact details of the applicant including company details and responsible person •Contact details of the EAP, including summary of applicable past experience	•Farm details (farm sizes and farm names & 21 digit Surveyor General Code for each farm portion) •Surface right owner details and title deeds numbers •Location and relation to other urban areas	•Indicates all farm boundary and significant project activity boundary •Relation to nearest town •Uses coordinates and spheroid •Uses a suitable scale, ideally not less than 1: 250 000 with north point •Surface structures and registered servitudes where applicable •The topography of the land to which the application relates

Figure 1: Application introductory information requirements

3.2 Description of the proposed overall activity

The project should be sufficiently described so that the CA can understand the processes and related prospecting/mining activities taking place on site including beneficiation. Infrastructure needs such as roads, rail, electricity, potable water and associated services that will be upgraded or constructed must also be detailed. Thus the full scope of the project needs and activities must be detailed. This will allow proper context to be developed by the EAP to assess the scale of the operation and environmental approvals required for specific activities (Figure 2).

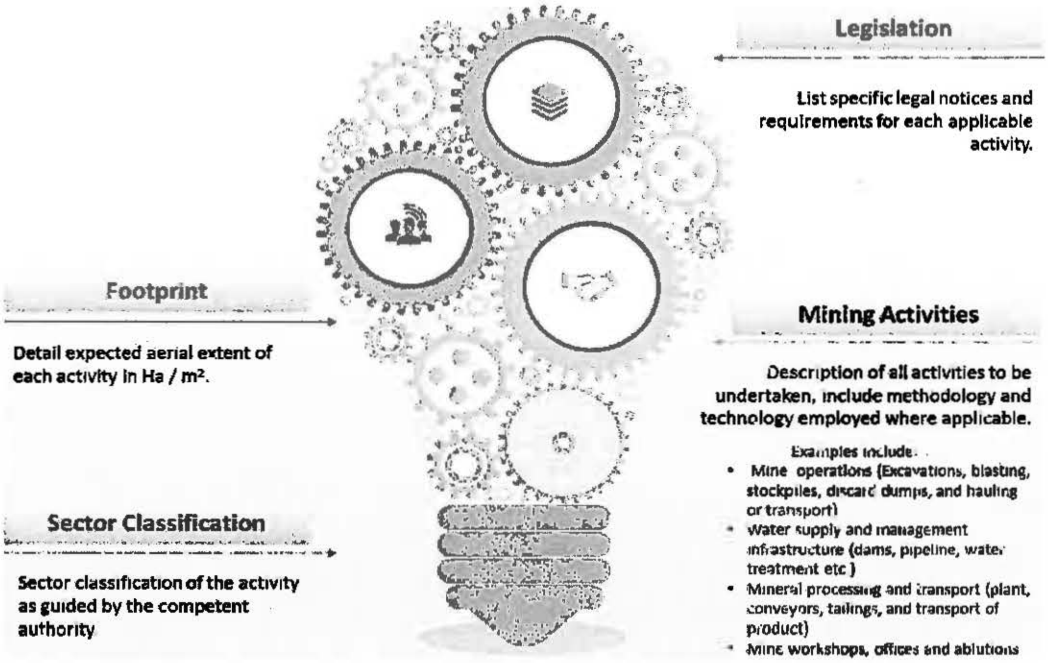


Figure 2: Activity description

3.3 Project motivation

3.3.1 Need and desirability

The need and desirability should ultimately address how the mines development is justifiable based on socio, environmental and economic outcomes (Currently, the EAP must take into account the Guideline on Need and Desirability in Terms of the EIA Regulations, 2014). Significantly, information used to assess need and desirability should also be is evidence-based and not subjective.

When formulating project proposals and when evaluating project specific applications, the strategic context of such applications and the broader societal needs and the public interest should be considered. To better address these considerations and associated cumulative impacts, the compilation of information and maps that specify the attributes of the environment in particular geographical areas, including the sensitivity, extent, interrelationship and significance of such attributes must be taken into account. Social and economic context is best determined in relation to the municipal development frameworks.

Need and desirability must be considered as part of an EIA process, taking into consideration spatial development framework (SDFs), environmental management framework (EMFs) and other relevant plans, frameworks and strategies. Whether a proposed activity will be in line with or a deviation from the plan, framework or strategy, is not the issue, but rather the ecological, social and economic impacts that will result because of the alignment or deviation

Need and desirability should take into consideration aspects listed in Table 1. Concerns relating to need and desirability as well as justifiable economic and social development are further detailed in Appendix A.

Table 1: Need and Desirability Aspects

Aspect	Description
Local and regional development context	Mining activities proposed must be framed within the context of local and regional development plans. Where the operation envisaged is large enough, national context may also need to be provided. The strategic context for informing need and desirability should be addressed by referring to municipal integrated development plans and local or regional spatial development frameworks.
Local and regional effects	Need and desirability must address where the mine deviates or promotes the outcomes of municipal integrated development plans and local or regional spatial development frameworks. The consequences and cumulative effects of the operation and post closure conditions expected should also be detailed.
Financial viability	This must be described within the context of justifiable economic development. Financial viability should not just indicate if the proposed mine development is profitable to investors, but should also indicate broader community needs, environmental impacts and socio-economic benefits.

Sustainable development encompasses environment, social and economic dimensions. These dimensions, in mining, can become environmentally sustainable by developing and integrating practices to reduce the environmental impact of mining activities. When conducting the need and desirability, sustainability should be considered as an underlying principle since an integrated approach could reduce water and energy consumption, minimise land disturbance and waste generation and prevent pollution (soil, water and air).

3.3.2 Project alternatives

Meaningful consideration should be given to alternative processes or practices which can be employed to meet the requirements of mine development, operation and closure. Registered interested & affected parties (RI&APs) must be provided with an opportunity of providing inputs into the process of formulating alternatives. The number of alternatives that are selected for an assessment should be determined by the range of potential alternatives that could be reasonable and feasible. The process of selecting alternatives should be clearly documented. Generally alternatives can be grouped into six categories (Table 2).

Table 2: Categories for project alternatives

Property or location
Mineral extraction location is based on the ore deposit. Alternative location of the mining area may be very limited and is normally in reaction to sensitive environments or community concerns where the mine area is decreased and results in a loss of mineable reserves. The location of mine activities, however, has a much broader scope. The location of key mine infrastructure (i.e. tailing facilities, beneficiation plant, workshops and access routes etc.) should be chosen to protect public safety and minimise impact on sensitive receptors and resources. An example of this would be through the use of buffer zones, in which the site mine infrastructure is

located further away from sensitive receptors even though it may increase operational costs.
The type of activity
Refer to the type of mineral extraction methods considered. This is limited by location, depth, grade, physical environment (topography, climate etc.) and safety considerations. Mining methods primarily consist of open pit, opencast strip mining, underground board and pillar, underground longwall mining, re-mining of surface tailings deposits (typically through sluicing), ocean bed extraction, and unconventional methods (i.e. Coal Seam Gasification, Coal Seam Methane Extraction). An operation may consider using one or a combination of mining methods to extract a resource optimally whilst reducing its impact.
Design and/or layout
Mine layout refers to the mining scheduled and the corresponding location of mine disturbances to implement the mine schedule. Mine layouts are based on the location, depth and expected grade of the ore body. The design should consider operational and closure related impact and adjust accordingly to mitigate these. Some examples to illustrate these include, changing the location of an opencast boxcut to reduce long term ground water impacts, location of adits, ventilation shafts and emergency bunkers.
Technology used
Technology has a wide application on mining activities and may include: • Beneficiation methods – physical separation methods versus magnetic vs chemical beneficiation. • Pollution control methods - typically this may include mechanisms to reduce affected water production (such as cut –off drains) and water affected water management options (such as location and pollution control dams and treatment methods for affected water. • Mine waste management – mine waste such as waste rock dumps and tailings dams can be placed and managed in alternative ways to reduce impact. Examples of this include waste characterisation to facilitate in-pit tailings disposal and negate the construction of large tailings dam, or the use of paste technologies to increase water recovery and reduce the facilities total footprint.
Operational aspects
A range of issues can be considered and implemented to enhance the environmental performance of the mine. These are dependent on the type of operation but may include: • Operating hours and designating set times for specific activities such as blasting. • Setting specific traffic control mechanisms for mine vehicles and haul routes. • Dust control methods such as the use of chemical dust suppressant on mine haul roads.
The 'no-go' option
The "no-go" option deals with assessing the social and environmental impacts where the mining activity does not take place. Typically this would involve the loss of jobs and economic stimulus into the area as a result of the mining activity. However, this view should be balanced with benefits derived from alternative land uses such as agriculture and eco-tourism. The no-go option should also consider the benefits of not mining as it relates to water resources and the maintenance of natural habitats.

3.4 Policy and Legislative context of the application

When required to include a policy and legislative section, the EAP or the applicant should describe the context within which the proposed activity is located and how the activity complies with and responds to this. Policy and legislative requirements should be identified along with a description of how the applicant intends to comply with these. Note 1 illustrates a potential layout for an activity based legal register.

Note 1: Example of Policy and Legislative Context		
Activity	**Impacts**	**Significance (if not mitigated)**
Applicable Legislation and Guidelines used to Complete the Report	***Reference and description***	***How Does this Development align to the Policy and Legislative Context)***
(List of environmental policy and legislation which is applicable to the mine development such has legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to the activity and are to be considered in the assessment process)	*Indicate the relevant section applicable to the specific activity/ies being undertaken and describe why this is applicable*	*e.g. In terms of the National Water Act -Water Use Licence has/has not been applied for*
e.g. National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended	e.g. Part A, Section 3, d), i)	e.g. An environmental authorisation has been applied for
e.g. National Heritage Resources Act, 1999 (Act No 25 of 1999)	e.g. Section 18 Permission to remove or alter heritage resources	e.g. Heritage study undertaken by specialist, relocation application for the graves has been submitted

4 Requirements for Assessing Impacts

What is to follow is a detailed description of the manner in which to assess the impacts of a prospecting or mining activity for the purposes of an application for an EA. This Guideline does not directly repeat the requirements for a basic assessment report (BAR), scoping and environmental impact report (S&EIR) and environmental management report (EMPr) which requirements are prescribed in the EIA Regulations, but is rather aimed at providing guidance as to the manner within which to ensure the impacts are adequately addressed and assessed in an application for an EA.

4.1 Environmental baseline description

The environmental baseline should document the current quality of the environment within the area of influence before project inception. The area of influence may include, for example:

- The watershed within which the project is located;
- Noise and light-shed (where noise and lightening can affect humans, wildlife and flora);
- View-shed that will be affected and the type and condition of vegetation;
- Any affected estuary and coastal zone;
- Off-site areas required for resettlement or compensatory tracts;
- The air-shed (e.g. where airborne pollution such as smoke or dust may enter or leave the area of influence);
- Migratory routes of humans, wildlife, or fish, particularly where they relate to public health, economic activities, or environmental conservation; and
- Areas used for livelihood activities (hunting, fishing, grazing, gathering, agriculture, etc.) or religious or ceremonial purposes of a customary nature.

This information should then be analysed during the environmental impact assessment and will be used to predict and quantify the impacts. The environmental baseline should be established in suitable detail to record the environmental conditions and seasonal variability prior to development, to permit the assessment of potential effects and to provide a baseline with which to monitor future changes.

At a minimum, the biophysical environmental data should be based on information in the public domain. At the lowest level, this information may be adequate for a scoping level environmental description or to serve as the baseline from which site-specific investigations can be planned. Dependent on the complexity and degree of disturbance of the site, this generalised information may prove adequate for some small-scale, short-lived or low-impact prospecting or mining operations. It is necessary to provide site-specific and detailed information on the basis of investigations by registered specialists in most situations where permanent or significant impacts will arise from prospecting or mining. Examples of baseline data required is further described in Appendix B. It is advisable that the process of environmental baseline investigations include the following tasks:

- An appropriate combination and balance of desktop studies, field surveys, site information collection and technical consultation conducted at the appropriate time for species/area being studied;
- Consideration of all available documentary records, research papers and other relevant information;
- Use of recognized survey and analysis techniques;
- Identification and provision of appropriate (preferably quantitative) descriptions of the baseline environmental conditions;
- Identification of key environmental features that may enhance, constrain or limit the direction and rate of environmental change;
- Explanation of links, interactions and dependencies between environmental components;
- Verification of desktop and other information by systematic field surveys;
- Include predicted changes to the environment as a result of climate change; and
- Acknowledgement of the implications of gaps and limitations in information and data.

A prediction of change can only be as effective as the baseline information from which it is derived. The specialist must also indicate and emphasize where the baseline conditions may change due to natural extreme events or cyclical environmental processes. If these are beyond the influence of the proposed project, the specialist should indicate how these need to be taken into account in the project design or through mitigation measures.

4.2 Specialist Studies

Specialists can be involved for different purposes during various stages of the EIA process. Specialists can therefore provide input during pre-application planning/screening or following the submission of an application for statutory approval of the proposed development (i.e. during screening, scoping and/or impact assessment). Table 3 presents the planning process that the specialist should follow.

Depending on the nature of the project and the environmental context, specialist involvement will vary in intensity (i.e. level of detail) and may include any or all of the following approaches:

- Provision of a specialist opinion or comment;
- Archival research and literature review;
- Detailed baseline survey (including site visit/s);
- Consultation and interviews;
- Mapping and simulation modelling; and
- Assessment of impacts and their significance.

Table 3: Specialist planning process

SPECIALIST PLANNING PROCESS
Describing the legal, policy and planning context
The purpose is to provide an indication of potential opportunities for and constraints to the development (including potential "fatal flaws") that may determine the level of environmental assessment required. This may justify early changes to the project description (e.g. if legislated thresholds/standards are exceeded).
Identifying and responding to issues
The specialist may be involved during the screening and scoping phase to assist in the identification of issues associated with the proposed project, as well as to provide responses to the issues raised by stakeholders. This is to ensure that the full range of key issues is identified as early as possible in the EA process.
Identifying alternatives
Specialist involvement may be required to proactively identify and advise on practical alternatives regarding the proposed project (e.g. design, layout, location, technology, approach, route alternatives) that avoid or reduce negative impacts and enhance project benefits. Alternatives should be well motivated. The identification of alternatives to the originally proposed project description is usually best undertaken in a workshop forum involving the project proponent, the EAP and other specialists. Relevant authorities may also be involved in this process. Specialists may also be required to undertake a more detailed investigation of alternatives.
Developing terms of reference and defining scope of work for the specialists
Where the need for specialist involvement in the EA process is identified, whether this is to undertake a baseline survey and description of the affected environment or to assess potential impacts associated with the proposed development, a specialist may be required to assist the EAP in drafting appropriate terms of reference for the proposed specialist input. Terms of reference for specialist involvement should, therefore, be appropriate to the purpose and intensity/scale of involvement and should be discussed and agreed between the EAP and the specialist. The specialist needs to determine how much data will be required to supplement existing information and assess whether a significant impact will occur. This can be accomplished through a combination of: • consultation with the independent peer reviewer; • interdisciplinary specialist workshops; • collecting existing data on the area to be affected and then performing a gap analysis to determine what information is available and what information is still required; • visiting the project site and its surrounds; and • Consultation with national, provincial and/or local government departments, as well as professional, statutory and voluntary organisations.
Predicting and assessing impacts
Where insufficient information is available to address key issues raised during scoping, a specialist may be

required to assess the potential positive and negative impacts of the proposed development on the biophysical, social and economic environment (as relevant to the issue). The level of detail of specialist input will vary, depending on the type of development, the environmental context and available information; however, any assessment should evaluate direct, indirect and cumulative effects and should be undertaken in accordance with defined impact assessment criteria.
Recommending management actions and monitoring programmes
The specialist should provide practical, clear and unambiguous recommendations for management actions and monitoring programmes. Management actions would include measures for avoiding, mitigating, compensating for or rehabilitating negative impacts, or enhancing project benefits. Without compromising the objectivity of the specialist assessment, the identification of appropriate, practical and feasible management actions and monitoring programmes is generally best achieved through workshops and discussions between the EA team of specialists and the project proponent, facilitated by the EAP. This is particularly important to resolve situations where two or more specialists on the EA team might propose conflicting management actions, or might propose actions that might give rise to impacts that need to be addressed by other specialists.
To undertake an independent peer review of specialist input
In certain circumstances the need for independent peer review of specialist studies may be identified during the course of the EA process. For example, this may be required if the project is complex and controversial or if there are high levels of uncertainty and risk associated with the information provided. Where specialists are commissioned to provide an independent peer review, the purpose of their involvement is to check whether the specialist report meets minimum requirements, is reasonable, objective and scientifically sound. Consultation with the peer reviewer, other specialists, government departments and other organisations is recommended to assist the specialist to: • identify existing data to assist in defining the baseline conditions; • identify specific interdependencies between specialists in terms of information needs and formats; • identify key issues and help define likely significant impacts; and • avoid duplication of previous studies and assess the validity of field data. It is advisable for consultation to take place between the specialists and key I&APs, who possess particular insights and relevant indigenous knowledge that may improve and add to the understanding of the affected environment.

4.2.1 Specialist reporting requirements

While a systematic and scientific approach is vital for specialist investigations, the findings need to be conveyed to the authorities and RI&APs in easily understandable, non-technical language. The contents of specialist reports are often not suited to public reporting and it is the responsibility of the EAP to integrate the specialist information into the environmental impact report, so that it is more accessible to authorities and RI&APs. The original specialist study report should, however, be available as a stand-alone report for reference, should further detailed information be needed.

4.2.2 Choosing the right specialist

The levels of knowledge, expertise and competence of the specialist scientist have a strong influence on the integrity of information and findings of the EA. It is therefore important to ensure that the most appropriate people are chosen to do the required studies. Particular credentials to look for in a specialist include:

- Demonstrated competence and a proven track record in the specialist topic (CV should include a list of peer reviewed publications and contract reports);
- Appropriate academic and specialist qualifications; and
- Professional membership of a recognized professional body.

Ideally, the chosen specialist should have good people skills and the ability to communicate and interact as a team player with other specialists. Having chosen the specialists, it is advisable that they confirm in writing that they are able to meet their terms of reference according to the specified requirements (including the necessary expertise to compile the required specialist report) and within the agreed time and budget allocation.

4.3 Impact identification and assessment

An impact assessment is undertaken in order to:

- Identify the potential impacts of a proposed development on the environment;
- Predict the likely nature of such impacts; and
- Evaluate the significance of the potential impacts and propose mitigation measures to minimise impacts.

Project alternatives should be considered in the environmental assessment process to define the most suitable layout and activity plans or implementation, which process is highlighted in Figure 3. It is important to note that during the impact and risk identification, public participation and baseline assessments should be conducted, while specialist assessments should be taken into consideration during significance rankings.

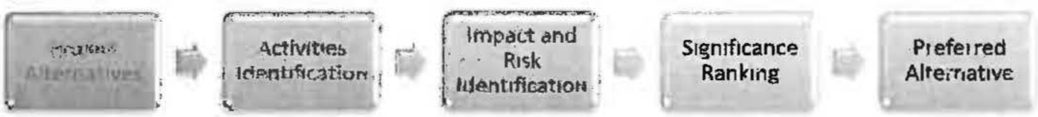


Figure 3: Impact Assessment Process

4.3.1 Impact identification

Various methods can be used to identify impacts, these methods include:

- Ad hoc approaches (e.g. project-, sector- or environment-specific guidelines);
- Checklists (i.e. the listing of potential impacts);
- Matrices (e.g. the Leopold Matrix);
- Networks (i.e. the presentation of higher order impacts and linkages using directional diagrams);
- Over lay maps; and
- Modelling procedures (i.e. computerized, mathematical, physical scale models or descriptive models).

The potential impacts should be identified for the activities taking place on the initial site layout. This is informed by the typical known impacts of such activities based on the site sensitivities, consultation with RI&AP's and previous experience from other related sites and operations.

4.3.2 Impact Assessment methodology

Impact identification and prediction means forecasting the change of environmental parameters due to development. These parameters may also be changing due to climate change and should be included. Impact identification and prediction is a stepwise procedure to identify the direct, indirect and cumulative impacts (relating to both positive and negative impacts) for which a proposed activity and its alternatives will have on the environment as well as the community. For an example of an impact assessment methodology see Appendix C1.

This should be undertaken by determining the geographical, physical, biological, social, economic, heritage and cultural sensitivity aspects of sites and locations as well as the risk of impact of the proposed activity. Generic criteria, which have been drawn from published literature and South African practice, can be used to describe the magnitude and significance of impacts in a systematic manner. For typical criteria and management measures see Appendix C2.

A matrix selection process is the most common methodology used in determining and ranking the site sensitivities, namely the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks (refer to Table 4). Significance of impacts should be determined for each phase of the mining lifecycle this includes; **pre-construction, construction, operational, closure (including decommissioning) and post-closure phases**.

Likely impacts should be described qualitatively and then studied separately in detail. This provides consistent and systematic basis for the comparison and application of judgements. Ratings should then be assigned to each criterion. The significance of impacts should further be assessed both with and without mitigation action. Impact magnitude and significance should as far as possible be determined by reference to either legal requirements (accepted scientific standards) or social acceptability. If no legislation or scientific standards are available, the EAP can evaluate impact magnitude based on clearly described criteria.

The description of significance is largely judgemental, subjective and variable. However, generic criteria can be used systematically to identify, predict, evaluate and determine the significance of impacts resulting from project construction, operation and decommissioning. The collection of potential impacts (environmental and social) identified during the environmental assessment should as far as possible be quantified. The process of determining impact magnitude and significance should never become mechanistic. Impact magnitude is determined by empirical prediction, while impact significance should ideally involve a process of determining the acceptability of a predicted impact to society. Making the process of determining the significance of impacts more explicit, open to comment and public input would be an improvement of environmental assessment practice. The criteria for assessing and ranking the impacts using a matrix selection process are detailed in Table 4. Table 4 provides the basic criteria which EAPs and specialists can adopt when undertaking an impacts assessment. Once risks have been identified, risks will then be ranked to provide priority risk ratings.

Table 4: Suggested criteria for assessing and ranking impacts using a matrix selection process

Ranking	Description	Example
Nature	An evaluation of the effect of the impact related to the proposed development	• Positive • Negative
Extent or spatial scale of the impact	A description should be provided as to whether impacts are either limited in extent or affect a wide area or group of people. Cumulative impacts must also be considered as the extent of the impact as may increase over time.	Impacts can be site-specific, local, regional, national or international: • Site: the whole or a portion of the mining site • Region: the area including the mine, the surrounding neighbours and/or towns
Duration	It should be determined whether the duration of an impact will be short-term, medium term, long term or permanent. Cumulative impacts must also be considered as the duration of the impact as it may increase over time	• Once off: impact will only occur once and thereafter not at all • Short term: dissipation of impact through active or natural mitigation in a time span shorter than 5 years or life of the mine (0-5 years) • Medium term: impact will last for 5-15 years, thereafter it can be entirely negated • Long term: the impact will last for the entire operational life of the mine, but will be mitigated thereafter • Permanent: the impact will be non-transitory
Intensity	A description should be provided as to whether the intensity of the impact is high, medium or low or has no impact in terms of its potential for causing negative or positive effects. Cognisance should be given to climate change which may intensify impacts	• Low: natural processes or functions are not affected • Medium: affected environment is altered but function and process continue in a modified manner • High: function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases
Probability	The probability is the quality or condition of being probable or likely	(A) Highly probable (high likelihood): greater than 50:50 chance of occurrence (B) Probable (low likelihood): less than or equal to 50:50 chance, but at least a 1:20 chance of occurrence (C) Improbable (negligible): less than 1:20 chance of occurrence
Significance	Impact that may have a notable effect on one or more aspects of the environment or may result in non-compliance with accepted environmental quality standards, thresholds or targets and is determined through rating the positive and negative effects of an impact on the environment based on criteria such as	• No impact • Low: Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Biophysical, social, cultural and economic activities of communities can continue unchanged. In the case of beneficial impacts, alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming.

	duration, magnitude, intensity and probability of occurrence. Mitigation measures should be provided with evidence or motivation of its effectiveness	• Medium: Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is both feasible and fairly easily possible. Biophysical, social, cultural and economic activities of communities are changed, but can be continued (albeit in a different form). Modification of the project design or alternative action may be required. In the case of beneficial impacts, other means of achieving this benefit are about equal in time, cost and effort. • High: Of the highest order possible within the bounds of impacts that could occur. In the case of adverse impacts, there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or some combination of these. Biophysical, social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt. In the case of beneficial impacts, the impact is of a substantial order within the bounds of impacts that could occur.
Degree of certainty	A description should be provided of the degree of certainty of the impact actually occurring as unsure, possible, probable or definite. Impacts will occur regardless of preventable measures	• Definite: More than 90% sure of a particular fact. Substantial supportive data exist to verify the assessment • Probable: Over 70% sure of a particular fact or of the likelihood of that impact occurring • Possible: Only over 40% sure of a particular fact or of the likelihood of an impact occurring • Unsure: Less than 40% sure of a particular fact or the likelihood of an impact occurring
Mitigatory potential	The potential to mitigate/ manage the negative impacts and enhance the positive impacts should be determined. For each identified impact, mitigation objectives that would result in a measurable reduction in impact should be provided. If limited information or expertise exists, estimates based on experience should be made. For each impact, practical mitigation measures that can affect the significance rating should be recommended. Mitigation measures should be provided with evidence or motivation of its effectiveness. Management actions that could enhance the condition of the environment (i.e. potential positive impacts of the proposed project) should be identified. Where no mitigation is considered feasible, this must be stated and the reasons provided. The rating both with and without mitigation or enhancement actions should be recorded. Quantifiable standards (performance criteria) for reviewing or	• High: High potential to mitigate negative impacts to the level of insignificant effects • Medium: Potential to mitigate negative impacts. However, the implementation of mitigation measures may still not prevent some negative effects • Low: Little or no mechanism to mitigate negative impacts

	tracking the effectiveness of the proposed mitigation action should be provided where appropriate	
Acceptability	Criteria and standards that exist for acceptability are either emissions-based or they relate to the receiving environment (e.g. air quality, water quality or noise). Establishing the acceptability of a potential impact is as important as determining its significance. An impact identified as being non-significant by a specialist may be unacceptable to a particular section of the community. On the other hand, a significant impact may be acceptable if, for example, adequate compensation is given. The level of acceptability often depends on the stakeholders, particularly those directly affected by the proposed project. Ratings that can be used for acceptability are given. Targets for acceptability are defined through the most sensitive receptors and through achievable outcomes.	• High (unacceptable): Abandon project in part or in its entirety. Redesign project to remove or avoid impact • Medium (manageable): With regulatory controls, with project proponent's commitments • Low (acceptable): no risk to public health or environment

4.3.3 Risk Ranking Outcomes

Risk assessment outcomes rank impacts/risks accordingly so that higher significant impacts/risk are highlighted and appropriate commensurate mitigation measures are defined and implemented. For each of the impacts identified, a significance rating is generated, this is usually denoted as:

High	Normally there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or some combination of these. Biophysical, social, cultural and economic activities are disrupted to such an extent that these come to a halt. In the case of beneficial impacts, the impact is of a substantial order within the bounds of impacts that could occur.
Medium	Impact is not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Mitigation is both feasible and fairly easily possible.. Biophysical, social, cultural and economic activities are changed, but can be continued (albeit in a different form). Modification of the project design or alternative action may be required. In the case of beneficial impacts, other means of achieving this benefit are about equal in time, cost and effort.
Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Biophysical, social, cultural and economic activities can continue unchanged. In the case of beneficial impacts, alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming.
No Impact	A description of the preferred alternative and site layout should be provided taking into consideration the comparison of the originally proposed site plan. A comparison plan should include environmental features and current land uses as well as the issues raised by interested and affected parties.

Figure 4: Generally accepted meaning of significance rating

4.4 Assumptions, uncertainties and gaps in knowledge

Knowledge gaps and assumptions pertaining to the baseline data and impact assessment must be clearly highlighted. Knowledge gaps are typically identified within the specialist and baseline studies and should be consolidated within the BAR/EIAR. The risk associated with knowledge gaps or assumptions should also be detailed based on the extent of current knowledge, applying a cautious and risk adverse approach. Future planned studies, investigations and operational compliance monitoring should be informed based on filling knowledge gaps and confirming assumptions.

The mitigation measures proposed to manage activities or outcomes where high risk knowledge gaps exist should also be commensurate with a cautious risk approach. These management measures can be scaled down appropriately as future studies and operational management inform risk management or mitigation measures. Alternatively, should management measures prove to be insufficient in reducing risk of increasing the environmental impact then provision should be made for upscaling the mitigation measure.

4.5 Reasoned opinion of the EAP

The opinion of the EAP is to give the CA confidence that the mine's activities are understood and alternatives have been considered. Risks relating the activities have been identified and impacts have been assessed. Risk management outcomes are acceptable given the existing knowledge base when weighed up against positive socio-economic returns expected well as post closure liabilities (which may remain over a much longer timeframe). The opinion should at a minimum contain:

- Reasons why the activity should go ahead or not; and
- Highlight conditions to be included in the EMPr. This should provide a summary of planning, construction, operational, rehabilitation and closure conditions which are necessary to ensure the projects implementation will be acceptable.

4.6 Deviations from the approved scoping report and plan of study

The scoping process identifies the proposed mining activities and informs which specialist investigations and data requirements are required to assess the mine's impact. The scoping report also should details the methodology used to identify and determine the significance of potential environmental impacts and risks. Any deviations from the methodology used, activities to be undertaken or methodology for undertaking the specialist studies should be clearly noted. Upfront sensitivity analysis using existing databases may alter mine plans or activity layout and operation. These alternatives become the primary activities on which the mine is planned and assessed in the EA. It is important to note that deviations here do not refer to deviations from an EA, but a deviation from within the same application.

An example would be the use of water in the mining process. Initially the mine proposes using existing groundwater resources in its plant water make-up. However further stakeholder engagement may identify neighbouring operations whose affected process water may be used on the mine. This would require a new water pipeline which was not scoped in the original scoping report. But the reuse of affected water is more beneficial to the environment and both parties concerned and this becomes the primary option for obtaining plant make-up water which is then detailed and assessed in the EIA study.

5 Requirements for Impact Management

This chapter of the MIR guideline provides guidance on key concepts and sections that are critical in the development of a comprehensive EMPr, a vital supporting document required in the application process for the management of mines, and similarly to the environmental assessment chapter. This Guideline does not directly repeat the requirements for an EMPr, which requirements are prescribed in the EIA Regulations, but the aim is not only to provide guidance but also to provoke the required thought processing to develop a high quality management programme in-line with the specific mining application being investigated.

5.1 Description of the Aspects

Aspects provide a description of how the environment is altered (impacts) as a direct or indirect result of undertaking mining activities or services. All the activities related to the different phases (operations, etc) should be identified; these can also be grouped into applicable geographical areas or processes. The aspects for each of the activities must be listed along with the expected impacts.

Note 2: Example of impact register

Activity	Impacts	Significance (if not mitigated	Mitigation	Significance (if mitigated)
		CONSTRUCTION		
Construction of conveyor belt	Vegetation removal along servitude	Medium	Ecological investigation Identification and relocation of sensitive species	Low
		OPERATIONAL		
Operation of conveyor belt	Dust impact	Medium	Water sprays included at loading, offloading and transfer point	Low
		DECOMMISSIONING		
Breakdown and removal of the conveyor belt	Soil compaction and erosion	High	Topsoil stripped from servitude during construction Footprint area is ripped Topsoil replaced to minimum 250 mm depth Topsoil seeding and fertilised to ensure revegetation	Low

5.2 Description of Impact management outcomes including management statements

5.2.1 Determining impact management outcomes

Impact management outcomes must:

- Be set for the expected activity based impacts as identified per project phase as in the impact identification and significance rating process ;
- Be informed by stakeholder expectations and ensure legal compliance;
- Be clearly documented;
- Be measurable to determine compliance;

- Describe the desired outcome of the management measure/s prescribed or the standard to be achieved; and
- Be aligned to the mines closure objectives.

5.2.2 Impact management statements

Management statements detail the processes, procedures and practices required to achieve an impact management outcome. An example would include water management on the mine over the life of the mine. To elaborate on this example, all the potential water issues for each stage of the mines life are summarised in Note 3. Contact the CA for all applicable and relevant guidelines.

Note 3: Example of Impact Management Statement

1. Exploration	• Temporary water supply • Impacts of water management on local water resources/users • Potable water treatment • Discharge of excess drilling water • Waste water disposal • Site stormwater management	2. Mining, minerals processing & refining	• Water supply management • Water treatment (worked water & potable) • Mine dewatering • Worked water recovery, storage and reuse • Worked water disposal (discharge management) • Dust control and contamination management • Catchment management (including AMD) • Performance monitoring and reporting
3. Rehabilitation	• Post-mining landform drainage design • Contaminated site remediation • Borefield and water supply scheme decommissioning • Mine pit lake modelling and formulation of closure strategies • Stakeholder approval and development of catchment management plans	4. Resource development & Design	• Water supply- identification & quantification • Impacts of water abstraction/diversion on local water resources/users • Government approvals • Water supply, storage & treatment (design & construction) • Dust suppression and dewatering discharge • Waste water disposal • Site stormwater management
5.Post-mining and closure	• Rehabilitation performance monitoring • Erosion control and drainage maintenance • Contaminated site remediation verification • Stakeholder and regulatory sign-off		

The management statement would need to address all water related impacts for each of the activities in each of the mine phases listed above. A hierarchy of management tools used is seen in Figure 5.

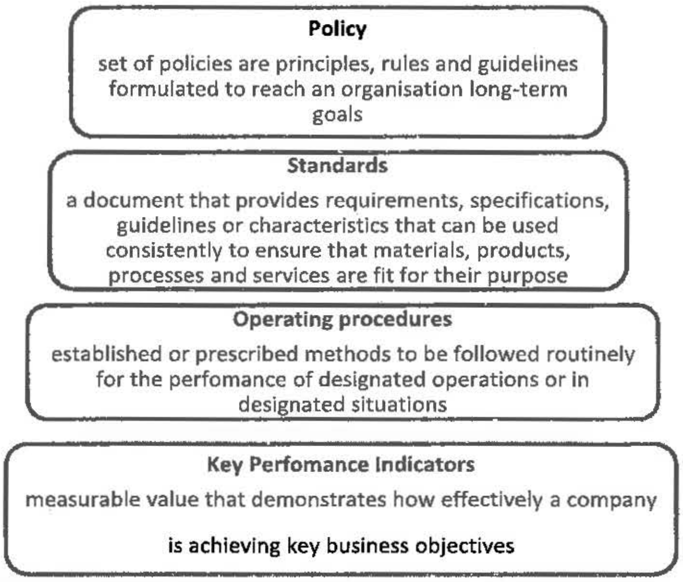


Figure 5: Hierarchy of Management Tools

Managing measures contemplated can be grouped into:

- Modification measures – changes to process and or practices to reduce risk.
- Control – either through physical control or operational practices to ensure acceptable performance is maintained.
- Remedial action – rehabilitation and pollution clean-up processes and practices.
- Avoidances – where activities can be mitigated to an acceptable level, these are stopped or avoided.

5.2.3 Impact management system

The impact management system should be detailed as part of the EMPr, including specialist studies. This will ensure that:

- Management measures and their outcomes are clearly understood and documented;
- Adequate resources (financial and labour) will be allocated; and
- Environmental performance will be integrated into the day to activities of the mine.

A process for a generic impact management system is outlined in Figure 6.

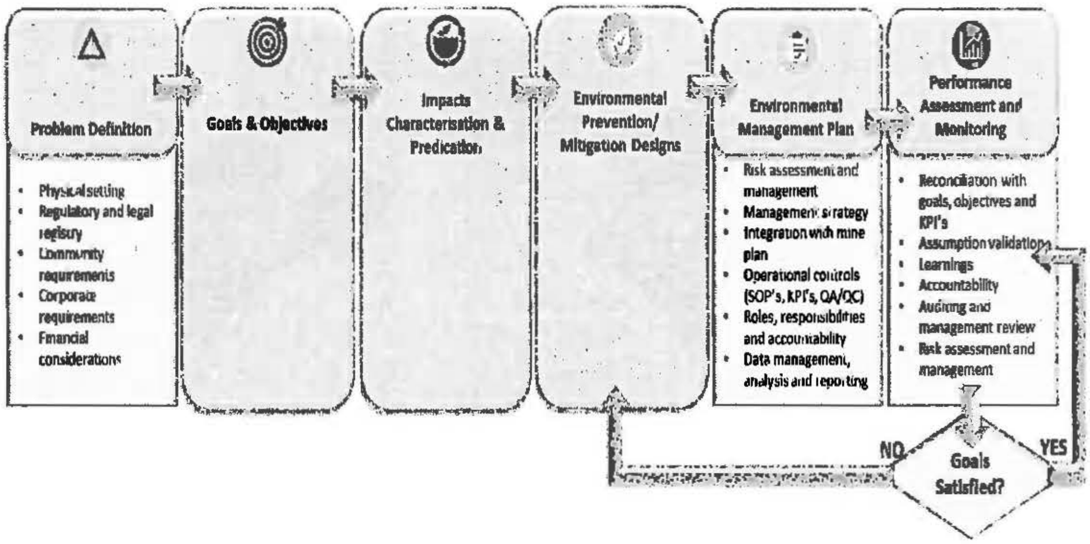


Figure 6: Impact Management System

5.3 Monitoring of Impact Management Actions

Monitoring and auditing are processes designed to help a mining company achieve good sustainable development performance, and verify that this has been done. In broad terms, this can involve:

1. Tracking progress over time;
2. Determining whether agreed objectives or standards have been met; and
3. Benchmarking procedures and performance against those of other mining.

Monitoring is the gathering, analysis and interpretation of information for the assessment of performance. Examples commonly include monitoring of water quality, impacts on flora and fauna (as well as recovery following the implementation of control or rehabilitation measures), social aspects and community development, air quality, noise, vibration, greenhouse gas emissions, and the extent to which rehabilitation and final land use objectives are being met.

Auditing is systematically reviewing environmental awareness of employees, monitoring procedures and results, and checking that all commitments have been fulfilled or completed by comparing the audit findings against agreed audit criteria. Planning for monitoring over the life of the mine is most cost-effectively based on assessment of the key environmental and stakeholder risks, and changes to the community. Regular review of the risks and associated monitoring is needed to ensure objectives are met and findings are used to inform improved management decisions (adaptive management) and practices. This continual evaluation process is indicated in Figure 7.

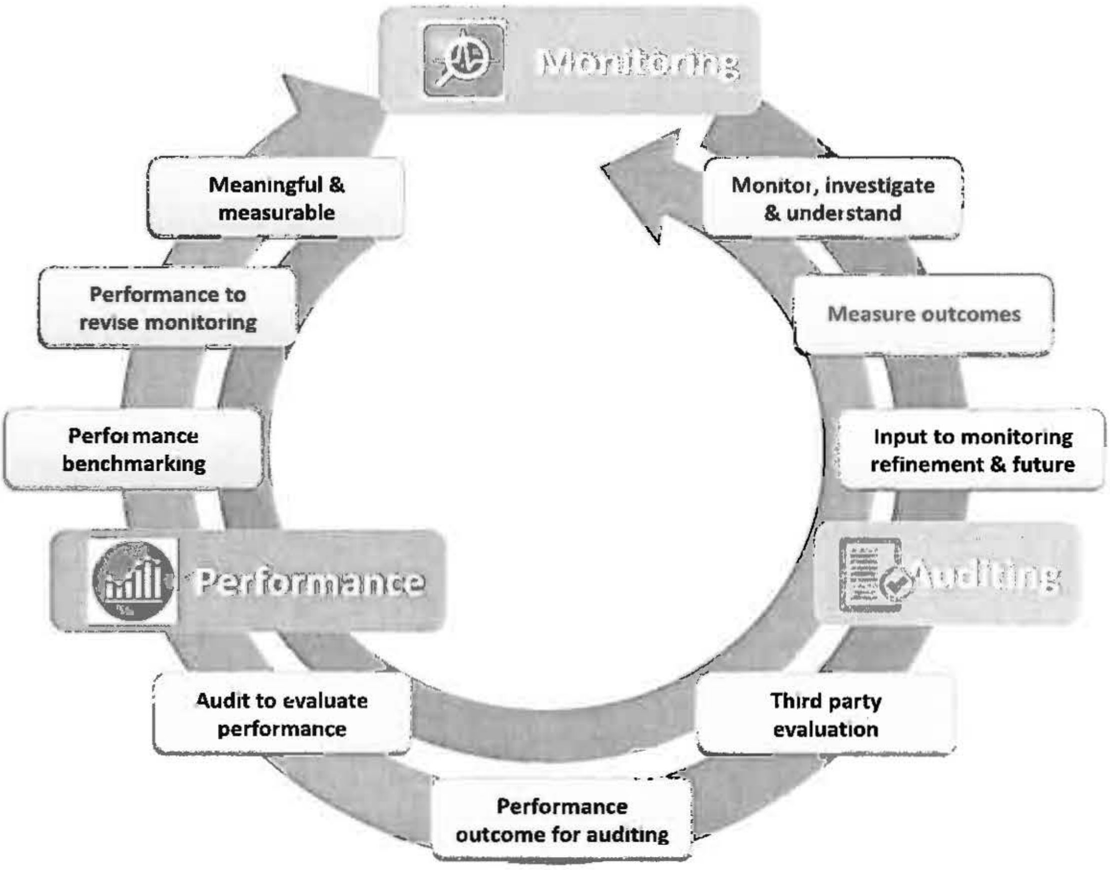


Figure 7: Continuous performance monitoring and evaluation cycle

A monitoring program must be informed through the management of key risk, this entails:

1. Parameters that are relevant to the key risk over the LOM and not just parameters likely to appear in the approvals permit;
2. Adaptability to and pre-empts changes to the risk profile of activities over the life of the mine, and is not just a one size fits all;
3. Includes analysis of trends in key parameters with sufficient sensitivity to provide early detection of trends which require further investigation; and
4. Using substantiated knowledge of the likely sensitivities and responses of the receiving environment and stakeholders.

5.3.1 Monitoring programme design

A monitoring and performance evaluation programme must address:

1. Mechanisms for monitoring compliance with and performance assessment against the environmental management programme and reporting thereon.
2. Indicate the frequency of the submission of the performance assessment report.

The process for monitoring programme design is further detailed in Figure 8.

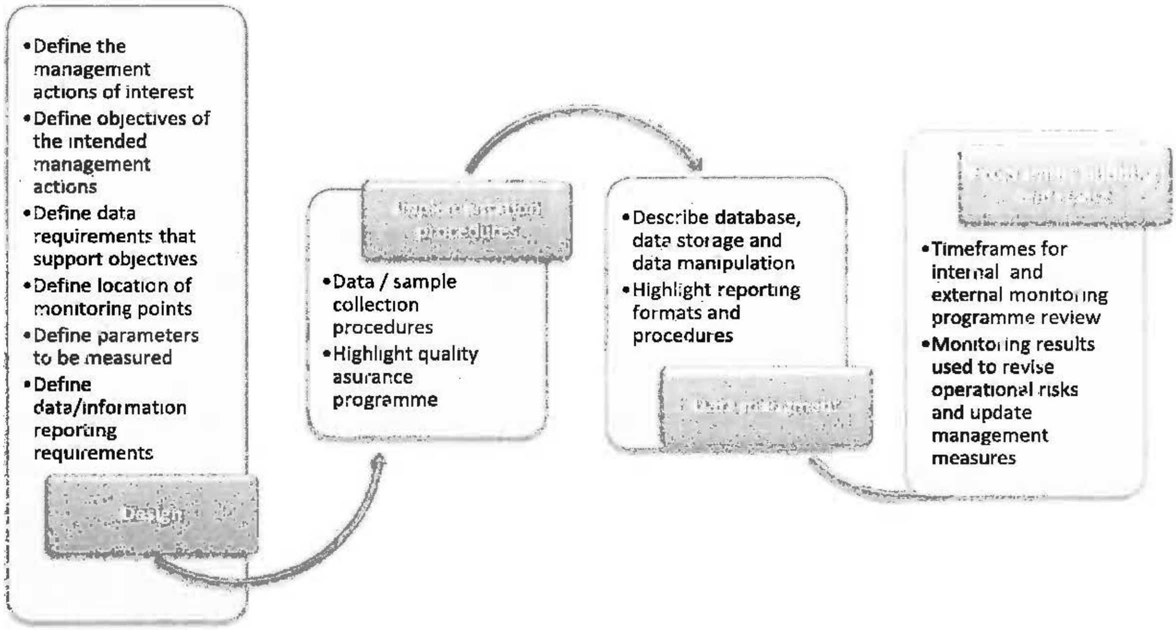


Figure 8: Monitoring programme design

5.4 Environmental Awareness Plan

The environmental awareness plan should provide industry employees the opportunity to understand the risks associated with mining activities. This can be done through various means, such as training, symposiums and/or skills development. The awareness plan should also outline the manner in which risks are to be dealt with to avoid pollution or degradation of the environment.

5.5 Details of Undertaking

The application for an EA must also include an undertaking under oath or affirmation by the EAP in relation to:

- The correctness of the information provided in the reports;
- The inclusion of comments and inputs from stakeholders and RI&APs;
- The inclusion of inputs and recommendations from the specialist reports where relevant; and
- Any information provided by the EAP to RI&APs and any responses by the EAP to comments or inputs made by RI&APs.

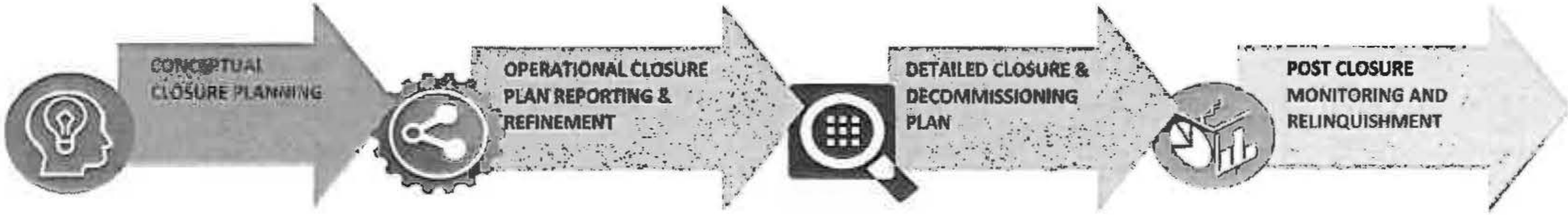
5.6 Conceptual Closure Planning

Mining should be considered a temporary land use, and the general ethos is to mine towards closure. 'Mining for Closure' is facilitated through integrated mine planning where a mine closure plan should be an integral part of the whole mine life cycle with the ultimate aim to ensure that:

- Environmental resources are not subject to physical and chemical deterioration;
- The end land use or land capability of the site is beneficial and sustainable in the long term;
- Biodiversity is maximised through the establishment of indigenous vegetation where possible;
- Any adverse socio-economic impacts are minimized, and
- All socio-economic benefits are maximized.

Planning for closure should commence at the feasibility phase of an operation. In this way, future constraints on, and costs of, mine closure can be minimised, post-mining land use options can be maximised and innovative strategies have the greatest chance of being realised.

As seen in Figure 9 closure planning is a continual process. A vision for the closure of the operation is required to guide the development of the initial Conceptual Closure Plan. **This will form part of the initial application made to obtain a mining right.** As mining progresses, the plan will become more detailed and altered accordingly, based on operational feedback to close data gaps such as concurrent rehabilitation performance monitoring, further stakeholder engagement, changes to mine activity, legislative requirements etc.



- Compiled from feasibility phase - to project approval phase
- Aligns closure vision within broad environmental and socio-economic context
- Developed with stakeholder inputs

- Ongoing development & implementation - increasing detail
- Regular review and updating to include operational, experimental and socio-economic feedback
- Used during operational life on mine, typically 5 - 30 years

- Provides summary of rehabilitation / closure activities undertaken during the life of the main
- Provides detail on final rehabilitation and infrastructure decommissioning to effect closure and achieve end land uses
- Set out post closure monitoring program to allow for relinquishment
- Increasing detail to capture all risks typically implemented during the final 5 years of the operation

- Provides summary of operational and decommissioning activities undertaken to achieve closure
- Details monitoring results to prove acceptable residual environmental and socio-economic risks and end land use objectives have been met
- All data and supporting information is collated and handed over to obtain a closure certificate.

Figure 9: Closure planning over the mining life span

Conceptual closure planning is an integrated process with two key outputs. These are:

- The conceptual closure plan; and
- The initial rehabilitation plan;

Each of these outputs are interrelated and require specific inputs to ensure the closure planning process achieves the aims of "Mining for Closure". Figure 10 provides the relevant sub-sections that relates to a specific concept or topic.

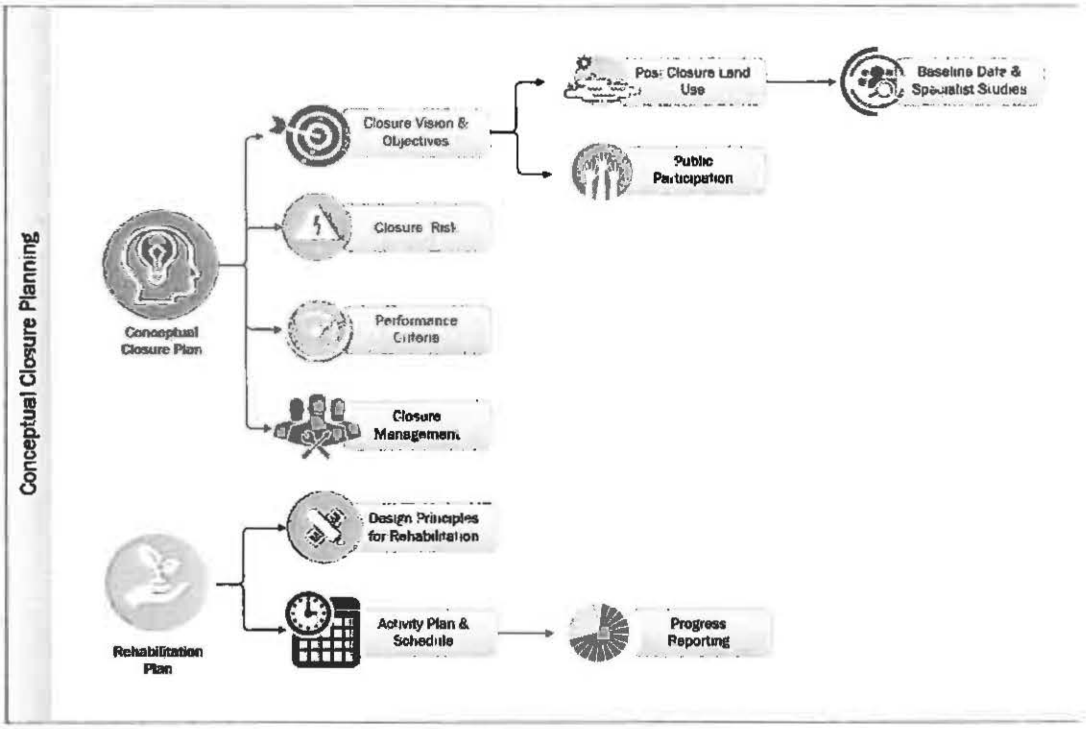


Figure 10: Integrated Conceptual closure planning process

5.6.1 Conceptual Closure Plan

5.6.1.1 Determining a closure vision and closure objectives

As a general guide, the Government's broad closure objectives are:

- Physically safe to humans and animals;
- Geo-technically stable;
- Geo-chemically non-polluting; and
- Capable of sustaining an agreed post-mining land use.

The closure of a mine is guided by the closure vision and closure objective which is developed during the conceptual closure plan phase. Determining a closure vision and closure objectives will therefore be discussed in this section. Table 5 describes the steps that should be taken to produce a closure vision.

Table 5: Development of the closure vision

Steps	Process
STEP ONE *A broad understanding of the environment and socio economic context*	This provides the baseline information needed to determine the opportunities and constraints that exist which influence mine closures.
STEP TWO *Determine post closure vision of how the closed mine is best integrated with the surrounding environment and its socio-economic functions*	A risk based approach should be used to (ICCM Closure Planning for Integrated Mine Closure Tool Kit): i To evaluate, based on a specific issue (e.g., biodiversity, community health), the risk or opportunity associated with that issue and subsequent management of the risk or opportunity; or ii To evaluate, based on a specific closure goal, the risk that this goal will not be met (adapted for use with goal setting) and subsequent management of that risk.
STEP THREE *Review internal and external Sustainable Development commitments*	Broader SD commitments may impact on the closure vision and should be considered in the development of the closure vision. This commitment may include: i. Internal SD commitment such as commitments relating to long term social developments such as skills transfer in the local community. Vision may thus include use of existing mine infrastructure post closure to further facilitate this commitment. ii. External commitments such as those made to neighbouring land owners and local government for transfer of land and or equipment for future use. The Closure Vision must accommodate these to ensure that they meet post closure.
STEP FOUR *Define post closure land use for all mining disturbed land*	Rehabilitation of mining activities will take place during the operation and at closure of the mine. Rehabilitation should thus be managed with the aim of attaining the desired land use. Hence the post closure land use(s) for each mining affected area must be identified upfront. In many instances the post closure land use will be a trade-off between societal and environmental benefits. This needs to be understood and developed within the context of integrated planning. Specific post mining land use considerations are seen in Figure 11.

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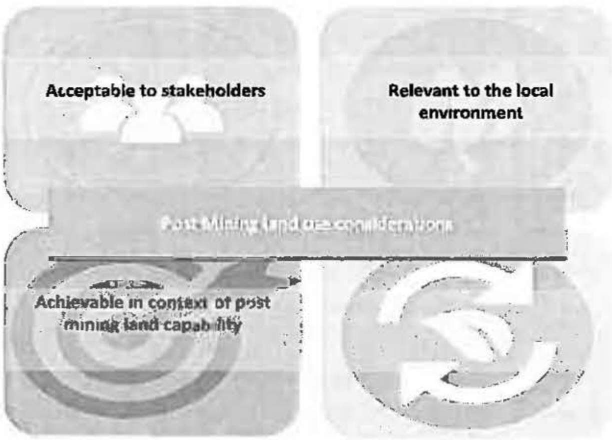

Figure 11: Post mining land use considerations

The following hierarchy of land uses provides a guide for determining post mining land uses:

- Reinstate "natural" ecosystems as similar as possible to the original ecosystem;
- Develop an alternative land use with higher beneficial uses than the pre-mining land use;
- Reinstate the pre-mining land use; and
- Develop an alternative land use with other beneficial uses than the pre-mining land use.
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<tr>
<td>STEP FIVE
Define post closure uses for all infrastructure used during mine life</td>
<td>This must be integrated with the post closure land identified above. Where possible mine infrastructure should be used to support the post closure social development commitments defined in Step 1.</td>
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Clear closure objectives should be set which are consistent and attainable with the projected future post closure land-use as guided by the closure vision. Closure objectives describe the long term goals for closure outcomes and thus should be outcome based and measurable. These objectives must be developed based on the proposed post-mining land use(s) and, be as specific as possible to provide a clear indication to government and the community on what the mine commits to achieve at closure. Closure objectives should be established in consultation with relevant government departments, local councils, landowners etc.

Any residual liabilities relating to the agreed land use must be identified and agreed to by the key stakeholders. Closure objectives should be developed based on adequate baseline data, such as materials characterisation, and/or the best available data to be used for this purpose. These should be further refined during the life of mine (LOM) as the closure plan is updated.

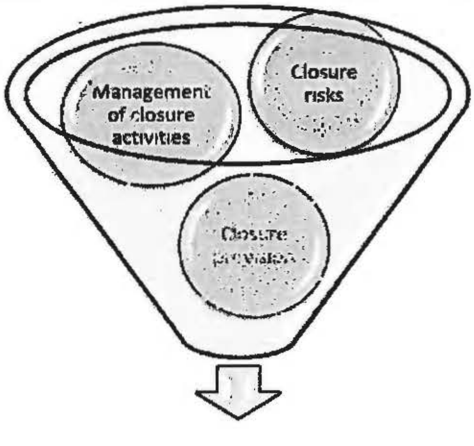
See Appendix D1 and Appendix D2 for examples of closure objectives and vision, respectively.

5.6.1.2 Closure risk assessment

A risk assessment is required to ensure a consistent approach to the identification and management of issues associated with mine closure. Typically, each risk issue (or aspect) can be assessed for its potential environmental, economic, social and regulatory risk factors. A product of this process is the creation of a comprehensive closure risk register that identifies the issues, their risks and their priority.

Unacceptable risks are then mitigated to acceptable levels through the development of control options against each of the risk factors. Following the selection of the most appropriate control option, it is possible to calculate the level of residual risk that may remain after mitigating strategies have been applied. These options may then be used in determining probabilistic costing as a basis for the initial financial costing and provisioning.

The closure risk assessment should contain the minimum information necessary to determine the potential financial liability associated with the management of latent environmental liabilities post closure. This should be determined within the context of the proposed post-closure mining land use(s) with the initial closure criteria having been met. The closure risk assessment should address



the concepts indicated in

Figure 12. A structured risk/opportunity assessment process should be used to:

- Minimize the negative consequences of closure;
- Maximize the positive benefits of closure;
- Minimize the likelihood that closure goals are not met; and
- Maximize the likelihood that opportunities for lasting benefits are captured.

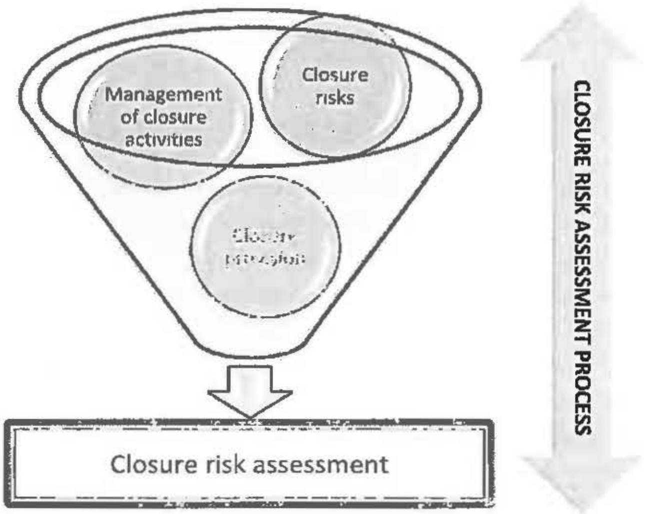


Figure 12: Closure risk assessment

A structured risk assessment methodology along with a meaningful stakeholder consultation process enables identification, early in the planning process, of mine closure risks and opportunities associated with closure, and management strategies to preserve, maintain or enhance environmental values or beneficial uses after closure. Provision should be made for ongoing stakeholder engagements to accommodate changes in stakeholders throughout the life of mine (LOM). A general closure risk management process is seen in Table 6.

Table 6. Detailed risk assessment process

Risk Theme	Process

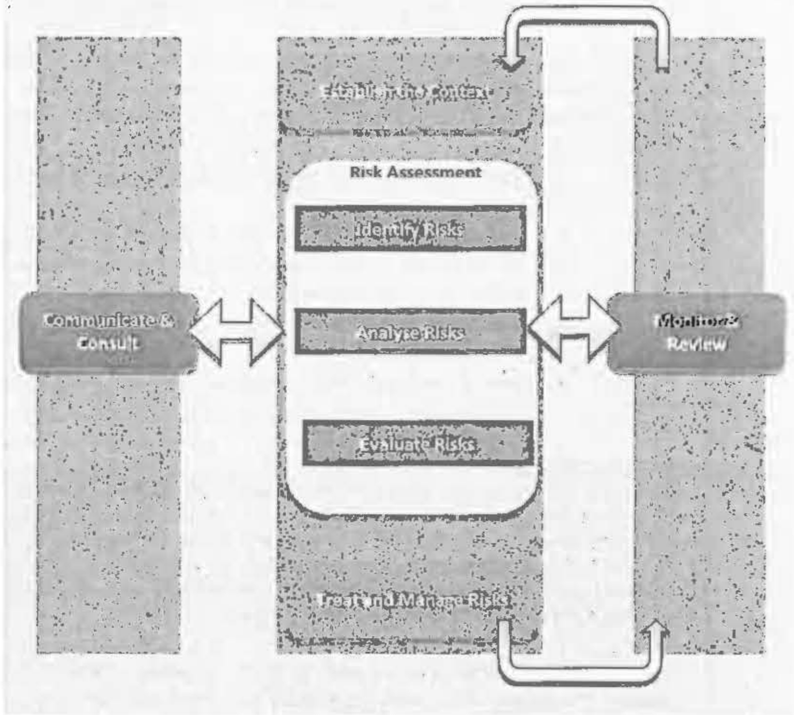


Figure 13: Closure risk management process

Risk identification	Firstly, the criteria against which risks will be evaluated should be established and the structure of the analysis defined. This should take cognisance of the external and internal risk management context. Closure risks can be grouped into 6 major types, these include (in no order of priority): • Health and Safety Risk, • Natural Environment Risk, • Social Risk, • Reputational Risk, • Legal Risk, and • Financial Risk Identification of risks can be undertaken through a combination of brainstorming, what if scenario's or checklists etc. Risk information should be obtained from experienced professionals involved in the operation and subject matter specialists who jointly understand the activities that will be carried out, and their potential impacts on the business and assets within the wider environment. Information from experts is most often obtained during specifically convened workshops and subsequent on-going follow up consultations. External stakeholders must also be consulted to identify other risks and comment on risks that have broader community consequences. A range of stakeholder viewpoints are required to better define risks. The outputs from the risk identification process should be documented to: • Effectively communicate all risks, • Be used as a reference for development of future management strategies, • Used as a reference when reviewing the risk during the operational phase, and • Forms a record for due diligence purposes.
Risk analysis and evaluation	The objective of the risk analysis is to produce outputs that can be used to evaluate the nature and distribution of a risk, and to develop appropriate strategies to manage the risk. The risk assessment process in a conceptual closure plan should: • Identify potential issues the risk of undesirable closure outcomes , or

- Reduce the opportunity for realising lasting benefits.

The level of risk is determined as a combination of likelihood versus consequence. Events or issues with more significant consequences and likelihood are identified as 'higher risk', and are selected for higher priority mitigation actions to lower the likelihood of the event happening and/or reduce the consequences if the event were to occur. Risk analysis tools that can be considered include:

- Matrix: used to define various levels of risk as the outcome of harm probability and harm severity categories;
- Root cause: the method of problem solving to identify faults or problems;
- Cause and effect: method of listing possible reasons and outcomes associated with a particular problem or situation;
- Influence diagram: is a compact graphical and mathematical representation of a decision tree; or
- Bow tie analysis: risk evaluation method that can be used to analysis and demonstrate causal relationships in high risk scenarios.

Qualitative methods

Qualitative methods use descriptive terms to identify and record consequences and likelihoods of events and resultant risk are the most commonly applied methods. They can provide a general understanding of risks comparatively between events. Outputs from qualitative risk analyses are usually evaluated using a risk matrix format to group risk events into classes. An example of this is seen in Appendix E. Qualitative approaches are best used as an initial exercise where there are many complex risk issues and low-risk issues that need to be screened for practical purposes.

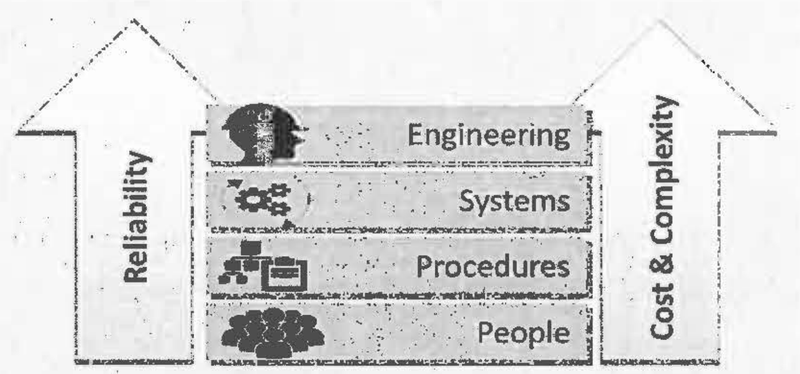
Semi-quantitative methods provide a more detailed, prioritised ranking of risks than the outcome of pure qualitative risk assessments. Semi-quantitative risk assessment advances the qualitative approach by attributing values or multipliers to the likelihood and consequence groupings. Semi-quantitative risk assessment methods may involve multiplication of frequency levels with a numerical ranking of consequence. Several combinations of scale are possible with this method.

Quantitative methods

The quantitative risk assessment is used across the full range of risk applications, from deriving a preliminary separation of risk events to comprehensive assessments. The comprehensive assessments can derive detailed risk profiles for priority rankings, estimates of the costs that may be incurred due to risk events, input to financial models, and a basis for cost-benefit analysis.

Quantitative methods identify likelihoods as frequencies or probabilities. They identify consequences in terms of relative scale (orders of magnitude) or in terms of specific values (e.g. estimate of cost, number of fatalities or number of individuals lost from a rare species); refer to example in Appendix E.

However, quantitative risk approaches are often not intuitive and require some up-front learning investment by decision makers. Quantitative risk assessments are very useful for development and justification of comprehensive risk treatment strategies and for internal business decisions that involve complex business risk events and a wide range of environmental and social issues. However it is dependent on the availability of necessary data, and the capacity and commitment of the organisation to manage the process and to source the required expertise.

Risk management and treatment	The most important outcome of the risk management process is to take action in order to manage significant risks and to capitalise on opportunities. Risk treatment is the term used to describe the approach taken to manage a risk. When deciding on controls to manage the risk, the 'Risk Hierarchy of Control' can be used to maximise the effectiveness. Increasing confidence in risk management is achieved by applying high-reliability control to risks with high potential consequences. This is graphically illustrated in Figure 14.  **Figure 14: Types of Risk Control** The control objective is a statement of the target outcome of the risk control whilst the performance target specifies the required level of repeatability of the control or conversely the maximum allowable 'failure-on-demand' for control. This will also provide the basis for the assessment of the effectiveness of controls during the operational phase. Risk identification and management can be an iterative process, which is seen in Figure 15. Potential issues are identified and monitoring and community engagement programmes can be properly formulated and implemented during the operational phase. As information is received, the risk assessment process can be revised the outputs further refined.

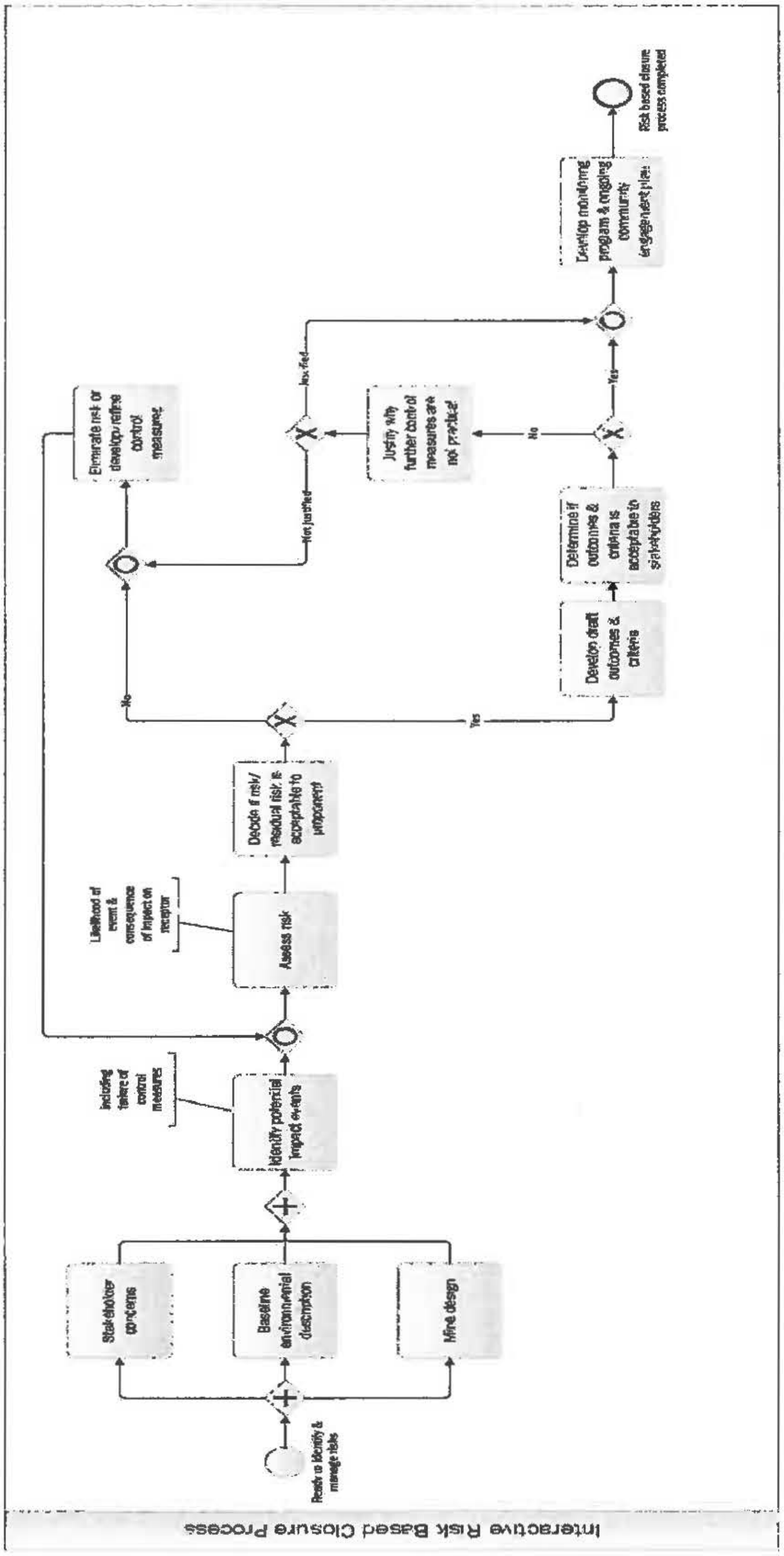


Figure 15: Iterative Risk based Closure Process

5.6.1.3 Performance assessment and monitoring mechanism

The conceptual closure plan should identify the types of monitoring programs that may have to be undertaken to allow verification that the closure planning process is sufficient. Monitoring programs can be divided in two broad categories (environmental monitoring and socio-economic monitoring). Both need to establish:

- Baseline conditions;
- A quantification of changes that might occur as a result of environmental and societal evolution without the mining operation;
- A quantification of changes that might occur as a result of the mining operation;
- How progression towards goals can be measured; and
- How the achievement of goals can be demonstrated.

The last two items require a process for assessing information which validates if closure objectives are being met. At the conceptual stage, it is not necessary to detail these processes, but it is important to confirm that these processes are practical and achievable. For an example of a typical performance assessment and monitoring mechanism see Appendix F.

Performance assessment and monitoring mechanisms should relate to specific criteria to ensure closure objectives can be reached. Indicative completion criteria, based on a conservative estimate of closure performance must be capable of objective verification and based on the best available data at the time. As more information becomes available, more comprehensive and detailed completion criteria can be determined. These indicative criteria should be described in the conceptual closure plan but developed further as mining progresses. The criteria should be:

- Specific enough to reflect a unique set of environmental, social and economic circumstances;
- Flexible enough to adapt to changing circumstances without compromising closure objectives;
- Include environmental indicators suitable for demonstrating that rehabilitation trends are heading in the right direction;
- Undergo periodic review resulting in modification if required due to changed circumstances or improved knowledge; and
- Based on targeted research which results in more informed decisions.

5.6.1.4 Closure management

Standard closure issues which should be addressed are provided in Table 7, including issues that should be taken into consideration.

Table 7: Aspects of closure management

Aspects of closure management	Description of aspects of closure management
Closure issues	**Mine surface closure** • Mine surface structures • Mine residue sites • Off site infrastructure • Waste disposal facilities • Social infrastructure **Mining area closure** • Underground mining • Open pit / opencast areas • Seaborne mining areas **Biophysical closure or rehabilitation** • Biodiversity fauna, flora, sensitive species • Protected habitats/ ecosystems • Groundwater • Surface water • Air quality • Soil and land capability • Land use • Topography or visual **Social closure** • Employees and their dependants • Interested parties and affected parties • Government and authorities
Description of listed	Rehabilitation of a mining area and rehabilitating it to its agreed post closure land use/s, in

activities undertaken for rehabilitation	some instances may require further environmental and or other approvals. A simple example would be EAs required to manage mine affected water post closure. These could include treatment plants, new pollution control dams, construction of wetland treatment systems etc. Approval timeframes should be noted and allowance made to ensure specialist studies to support these applications are budgeted for timeously during the life of the mine.
Information on any proposed avoidance, management and mitigation measures	
Description of manner to modify, remedy and comply with environmental standards to prevent environmental degradation during closure.	
The process for managing environmental damage or degradation as a result of closure	
Details of all public participation processes conducted.	

5.6.2 Rehabilitation Plan

The rehabilitation plan describes the physical activities that will be undertaken to implement the closure plan during the course of the mines construction and operational phases. Thus rehabilitation must be as concurrent as possible. The construction phase and initial mine operations will take place in the first year of operations. Therefore the initial rehabilitation should address:

- Effective mine layout and scheduling to reduce impacts;
- Detail rehabilitation standards for physical rehabilitation activities to be undertaken during the initial period; and
- Detail the initial rehabilitation schedule.

5.6.2.1 Planning considerations for the conceptual mine layout plan

Planning must be done where an initial mine layout is optimised according to legal, environmental and social constraints to minimise cost and negative impacts and maximize positive social outcomes and the achievement of end land use objectives.

Essentially, closure objectives should be outlined so that the planning is done with the end use in mind. The key planning phase activities are indicated in Figure 16. The detail provided on application must include the total extent of the mine footprint/impact over its maximum possible life. Later expansions or changes to activities will need to be addressed through an amendment to the EA.

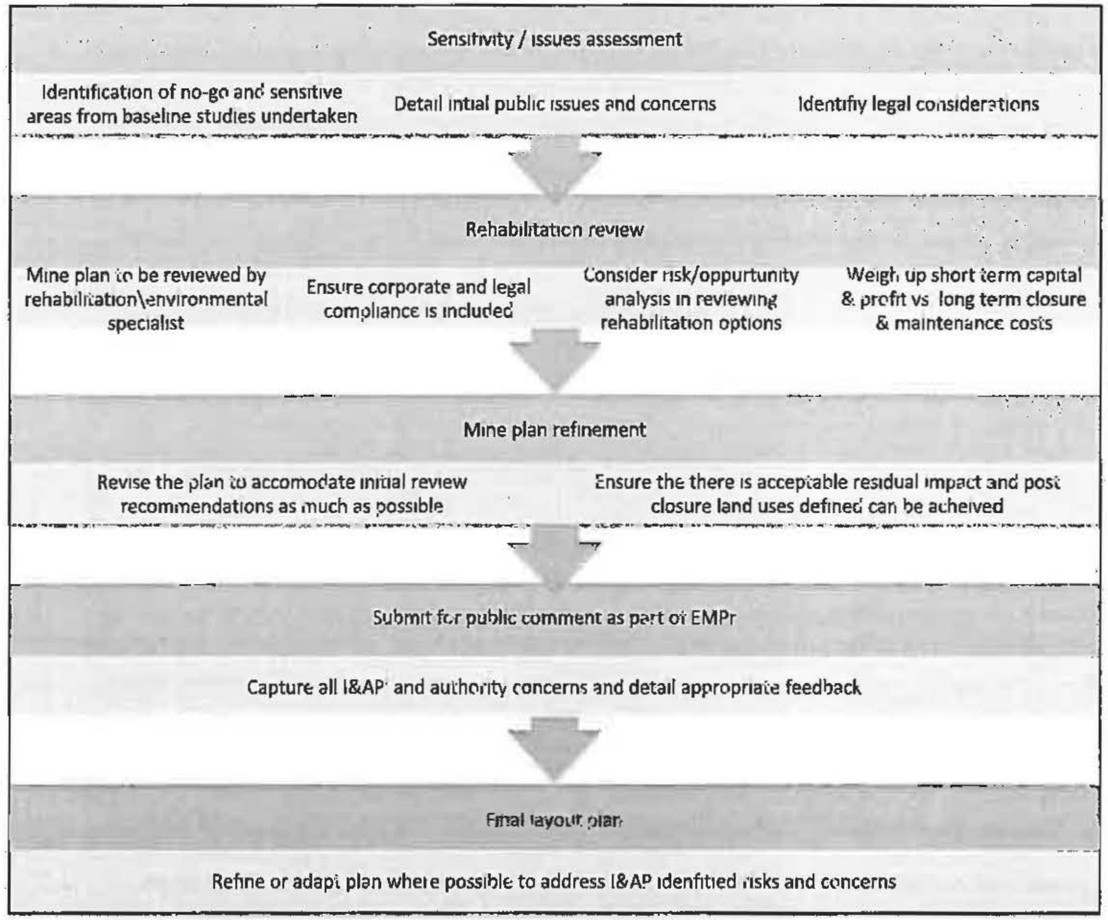


Figure 16: Planning considerations

Effective rehabilitation and subsequent achievement of closure objectives is initiated through proper planning of the mine layout which is implemented in the construction phase and further managed during the subsequent operational phase. Alternatives in the mine design, mining, processing methodology and mining layout is included as part of the initial impact assessment. Initial mine planning should:

- Ensure that mine planning has minimised the disturbed area for mine infrastructure mine excavations;
- Minimise or reduce steep cut and fill and other expensive earthworks;
- Optimise resource extraction layout to reduce long term water impacts;
- Avoid impacts on identified sensitive areas;
- Ensure that construction crews restrict their activities to the planned areas;
- Locate all soil and overburden stockpiles in areas where they will not have to be removed prior to replacement for final rehabilitation;
- Ensure all stockpiles (especially topsoil) are clearly and permanently demarcated and located in defined no-go areas;
- All infrastructures should be designed with closure in mind – either with clearly defined dual purpose or with ease of deconstruction;

- Appropriate water management infrastructure is in place to manage affected water created during the construction phase (this is then further expanded as required during the operational phase);
- Optimise haul distances for ore and overburden;
- All soil stripping should be done in strict compliance with a soil stripping guideline as developed by each individual operation;
- Rock quarries and borrow-pits should be included in the construction environmental plans; and
- Views of affected communities and interested and affected parties should be considered when developing a mine layout.

5.6.2.2 Rehabilitation standards

Mineral extraction typically include opencast and strip mine, underground long wall and hard rock mines, sand and gravel extraction, dredging operations and gemstone mining. Each mine will have particular characteristics which will influence principles and practices adopt for the rehabilitation programme. Relevant industry practise standards and guidelines should be consulted when developing mine specific rehabilitation standards. These should be further adapted to take into account local needs and constraints to achieve the desired outcome. Table 8 demonstrates some principles that should be considered when developing rehabilitation standards.

Table 8: General Rehabilitation Principles

Develop clearly-defined rehabilitation plans prior to the commencement of mining	Identify and understand all legal and other requirements to ensure compliance
Always remove and retain topsoil from disturbed footprints areas for subsequent rehabilitation. Where possible, retain cleared vegetation for replacement on disturbed areas	Always seek to reinstate the natural drainage patterns where feasible
Maximise concurrent rehabilitation to facilitate stripping and immediate replacement of topsoil on rehabilitation areas and reduce mine affected water generation	Identify (characterise) contaminants exposed in overburden or exposed rock strata. Screen with suitable material to prevent mobilisation
Where topsoil is stockpiled, stockpiles should be seeded to reduce erosion	Erosion protection measures to be planned and implemented during rehabilitation
Shaped landforms should be stable, adequately drained and suitable to achieve long term land use identified	Compacted areas should be ripped accordingly to facilitate root penetration unless subsurface conditions dictate otherwise
Landforms should be compatible with surrounding landscape to reduce visual impact	Indigenous plant species selected for revegetation should be consistent with post mining land use, control erosion and

	contribute to stable and compatible ecosystem formation
Include adequate monitoring and management measures to prove sustainability of land use and issuance of a closure certificate.	Declared weeds and pest should be prevented from establishing on rehabilitated areas

5.6.2.3 Rehabilitation schedule

The rehabilitation schedule provides detail on which specific activities should be undertaken to effect closure in identified mine areas or zones. The conceptual closure plan provides high level detail on the schedule for the LOM, with more detailed focussed on the construction and first year operational phase. As operations continue the closure schedule will be adjusted and become more detailed.

The closure schedule should describe timeframes for:

- Planned mine infrastructure construction period;
- Commissioning of pollution control infrastructure;
- The rehabilitation schedule (refers to the rate of rehabilitation and typically includes levelling, topsoiling and revegetation);
- Timeframes for selected specialist studies expected; and
- Socio economic interactions.

Note 4: Concurrent Rehabilitation

Concurrent rehabilitation is a key element that should be planned and implemented during the operational phase. This will assist in reducing the closure cost and will have a significant impact on reducing post closure risk. Consideration should be given to incentivising mine management to reach concurrent rehabilitation goals.

5.6.3 **Content of an EMPr**

NEMA requires that an EMPr be submitted where an EIA has been identified as the environmental instrument to be utilised as the basis for a decision on an application for an EA in accordance to Appendix 4 of the EIA Regulations or where a government notice gazetted by the Minister provides for a generic EMPr, such generic EMPr as indicated in such notice will apply. However, currently, no generic EMPr is available for mining.

The EMPr must be compiled in a manner that ensures undue or reasonably unavoidable adverse impacts of a project are prevented or minimised and that the positive benefits of the projects are enhanced by ensuring that management actions are carried out effectively in order to achieve the management outcomes.
The objectives contained in the EMPr must contain binding impact management outcomes and must have management actions that are based on best practise scenarios.
The environmental outcomes that are included in the EMPr must be achievable as the holder will be required to fully comply with the EMPr and any non-compliance to the EMPr constitutes an offence.

6 Public Participation

According to principles outlined in the Rio Declaration (Principle 10), "environmental issues are best handled with participation of all concerned citizens". To give effect to this, it further outlines three basic elements involved in public participation:

- Access to information;
- Opportunity to participate in the decision-making process; and
- Effective access to administrative and judicial proceedings.

Note 5: Principle 10 of the Rio Declaration

Environmental issues are best handled with participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.

Public participation (PP) strengthens environmental decision-making through information exchange, understanding, increasing transparency and improving accountability. It is important to note that potential or RI&APs should be specifically consulted regardless of whether or not they attended public meetings. Information that is distributed to potential or RI&APs must include sufficient detail of the intended operation to enable them to assess what impact the activities will have on them or on the use of their land. Underlying principles of an effective public participation process (PPP) is outlined in Figure 17 (Chamber of Mines, 2002). This Guideline does not exhaustively set out the requirements for public participation during an application for an EA and the applicable provisions as contained in the NEMA and the EIA Regulations must be given effect to. Furthermore, the PP Guideline: PP in the Environmental Impact Assessment Process published in terms of section 24J of the NEMA must be taken into account. Figure 18 does, however, set out the key principles of PP, the steps of which include:

- Identifying stakeholders;

- Announcing the opportunity to participate;
- Obtaining issues for evaluation and suggestions for alternatives;
- Verification that issues have been captured and considered;
- Present findings for comment; and
- Announcing the authority's decision.

It is important to note that the PPP must not be conducted during 15 December to 5 January.

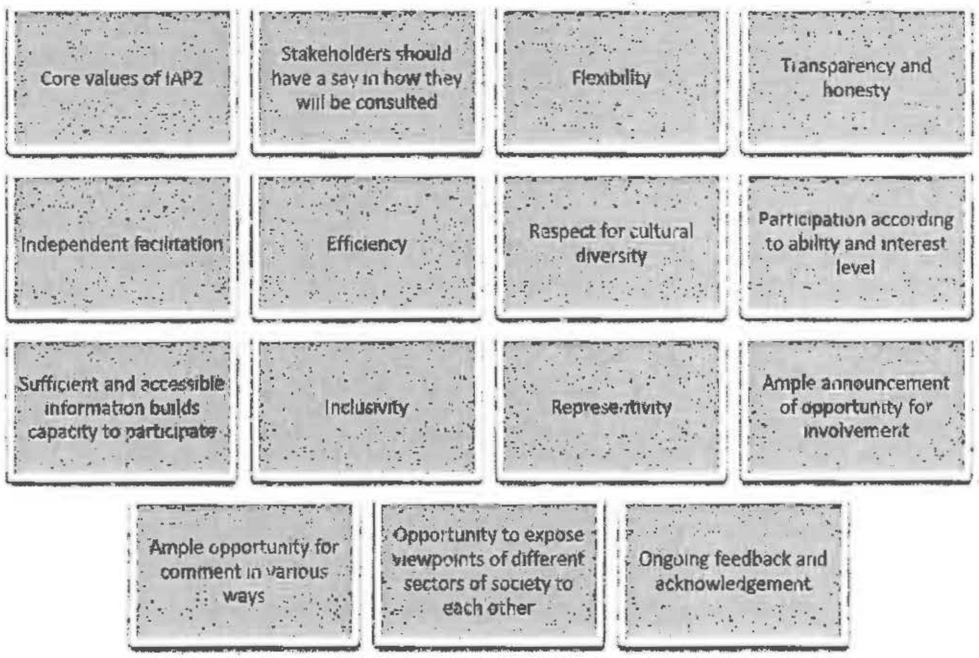


Figure 17: Underlying principle of Public Participation

Written consent is not required from the owner or person in control of the land if the activity is directly related to prospecting or exploration of a mineral resource or extraction and primary processing of mineral resources. The public participation process should be conducted for at least 30 days; this should also be conducted during the closure plan phase for at least 30 days. In addition consultation should be made with the CA, state departments that administer law relating to EAs, organs of state that have jurisdiction in respect to the activity to which the application relates and all potential or relevant RI&APs. It is important to note that the timeframes for a BA will differ to the timeframes of an EIA.

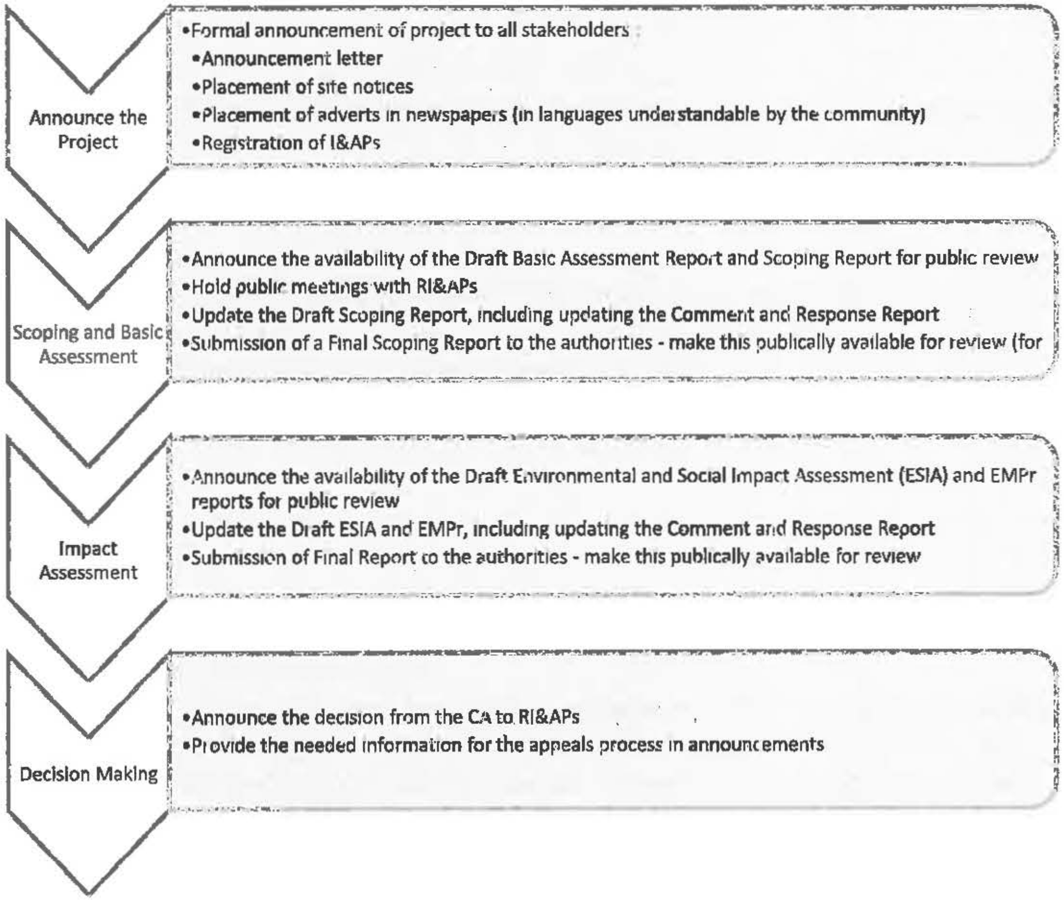


Figure 18: Public participation process

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Appendix A: Need and Desirability

Category	Typical issues	Examples of responses
Securing ecological sustainable development	Mine development impacts on ecological integrity and how these are accounted for	• Provide context of the mine development in relation to or impacts on sensitive areas, protected species, Critical Biodiversity Areas, designated conservation area etc • If impacts do occur, relate how these are accounted for such as percentage loss of habitat, or expected loss in population size etc
	Mining impacts (both positive and negative) disturbing or enhancing the surrounding ecosystems and the alternatives which need to be considered to avoid negative impacts and enhance positive impacts	• Provide summary of the significant impacts expected to indicate measures or alternatives to enhance these. Examples would include: o Altering mine plan to avoid wetland habitat disturbance o Undertaking ecological off setting by rehabilitating o Restoring an area of regional ecological importance
	Waste generation and management to avoid waste generation or minimise, reuse and/or recycle waste	• Highlight mines commitment to waste management by summarising key waste management practices and targets. These could include o Separation of waste at source to enhance recycling o Commitment to purchasing and using biodegradable cleaning product o Using specialist equipment and processes to treat or reclaim waste such as oil & water separation units and bio-filters for sewage treatment o Investing in local recycling initiatives for boarder community
	Non-renewable and renewable natural resources consumed during the LOM and the measures required to reduce and manage these to ensure responsible and equitable usage of the resources	• Discuss the measures used to ensure responsible and equitable use of resources • Highlight whether the mine will exacerbate the increased dependency on increased use of resources to maintain economic growth or decrease resource dependency (i.e. de-materialising growth) • Investigate whether the proposed location, type and scale of the development promotes a reduction on resource dependency
	The impact of mining on the ecosystem integrity and consequentially depleting the ecosystem	• Analysis whether the mine will jeopardise the integrity of the ecosystem by considering o The system's carrying capacity restrictions o Limits of acceptable change o Thresholds of the system • List the steps taken to reduce the mines ecological footprint, for example o Using less materials o Decreasing energy demand o Reducing the amount of waste generated o Incorporating water and air purification systems o Minimising the amount of land disruption
	The application of risk averse and cautious approaches (the precautionary principle) in terms of ecological impact.	• The application of the precautionary principle and the associated need to take precautionary measures is triggered by the satisfaction of two considerations precedent or thresholds, namely: o A threat of serious or irreversible environmental damage o Scientific uncertainty as to the nature and scope of the threat of environmental damage

Category	Typical issues	Examples of responses
		• Highlight and identify the limits in current knowledge, ensuring that the gaps, uncertainties and assumptions are clearly stated • Identify the level of risk associated with the limits of current knowledge • Discuss the extent to which the risk-averse and cautious approach was applied
	The positive and negative ecological impacts of the mining development on the people's environmental rights	• Negative impacts which should be avoided (if possible), minimised, managed or remedied include o Access to resources o Decreased opportunity costs o Loss of amenity (e.g. open space) o Nuisance (noise, odour) o Health impacts o Visual impacts • Positive impacts which should be enhanced include o Improved access to resources o Increased amenity o Improved air or water quality o Access to jobs or skills improvement opportunities
	Ecological influences of mining on the ecological impacts in terms of linkages and dependencies between human wellbeing, livelihood and ecosystems services of the area	• Highlight how the mines ecological impacts will result in socio-economic impacts on: o Livelihoods o Loss of heritage o Opportunity costs
	How will this development positively or negatively impact in the ecological integrity objectives/targets/considerations of the area?	• Negative ecological impacts include o Sinkholes o Loss of biodiversity o Destruction of adjacent habitats arising from the development of camps, towns and services stimulated by the mining project o Damage to soils including salination, acidification, pollution and compaction or loss of soil structure o Contamination of surface or ground water by sediment, mobilisation of salt, release of toxic elements from overburden, tailings or wastes, or spills of oil, chemicals or fuels as surface runoff or as underground seepage • Positive ecological impacts include o Landscape improvement o Slope stability o Access to other regions o Renewable energy
	The positive and negative cumulative ecological/biophysical impacts of the development	• Consider the size, scale, scope and nature of the project relative to its location and existing and other planned developments in the area • Cumulative effects can be: o Additive: the simple sum of all the effects

Category	Typical issues	Examples of responses
		o Synergistic: effects interact to produce a total effect greater than the sum of the individual effects. These effects often happen as habitats or resources approach capacity (e.g. fragmentation of habitat for a species can have limited effect until additional fragmentation makes the areas too small to support that species at all) o Time crowding: frequent, repetitive impacts on a particular resource at the same time (e.g. small-scale mining within a particular ecosystem) o Neutralizing: where effects may counteract each other to reduce the overall effect (e.g. infilling of a wetland for road construction and rehabilitating another wetland for water treatment o Space crowding: high spatial density of impacts on an ecosystem (e.g. rapid expansion of urban sprawl) • Crucial to the identification of cumulative implication of an activity of project is to have an understanding of the context within which the impact will occur
Promoting justifiable economic and social development	Socio-economic context of the area	• Identify the socio-economic context of an area by considering the following o The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) of the area o Any other strategic plans and frameworks of policies applicable to the area o Spatial priorities and desired spatial patterns (e g need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc) o Spatial characteristics (e g existing land uses, planned land uses, cultural landscapes, etc) o Municipal Economic Development Strategy ("LED Strategy")
	Socio-economic impacts of the development and its separate elements/aspects on the specific socio-economic objectives of the area	• Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives) • Highlight any skills development programs
	Address the specific physical, psychological, development, cultural and social needs and interests of the relevant communities	• Identify the specific needs of the communities surrounding the mine
	Ensuring an equitable impact distribution and be socially and economically sustainable in both the short- and long-term	• Will the development be both intra- and inter- generationally equitable?
	The benefit of the placement/location of the proposed mine towards the surrounding community	• Highlight and analyse how the placement of the mine will achieve the following o Creation of residential and employment opportunities o Reduce the need for transport of people and goods o Make use of underutilised land available within the urban edge o Encourage environmentally sustainable land development practices and processes o Investment in the area to generate high socio-economic returns o Discourage urban sprawl and contribute to compaction/densification o Contribute to the correction of historically distorted spatial patterns of settlements o Optimum usage of the existing infrastructure in excess of current needs

Category	Typical issues	Examples of responses
		○ Take into account special locational factor that might favour specific locations (e.g the location of a strategic mineral resource, access to the port, access to rail) ○ Impact on the sense of history, sense of place and heritage of the areas and the socio-cultural and cultural-historic characteristics and sensitivities on the area ○ Will the nature, scale and location of the mine promote or act as a catalyst to create a more integrated settlement
	The application of a risk-averse and cautious approach applied in terms of the socio-economic impacts	• Identification of limits of current knowledge (gaps, uncertainties and assumptions must be clearly stated). • Level of risk associated with limits of current knowledge related to the following: ○ Inequality ○ Social fabric ○ Livelihoods ○ Vulnerable communities ○ Critical resources ○ Economic vulnerability ○ Sustainability • How and to what extent was a risk-averse and cautious approach applied to the mine?
	The positive and negative socio-economic impacts resulting from the mine's impact on people's environmental rights	• Negative impacts which should be avoided (if possible), minimised, managed or remedied include: ○ Health (HIV/AIDS) ○ safety ○ social ills (drugs and alcohol) • Positive impacts which should be enhanced include ○ Improved access to resources ○ Increased amenity ○ Improved air or water quality ○ Access to jobs or skills improvement opportunities ○ Land value added ○ GDP improvement and wealth creation ○ Tourism income ○ Sharing benefit with other communities ○ Improving public services
	Consider the linkages and dependencies between human wellbeing, livelihood and ecosystems services which are applicable to the mine's area and the ecological impacts they will have	• Identify the relevant linkages between human wellbeing, livelihoods and ecosystem services. ○ E.g. the impact of over utilisation of natural resources on human wellbeing and the surrounding ecosystem
	Measures taken to pursue the selection of the "best practicable environmental option" to ensure environmental justice in terms of socio-economic considerations and adverse environmental impacts to safeguard from unfair	• Principles of best practice include ○ Ecologically sustainable development ○ Intra-and inter- generational equity ○ Accountability and compliance with international human rights and environmental

Category	Typical issues	Examples of responses
	discrimination against any person	standards and principles o The Precautionary Principle o Well informed and trained staff o Effective communication and openness o Flexibility o Continual improvement • Benefits of 'best environmental practice' include o Preventing harmful environmental and social impacts o Improved access to land for mineral exploration o Greater certainty of outcomes in the project application stage o Lower risk of non-compliance o Great acceptance/less resistance from key stakeholders (in particular local communities and land owners) o Lower financial burdens in the mine closure and rehabilitation phases o Lower risk of significant liabilities post-closure
	Measure taken to purse equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing	• Community consultation and engagement • Understanding the impacts and benefits of mining by the community • Community involvement in all stages of the mining
	Measures taken to ensure that the responsibility for the environmental health and safety consequences of the development are addressed throughout the mine's lifecycle. The health and safety of mine workers must be detailed in the Mine Works Programme, in accordance to the Mine Health and Safety Act	• Identifying Environmental Health and Safety (EHS) project hazards and associated risks as early as possible in the facility development or project cycle, including the incorporation of (EHS) considerations in to the site selection process, design, engineering planning process for capital requests, engineering work orders, facility modification authorisations or layout and process change plans • Understanding the likelihood and magnitude of EHS risks based on o The nature of the projects activities, such as whether the project will generate significant quantities of emissions or effluents, or involve hazardous materials or processes o The potential consequences to workers, communities or the environment if hazards are not adequately managed, which may depend on the proximity of project activities to people or to the environmental resources which they depend • Prioritizing risk management strategies with the objective of achieving an overall reduction of risk to human health and the environment, focusing on the prevention of irreversible and/or significant impacts
	Measures taken to ensure that the needs and wellbeing of all interested and affected parties are considered	• What measures were taken to ensure: o Adequate participation by all the interested and affected parties o Providing all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation o Promoting community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means

Category	Typical issues	Examples of responses
		o Ensuring openness and transparency and access to information in terms of the process o Ensuring that the interests, needs and values of all interested and affected parties were taken into account and that adequate recognition is given to all forms of knowledge, including traditional and ordinary knowledge o Ensuring that the vital role of women and youth in environmental management and development is recognised and their full participation therein is promoted
	Allowing for opportunities for all the segments of the community in terms of their interests, needs and values	• For example, a mixture of low-middle- and high-income housing opportunities • All opportunities provided must be consistent with the priority needs of the local areas (or that is proportional to the needs of an area)
	Measure taken to ensure that current and future workers will be informed of work that might potentially be harmful to human health or the environment and the dangers associated with such work	• Providing Health and Safety training and PPE.
	The mine's impact on job creation	• Job creation in terms of, amongst other aspects: o Number of temporary versus permanent jobs, o Type and skill set of labour available, o Location of the job opportunities versus the location of impacts (e.g. equitable distribution of costs and benefits) o Distance travelled by labourers and o Opportunity costs in terms of job creation (e.g. a mine might create 100 jobs, but impact on 1000 agricultural jobs)
	Measures taken to ensure that there was intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment and that actual conflicts of interest between organs of state were resolved through conflict resolution procedures	Meetings with stakeholders including government and municipal departments to align mining development within broader institutional frameworks
	Measures taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serves the public interest, and that the environment will be protected as the people's common heritage	• Ensuring the adequate and proper public participation was undertaken
	Proposed mitigation measures	• Are the proposed mitigation measures realistic • What long-term environmental legacy and managed burden will be left?
	Measures taken to ensure that the costs of remedying, preventing, controlling or minimising current and future pollution, environmental degradation and consequence adverse health effects will be paid for by those responsible for harming the environment (polluter pays principle)	• Preventative measures: If the environmental damage has not yet occurred but the threat of it happening is imminent, the operator must instigate preventative measures immediately • Remediation measures: If environmental damage has occurred to watercourses or protected species and natural habitats, the operator must instigate measures to restore, rehabilitate, replace or provide equivalent alternatives for the polluted natural resources and/or impaired

Category	Typical issues	Examples of responses
		functions These measures include o Primary remediation i e any remedial measure which returns the damaged natural resources and/or impaired functions to their original or "baseline" condition o Complementary remediation at a different location as compensation when primary remediation does not result in the full restoration of polluted natural resources and/or impaired functions o Compensatory remediation to compensate for the temporary loss of natural resources and/or functions from the date of damage occurring until the full restoration of the original condition
	Securing ecological integrity and healthy bio-physical environment	• Describe how the alternatives identified will result in the selection of the best practicable environmental option in terms of the socio-economic considerations
	Positive and negative cumulative socio-economic impacts	• Consider the size, scale, scope and nature of the project relative to its socio-economic impacts • Cumulative effects can be o Additive the simple sum of all the effects o Synergistic effects interact to produce a total effect greater than the sum of the individual effects These effects often happen as habitats or resources approach capacity (e g fragmentation of habitat for a species can have limited effect until additional fragmentation makes the areas too small to support that species at all) o Time crowding frequent, repetitive impacts on a particular resource at the same time (e g small-scale mining within a particular ecosystem) o Neutralizing where effects may counteract each other to reduce the overall effect (e g infilling of a wetland for road construction and creation of new wetlands for water treatment o Space crowding high spatial density of impacts on an ecosystem (e g rapid expansion of urban sprawl) • Crucial to the identification of cumulative implication of an activity of project is to have an understanding of the context within which the impact will occur

Appendix B: Baseline information requirements

Assessment criteria for determining baseline environment.	Data requirements
Geology, physiography and topography	Data is required on contour mapping, regional geophysical data (gravity surveys, shallow seismic profile, airborne resistivity etc), surficial or sub-outcrop extent of rock units or mineral commodities, soil classification and soil quality where this could be affected by mining activities Much of this data should be available from geological maps and where not available should be obtained from field studies Soil chemistry would be collected where potential impacts could occur from mining emissions (e g Concentrate storage and handling) Topographical information on topocadastral maps, digital elevation data
Climate and meteorology	Data is required on wind speed and direction, rainfall (frequency, duration, mean averages, storm events and return frequencies, Probable Maximum Precipitation), temperature and evaporation. Data collection methods include interpretation of data from nearby climate stations and in many cases installation of an on-site station
Soils and sediment quality-	Data on the natural soil catena collected through detailing mapping, soil classification and profile description Data are required to physically and chemically characterise sediments Sediment sampling would normally occur at surface water sampling stations however at a reduced sampling frequency Analyses would include organic carbon, loss of ignitions, grain size, moisture content and the same metals as analysed for water quality)
Pre-mining land capacity	Land capability must be assessed at the early planning process through consultation with provincial and local government agencies.
Land use	All existing and proposed land use including parks, reserves, protected areas, residential, commercial, forestry concessions, eco-tourism and industrial should be described and shown as appropriate on land use plans Specific data is required within the lease area to identify property ownership and surface rights Effects on future development
Fauna and flora	A detailed inventory is required on the species within and around the mining lease. Data collection would include literature sources, interviews with local people and field surveys. Maps should be prepared. Specific emphasis is required to identify endemic plans and animals, rare and endangered species, fisheries habitat and spawning areas, benthos and plankton species and diversity and use of terrestrial and aquatic plants and animals by people, wetland areas etc. There may be a requirement to obtain and analyse samples of fish flesh, aquatic vegetation and terrestrial vegetation to record the baseline levels of metals (notably mercury and other metals that may accumulate); sensitive ecological habitats and ecological balance
Hydrology and Hydrogeology (Ground water)	Data on watershed areas, stream flow statistics, water levels, bathymetry, currents, hazard lands This data is often available from published sources for large watershed but site specific data is often necessary to provide hydrologic data for the smaller watershed normally occupied by mining facilities (plant site, waste piles, tailing basins, etc) It is common to provide water level recording and continuous stream flow monitors Data is required on the groundwater flow patterns, aquifer characteristics (transmissivity, porosity, permeability), depth to water table, piezometric level and ground water quality Ground water should be analysed for the same parameters as surface water The extent of data will be site specific and will be extensive where acid rock and tailings are stored

Surface water	Detailed characteristics of the water bodies on the lease as well as more detailed seasonal characterisation of the receiving streams both upstream and downstream as well as any sub-watersheds where facilities will be built. Characterization requirements will vary but would typically include: pH, TDS, TSS, turbidity, conductivity, organic compounds (phenol and oil and grease), major anions (sulphate, chloride, fluoride, bicarbonate), alkalinity, acidity, major cations (Ca, Mg, Na, K), nutrients (TKN, total ammonia, phosphate, nitrate, +nitrite), trace metals (Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Se, Sb, Zn). Limits of detection should be below levels of environmental concern (normally set levels as suggested to protect aquatic species). Other elements could include bacteriological sampling (coliforms, faecal coliforms and standard plate counts), rare earth elements, radioactive elements, and other trace metals. The need for these would be determined on a site specific basis.
Air quality	Information would be required on dust fall, suspended particulates (Total, $PM_{2.5}$ and PM_{10}) and gases such as SO_2 and NOx. Data collection techniques would include literature surveys and field data collection
Noise and visual aspects	Data on the noise and visual impact of the mining operations should be included. Compliance with all the necessary regulations is vital. The use of digital elevation models (DEM) or digital terrain models (DTM) with geographic information systems can assist in the delineation of the areas where visual impacts may occur
Aspects of light	Attraction of birds and moths to lights during night operations. The impact of light pollution may extend to flight paths being affected, as well as scientific experiments such as the Square Kilometre Array in the Karoo
Regional socio-economic structures (Site of archaeological and cultural interest)	Data is required on: cultural/historic resources (archaeology); indigenous peoples; demographics, infrastructure; employment, income, skills and education; and public health.
Interested and affected parties	Comprehensive public participation is required. The importance of involving stakeholders including the broad public, NGOs, and authorities during the planning stages and throughout the LOM in an important facet of the environmental planning process
Transport	Data required for traffic can comprise the levels and composition of traffic, the character of the road network, road safety and accident levels, public transport services and use, cycling and pedestrian movements and facilities, pedestrian delay, noise and air pollution, dust and dirt created by existing traffic levels.

Appendix C1: Impact assessment: Methodology

Example of Impact Assessment Methodology

The activities arising from each phase will be included in the impact assessment tables. This is to identify activities that require environmental management actions for mitigation measures. The assessment of impacts will be conducted according to the synthesis of criteria required by the integrated environmental management procedure.

Criteria	Abbreviation
Nature/intensity of impact	Nat
Spatial extent of impact	Ext
Duration of impact	Dur
Probability of potential occurrence	Prob
Frequency of potential occurrence	Freq
Overall Significance	OS

Ranking of evaluation criteria

CONSEQUENCE	Nature / Intensity / Severity of Impact		
	Low	Impacts affect the environmental in such a way that natural, cultural and/or social functions and processes are not affected.	1
	Medium	Impacts affect the environment in such a way that natural, cultural and/or social functions and processes are altered	3
	High	Impacts affect the environment in such a way that natural, cultural and/or social functions and processes will temporarily or permanently cease	5
	Spatial extent of Impact		
	On-site	Impact occurs on-site	1
	Local	Impact occurs within 5km radius of the site	2
	Regional	Impact occurs within a 100km radius of the site	3
	National	Impact occurs within South Africa	4
	International	Impact occurs internationally	5
	Duration of Impact		
	Short-term	Through dilution and dispersion, the impact reduces to insignificant within 1 week	1
	Medium-term	Through dilution and dispersion, the impact reduces to insignificant within the life of the mine	2
	Long-term	The impact will cease after the operational life of the mine either because of natural process or by human intervention	3
	Permanent	Where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient	4
LIKELIHOOD	Probability of potential occurrence of the Impact		
	Improbable	The possibility of the impact materializing is very low either because of design or historic experience	1
	Probable	There is a distinct possibility that the impact will occur	2
	Highly probable	It is most likely that the impact will occur	3
	Definite	The impact will occur regardless of any prevention measures	4
	Frequency of potential occurrence of the Impact		
	Annually or less	Impact occurs at least once in a year or less frequently	1
	6 months	Impact occurs at least once in 6 months	2
	Monthly	Impact occurs at least once a month	3
	Weekly	Impact occurs at least once a week	4
	Daily	Impact occurs daily	5

CONSEQUENCE													
		3	4	5	6	7	8	9	10	11	12	13	14
	2	5	6	7	8	9	10	11	12	13	14	15	16
	3	6	7	8	9	10	11	12	13	14	15	16	17
	4	7	8	9	10	11	12	13	14	15	16	17	18
	5	8	9	10	11	12	13	14	15	16	17	[illegible]	[illegible]
	6	9	10	11	12	13	14	15	16	17	[illegible]	[illegible]	[illegible]
	7	10	11	12	13	14	15	16	17	[illegible]	[illegible]	[illegible]	[illegible]
	8	11	12	13	14	15	16	17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LIKELIHOOD	9	12	13	14	15	16	17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The significance of impacts is determined based on the evaluation of an activity's impact in terms of consequence and likelihood. Using the sum of the evaluated ranking, the overall significance can be classified as follows:

Low	Where it will not have a significant influence on the environment. Management measures can be proposed to ensure that significance does not increase	5- 11
Medium	Where it could have a significant influence on the environment unless it is mitigated or managed	12 – 17
[illegible]	Where it would have a significant influence on the environment regardless of any possible mitigation and hence must be either avoided or managed	[illegible]

Appendix C2: Impact assessment: Typical Criteria and Management Measures

Assessment criteria	Context	Typical impacts	Examples of mitigation measures
Geology	The intrinsic character of the rock, mineralisation or occurrence plays an important part in determining the mining method, beneficiation technologies, amount and the nature of waste materials and geochemical risk.	Mining operations typically have a permanent impact on disturbed rock masses which then influences the groundwater, topography of the site and can impact post-mining slope stability. The direct impact of mining on geology is seldom highly significant unless the long-term effects on groundwater or topography have important ramifications. Underground board and pillar mines do pose a geotechnical risk which needs to be investigated.	Geological mitigation as a result of mining cannot be mitigated, as the removal of the mineral will inevitably alter the geological profile, however mining methods specifically for underground operations can be altered to ensure long term geological stability so as to mitigate surface subsidence.
Climate or meteorology	Expected rainfall has a direct bearing on the volumes of clean and affected water generated which impacts on the design and sizing of water management infrastructure both during the operational and post closure phases. Accurate rainfall and evaporation data is required for the development of the mine water balance which impacts on mine design, operation and closure. Rainfall also impacts on floodline (1:50 and 1:100) determination for water courses which constrains the location of mine activities.	Mining activities impacts occur mainly through: 1. Dust and particulates related to mineral extraction (earth moving, blasting), transport (dust from conveyors and or dirt roads used) and beneficiation (crushing, screening, milling etc.) 2. Potentially harmful gaseous and radiogenic emissions	Operational control considered include: 1. Procedures designing and undertaking blasting 2. Mining layout considers wind direction and community impact 3. Use of tarpaulins, wetting and chemical suppressant on roads, stockpiles, conveyors and in beneficiation plants 4. Equipment maintenance to reduce noxious emissions
Topography	Topography is controlled to a large extent by the strength characteristics of bedrock and the age and weathering history of land surfaces of various ages	High relief or steep slopes can influence local rainfall and wind patterns, creating rain shadow effects that result in sharp rainfall gradients that cannot be adequately characterised by records from nearby or remote stations. Terrain morphology plays a critical role in defining the visual aspect of mining developments and can either reduce or enhance visual impact. Topographical changes can result in changes to the flow paths of surface water. Rehabilitation should strive to replicate the pre-mining topography	Topographic rehabilitation must consider all scenarios which may not be obvious at the time of mine planning and must be addressed as the mine develops and the EMPr must be reviewed periodically for continued relevance in the light of changed mine path or long-term plans.
Soil	The thickness, texture and nature of soil cover are strongly related to bedrock type and terrain morphology. Excavation and stockpiling of a thicker layer during site preparation results in dilution of the highly fertile organic component. The fertility of soil must be accurately assessed in order to design post-rehabilitation treatments that will restore the nutrient status of stockpiled topsoil. The rainfall intensity and erosion potential of the topsoil and overburden materials must be considered in the design of stormwater control structures and stable	Impact of mining on soils relates mainly to the excavation and stockpiling of the soil profile ahead of mining or infrastructure developments and restoration to the modified or levelled terrain during rehabilitation. Other impacts on in-situ and stockpiled soil include erosion by concentrated stormwater runoff, compaction and contamination by infiltrating runoff or leachate.	Topsoil, leaf and plant litter as well as subsoil must be stockpiled separately in low heaps. Microbial activity, seed viability and soil fertility are adversely affected by long periods of stockpiling when high temperatures can be generated in thick deposits, therefore the topsoil should be restored as soon as possible. An alternative is to "turn" or aerate the stockpiled topsoil regularly or plant legume crops that can restore some fertility to the soil. Soil removal creates permanent impacts that can be mitigated through restoration of soil cover, although the

Assessment criteria	Context	Typical impacts	Examples of mitigation measures
	gradients for residue deposits.		significance of the impact remains high.
Pre-mining land capability	The land capability of an area is defined by a combination of terrain form, soil types and thickness, slope gradients, rainfall and surface water hydrology, in association with broad agricultural potential, socio-economic and development planning criteria	Mining has a permanent effect on the site and surrounding land capability options of varying intensity and significance Subdivision of land and restoration to a non-natural condition by rehabilitation may not sustain pre-mining land capability during the post-mining period Even where the proposed mining area is small, the cumulative impact when seen in the context of other operations or long-term mining development can reduce sustainable land-use options	In certain instances pre-mining land capability can be restored based on implementation of well-planned rehabilitation activities, such as land form design, replacement of soil profile and topsoil depth
Land use	This aspect is very similar to the broad concept of land capability. Land use in urban and peri-urban areas may be zoned as part of a development framework outlined in the Integrated Development Plan (IDP).	Land use may be altered from arable agricultural conditions to grazing conditions post rehabilitation.	Post-mining land-use options must be assessed as part of the range of alternatives presented in the EMPr document and must be assessed by the review authorities relative to development priority frameworks or environmental conservation potential or goals.
Natural vegetation/plant life	Specialised vegetation types are commonly associated with relatively undisturbed areas of shallow, rocky soils or steep slopes where they have evolved to cope with low nutrient status and high drought stress levels The conservation status of any vegetation type must be assessed relative to the extent of undisturbed areas of this vegetation type in the surrounding area in order to reduce the possibility of cumulative impacts Certain vegetation types have been afforded legal protection status if they contain Protected, Rare, Threatened or Endangered "Red Data" species	Removal of natural vegetation to accommodate mining activities	Rehabilitation should strive to restore indigenous vegetation using locally sourced species and specimens, if possible Monitoring and management during the life of a mine is critical to ensure that undisturbed areas are not impacted by the mining activities that disturb adjacent land and that plants from these areas are not illegally removed and utilised Revegetation using diverse grass cover is commonly utilised and the choice of whether to use sod strips, hand sow-grass, hydroseed or create patches of climax grass species with seedlings, will be dictated by the size of the area, slope aspect and gradients and cost
Animal life	The focus of conservation efforts and planning in mining areas should not ignore birds, reptiles, amphibians and invertebrates in favour of small and large mammals. The focus of the impact assessment should place the pre-mining populations or conditions in the context of historical data and regional conservation areas.	The removal of vegetation, affecting the habitat for fauna.	Establishing whether a development will impact rare or threatened populations, by destroying habitat, restricting movement between populations, reducing breeding success, or whether it will create a cumulative impact relative to other developments or over time, are the key questions to be answered by the environmental description and interpretation of likely impact status. Once understood stood mitigation can be properly planned
Surface water	The sphere of management and protection of water resources in the mining environment is the responsibility of the DWS, Water Quality Management section	All developments impact surface water through modification of infiltration rates by increasing the extent of hardened surfaces Apart from reducing natural recharge to the shallow and deep groundwater zones, the increased runoff and altered storm hydrograph will also impact areas downstream or downslope where the flow is concentrated Destabilisation of watercourses due to increased flow causes erosion	Comprehensive manuals outlining mine water treatment and management, including surface water from the storm water runoff and residue deposits, underground water, groundwater, water reclamation and water and salt balances have been published by the DWAF as their best practise guidelines

Assessment criteria	Context	Typical impacts	Examples of mitigation measures
		and change in channel character or dimensions, destroys riparian vegetation, raises the floodplain water table, alters bed roughness and causes eroded sediment to be deposited downstream. Any change in sediment type or water depth can result in significant changes in the vegetation type and growth form within the channel that will impact the flow of floodwaters and probably cause more regular overbank flooding. River diversions also change the overall gradient and flow rates and impact flood discharge and erosion/sedimentation patterns at the site and downstream.	
Groundwater	The sphere of mining use or impacts on the groundwater environment is the responsibility of DWS and is addressed through the review process undertaken by officials from DWS.	The potential to store water is increased through secondary brittle fracturing, weathering or mineral dissolution to create secondary void space. A combination of different rock types can generate discrete groundwater compartments such as those within soluble dolomite confined by intersecting sub-vertical diabase dykes, the narrow fracture zones confined by fresh, impermeable rock, or porous horizontal strata confined above and below by impermeable strata. Seepage at the surface is often related to a porous or fractured rock overlying a relatively impermeable rock mass. Mine dewatering to reduce the threat of inundation by migrating groundwater can lead to changes in the near surface environment and catastrophic surface subsidence or sinkhole formation in dolomitic terrains. Sinkholes create conduits for clean or potentially contaminated surface water to mix with groundwater. Draining wetlands reduces the natural groundwater recharge.	Best practice guidelines are perhaps the most suitable means of ensuring that over-utilisation and groundwater contamination risk is reduced. Land-use planning should ensure that potentially polluting processes and facilities are placed where the aquifers are least vulnerable. Wellhead zoning to ensure setback of potential pollution sources based on aquifer transmission and pollutant travel times can be effective in protecting water sources. These approaches should be reflected in the catchment management strategies of local and provincial authorities.
Air quality	The impact of mining on air quality is through the release of noxious gases or wind transport, suspension and fallout of fine particulate matter as dust. Noxious gases produced by combustion include sulphur dioxide, hydrogen sulphide, carbon dioxide and carbon monoxide. Burning of coal residues by spontaneous combustion due to natural oxidation of carbon and pyrite is one of the most widespread and uncontrolled contributors to poor air quality in mining areas. Dust is almost inevitable from all forms of mining and forms one of the most visible, invasive, irritating and potentially harmful forms of pollution. Dust containing toxic metals such as arsenic, antimony, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, selenium, vanadium, zinc and their compounds are particularly hazardous. Dust in surface environments represents a health risk with respect to radiation, dust-borne diseases,	Dust generation is a problem related to the nature of the bedrock in both surface and underground mines. Land clearing, drilling, blasting, crushing and milling during beneficiation, the transport of the ore or beneficiated product on haul roads and creation of residue dumps all generate dust. Blasting, loading and dumping of rock generates dust, particularly in rock types with fine grain size or weak cementation such as shale, siltstone or banded iron formation.	Dust suppression must be undertaken in conjunction with a dust monitoring programme that places dust deposition gauges or receiving buckets, directional dust collection receptacles, high volume active air samplers or continuous particle monitors or even personal exposure samplers at generation sites, around the mine and in adjacent areas.

Assessment criteria	Context	Typical impacts	Examples of mitigation measures
	respiratory diseases silicosis and asbestosis, and has a high nuisance impact, lowering the quality of life in surrounding communities		
Noise	Many aspects of mining operations lead to an increase in noise levels over the ambient environmental levels.	The impacts of noise levels can be both physical and physiological at the high end of the spectrum but more commonly impact on communication or create psychological effects at the lower end of the spectrum. The highest magnitude noise impacts are commonly the high intensity, short duration noise levels created by blasting in surface or opencast mines. Blasting should not be carried out under very overcast conditions or low level cloud cover as this increases the noise and vibration transmission.	Impact of blasting within the context of a broader farming community where surrounding noise levels are relatively low.
Site of archaeological and cultural interest	Protection of archaeological sites, palaeontology sites and cultural heritage is an important factor in mine planning, both in the context of greenfield and brownfield developments The impact is mainly through the removal or disturbance of archaeological sites, palaeontology sites and cultural heritage, for example graves, which removal or disturbance may require a permit in terms of the National Heritage Resources Act (Act 25 of 1999)	Prospecting or mining operations may impact on the following sites of archaeological, palaeontology or cultural heritage 1 Structures older than 60 years 2 Graves 3 Archaeological sites such as rock art or material remains resulting from human activity that is older than 100 years	A cultural resource management investigation is a necessary part of any mine development and closure plan to ensure that the developer is aware of the range of cultural issues that could constrain the development or post-closure land-use options
Visual aspects	It is possible that a mine could impact on the genus loci or "Sense of Place", being that quality imparted by the aspects of scale, colour, texture, landform, exposure or land use that make the place unique or distinct with a character of its own. Visual quality or aesthetic appeal might also be affected if the degree of visual diversity or complexity, discernible textures or patterns or striking features and the landscape character are impacted.	Landscapes have different visual absorption capacity (VAC) with regard to accommodating a development. The distance from which a mining development can be viewed relates to the visibility or viewshed and the critical impact of the view is assessed in terms of the number of people passing that can see the development.	Careful design can reduce the visual intrusion or restrict the visual envelope of the development. Attention to colour or textural contrast can also be used to reduce the visual impact. The use of digital elevation models (DEM) or digital terrain models (DTM) with GIS can assist in the delineation of the areas where visual impact may occur.
Regional socio-economic structure	Integration of mining with the community and local government structures should be addressed at two levels The Integrated Development Plan (IDP) of the local authority should recognise mining as an important, often strategic, development and ensure that land-use planning and zonation makes provision for the demarcation of current mining areas and possible future expansion. This will reduce the potential for negative impacts on sensitive developments such as housing, roads and health care facilities	Socio-economic elements to consider 1 Broad Based Socio-economic empowerment (BBSEE) Charter and Scorecard for the South African Mining Industry 2 Social and labour plan 3 Interested and Affected Parties 4 Public participation 5 Financial provision for rehabilitation 6 Accommodation and/or transport of mine workers during the construction phase	

Appendix D1: Closure: Vision

Environmental status quo	Broader company SD commitment	Broader institutional requirement	Closure vision examples
Environmental • Refer to baseline environmental description • Detail key areas such as water quality, water uses and any sensitive areas	**Existing agreements** • High-level corporate agreements with government or communities to establish and maintain development programs (basic education, skills training etc) and or infrastructure (hospitals, schools, libraries, sanitation etc) • Each mine site is obliged to ensure these are implemented	**Environmental quality** • Closure to ensure regional environmental quality targets are maintained or enhanced. These considerations include • Catchment Water Quality Objectives • Catchment reserve determination • Surrounding land uses such as nature and game reserves • Identified sensitive areas identified for protection	• Rehabilitated areas will meet minimum criteria to enable a grazing land use • Run-off water entering the downstream environment will meet with the minimum receiving water requirements
Social • Pertinent social conditions which impacts closure vision to be described • Refer to education levels, proximity to nearest towns and settlements, population sizes, growth rates, existing services and infrastructure in the area. • Public health risk currently expected in the area • Site labour force size, source and impact on surrounding communities	**Site specific agreements** • Agreements with local communities and businesses these may include: • Access to grazing and farm land • Protection of local environment, i.e. development of nature reserves and parks • Rehabilitation of local affected environment (wetland restoration and alien species eradication) • Local skills recruitment and training programs • Upgrading of local infrastructure	**Local and regional development plans** • Development plan can constrain or be enhanced by the closure vision as surrounding land uses may be altered. Thus the closure land use may need to be altered in agreement with these.	• Rehabilitated areas will be fenced and returned to land owners/ community for future grazing use • A local primary school will be established and teachers trained during the life of the operation. At closure a trust fund will be set up to run the school for 5 years to ensure transition into local government education program
Economic • Regional economic factors to be considered include • Income levels, sources and distribution of affected communities • Expected economic ripple effect of salaried employees			• Local government has identified the lack of educational facilities as a core area to be addressed in the Local Development Plan.

The closure vision sets the scene for the closure objectives and land uses. As such it must be broad based, achievable, acceptable and relevant. Workshop discussions should be held with mine personal to identify the closure vision. The closure vision must also be presented and discussed with I&APs to ensure the vision developed with their inputs, understood and accepted.

Appendix D2: Closure: Objectives

Closure objectives should be as specific as possible given the conceptual operational plans, baseline data collected and results of the initial stakeholder engagement program.

Closure objective categories	Detail	Examples of poorly defined objectives	Examples of well-defined objectives
Physical stability and public safety	Address stability of the land form and any residual risks that may be posed to public safety as a consequence of the closure land form	• Opencast mining - final void will be shaped to suitable gradient and maximise stability • Underground mining – Sinkholes formed will be backfilled and levelled • Mine pit lake – access controlled to avoid public access • Mine related infrastructure and equipment – all infrastructure removed off site	• Opencast mining – final void shaped to a minimum of 1:3 slope to ensure stable high-wall. Low-wall to be shaped to minimum 1:5 slope to ensure post closure stability is suitable for grazing • Underground mining – Sinkholes formed will be reported to the DMR. Land use may continue once signed off as safe by the Inspector of Mines after rehabilitation activities were undertaken under the auspices of an independent mining or rock engineer • Mine pit lake – 3m high fencing erected around the site with hazard boards placed every 100 m • Mine related infrastructure and equipment – all equipment will be removed and sold as scrap or disposed at suitable landfill. Mine infrastructure will be decommissioned and removed for scrap or placed in suitable landfill. Any remaining concrete footings etc. will be broken down to 1m below ground level and disturbed footprint graded to free draining topography
Land use and land capability and land use	Detail the envisioned land capability and land use for the mine footprint. Where land uses vary on the site, these should be detailed for each area.	• Opencast mining – opencast rehabilitated areas to be free draining to support a grazing land capability rehabilitated areas. • Mine pit lake --made free draining • Mine related infrastructure and equipment – all infrastructure removed off site.	• Opencast mining – opencast rehabilitated areas to be backfilled and graded with slopes not exceeding 1:3 over more than 10% of the rehabilitation footprint. Top-soiling and re-vegetation to ensure a minimum to 250 mm of topsoil is placed and successfully seeded to support grazing conditions. • Mine pit lake – will be graded to maximum 1:3 side walls and made free draining with a maximum 1:8 slope reporting into the local stream X, 300 m downstream as per engineering designs. Topsoil placement • Mine related infrastructure and equipment – all infrastructure removed off site.

Visual quality	Provide overview of the closure state in relation to surrounding environment	• Mine rehabilitation will blend in with surrounding topography	• Opencast rehabilitation will be sloped to free draining topography with slopes angles greater than 1:5 to tie in with existing topography • Tailings facilities will be shaped to form a more natural 'whaleback' topography (if possible include expected slope angles) before being topsoiled and seeded
Ecology and biodiversity	Rehabilitated land use should primarily restore the pre-mining ecology and biodiversity unless alternative land use is envisaged (i.e. intensive agriculture)	• Decant water quality will not affect downstream biodiversity • Rehabilitation will ensure pre-mining biodiversity is restored	• Detail expected water volumes and refer to specific target decant water quality standards in-line with receiving water quality environment • Detail specific rehabilitation target such as grassland species composition, replanting sensitive species, soil quality targets, habitat creation etc. Provide overview of expected timeframes expected for desired outcomes to be achieved.
Socio-economic outcomes	Provide clearly defined outcomes from socio-economic programmes implemented	• Establish two SME's • Provide adequate water supply to the village	• Establish two SME's with a total employment of 100 full time locally sourced staff • Construct and implement reticulated potable water supply to 7 standpipes in the village. Sustainable water supply should at minimum supply 45 litres per person (estimated 2500) per day

Appendix E: Closure risk assessment

Semi-quantitative risk assessments provide a more detailed, prioritised ranking of risks than the outcome of qualitative risk assessments. Semi-quantitative risk assessment methods may involve multiplication of frequency levels with a numerical ranking of consequence. Several combinations of scale are possible, and example of this is shown in below.

		Consequence level				
		1	10	100	1000	10 000
Likelihood level	Descriptor	Insignificant	Minor	Moderate	Major	Catastrophic
1	Almost certain	1	10	100	1000	10 000
0.1	Likely	0.1	1	10	100	1000
0.01	Possible	0.01	0.1	1	10	100
0.001	Unlikely	0.001	0.01	0.1	1	10
0.0001	Rare	0.0001	0.001	0.01	0.1	1

Risk rating
Extreme
High
Moderate
Low

The risk matrix above uses relative values for consequence and likelihood to reflect their relative order of magnitude or risk rating. Descriptions for both the likelihood and consequence can be tailored to meet the specific conditions of the mine site or mining organisation (corporate entity) in general.

Appendix F: Performance assessment and monitoring

Closure monitoring must specifically tie in the operational monitoring program and must be designed to validate that an acceptable closure condition(s) as identified in the closure objectives have been reached.

SOURCE ACTIVITY	IMPACTS REQUIRING MONITORING PROGRAMMES	FUNCTIONAL REQUIREMENTS FOR MONITORING	ROLES AND RESPONSIBILITIES (FOR THE EXECUTION OF THE MONITORING PROGRAMMES)	STANDARDS TO BE ACHIEVED	MONITORING AND REPORTING FREQUENCY
Tailings storage facilities closure	Groundwater impacts relating to seepage and pollution plume development storage facilities	As built plans and final rehabilitation survey	Post closure monitoring team reporting to closure manager	Ensure final rehabilitation designs are implemented correctly	Ongoing as rehabilitation/closure takes place with a final survey on completion
		Seepage volumes and water quality		Seepage rate form toe drains should not exceed X m3 per annum as per groundwater model Water quality parameters indicated in Table X.	Monthly during closure and quarterly post closure for X years
		Ground water levels surrounding the tailings		Groundwater levels should not exceed a given level (as indicated in the groundwater mode)	Monthly during closure and quarterly post closure for X years
		Groundwater quality, both upstream and downstream		Ground water quality in downstream boreholes not to exceed values indicated in Table X	Quarterly for a period of X years post closure
		Physical erosion and stability inspections		Storm water management system to be constructed as per final rehabilitation designs Hydroseeding to take place once final topsoil layer is complete – revegetation to be established within one year	Monthly during construction Biannual inspection of erosion and water management system to take place for X years