

BRIEFING

University of Pretoria etd - v.d. Berg M (2004)

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Introduction

The **Western Limb Tailings Reclamation Project (WLTRP)** is a new initiative pursued by Anglo-Platinum. The project is concerned with the re-extraction of platinum from existing tailings impoundments at the Rustenburg Platinum Mines Limited - Rustenburg section (RPMR).

This project requires a terrain that will occupy approximately 850ha. The project is in its second year of operation and the necessary infrastructure to accommodate all operations has been erected. The infrastructure consist of the following:

- Tailings Disposal Facility (TDF)
- Associated topsoil stockpiles
- Return water dam
- Rock stockpile (fig 1-1)
- Concentrator complex (fig 1-2) and pipelines
- Roads, power lines etc.

Ultimately, the plant and associated components will be dismantled and removed after operation ceases. The TDF and waste rock dumps will remain and rehabilitation will be implemented to reduce further pollution of the environment. Current practice aims at re-vegetating TDF's in order to maintain stability and comply with environmental legislative frameworks.

The TDF needs to be stabilised to ensure safety for the public as well as to reduce adverse environmental impacts to an acceptable level before a closure certificate can be issued by the Department of Mineral and Energy Affairs. Only when this level of closure is achieved, is it possible to transfer ownership of the site and will the liability rest upon the new owner.

The "Closure concept"

The objectives for the successful closure of a mining facility as stipulated in the November 1998 edition of *Mining Environmental Management*, is as follows:

"Minimising long-term environmental liability, attaining regulatory compliance and maintaining geo-technical stability, while closing as quick and cost effectively as possible. All this should materialise within the general goal of returning the land to a safe and stable condition for the purpose of post-mining alternative functions. A successful closure procedure is a combination of innovative concepts, long-term commitment and multiparty cooperation." (Mudder & Harvey 1998:1)

These criteria are often not achieved. The lack of proper and updated closure plans has resulted in severe detrimental environmental, social and economic consequences in the past. Figure 1-4 is a diagrammatic example of a holistic approach. The emphasis is on the pre-defined closure and land use plan resulting in a long-term sustainable and productive land-use activity.

Waste generation and management (fig 1-3)

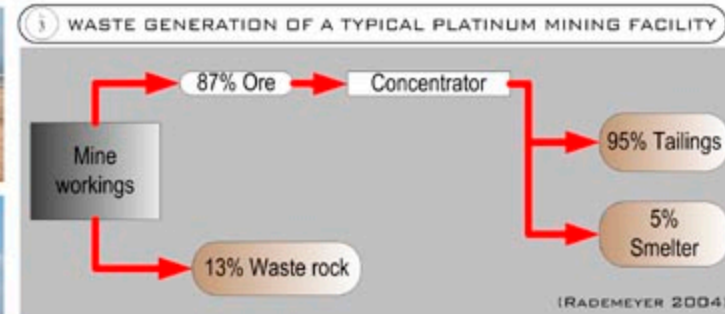
Tailings

The depositing of tailings occurs through various methods and in various forms depending on the characteristics of the tailings as well as the terrain where it will be deposited. It is common practice to deposit tailings of gold and platinum in a TDF. For the purpose of this study, one can define a TDF as being a permanent detention structure of mining waste above natural ground level.

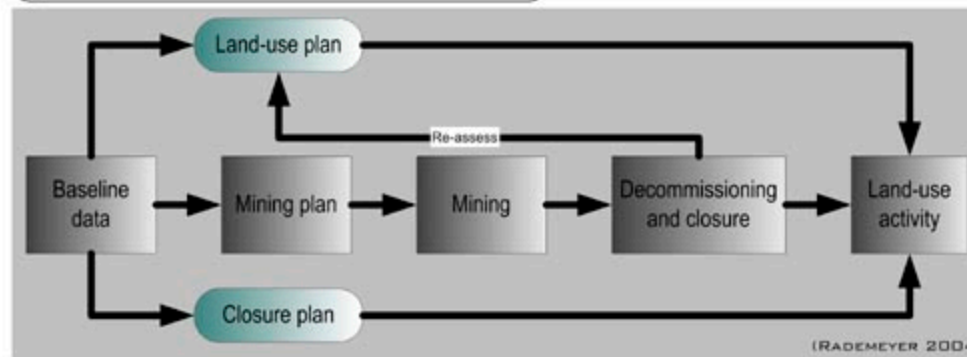
Tailings are defined "...as crushed rock particles that are either produced or deposited in slurry form. This encompasses the vast majority of finely ground mill or mineral processing wastes remaining after extraction of mineral values." (Vick 1983:1)

Waste rock (fig 1-1)

Waste rock often occurs in stockpiles near the plant and is occasionally applied in rehabilitation as a capping on the TDF to reduce the erosive effects of water and wind. If that is not the case, rehabilitation also needs to be applied on the stockpiles.

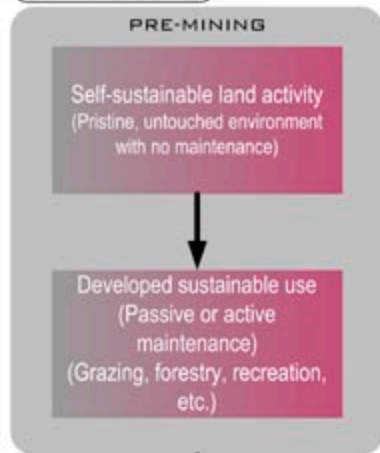


HOLISTIC APPROACH TO MINE PLANNING



GENERAL ENVIRONMENTAL LEGISLATION CRITIC

LIFE-OF-MINE



Pre-mining

The pre-mining environment entails either a green- or brown field site. The current land-use is often dictated by the surface conditions. Mining activity will often proceed regardless of existing conditions and to the detriment of environmental and social environments. It is often a scenario of which land activity will yield the greatest economic affluence. Mining is more often than not triumphant over any other land activity.

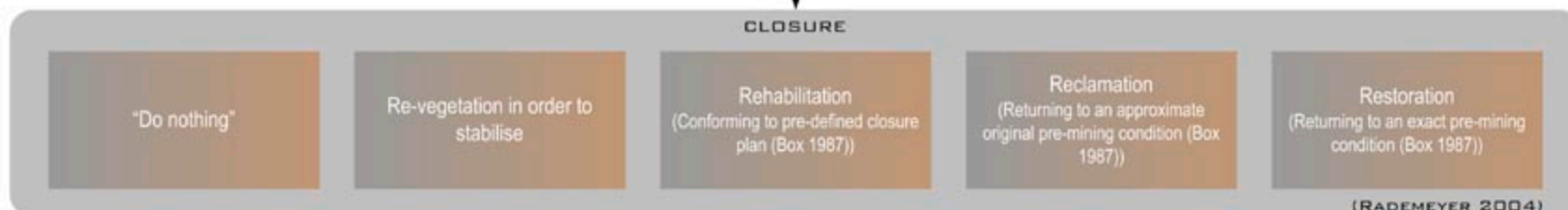
Exploitation

Exploitation will proceed for a determinate period of time. It is not uncommon for a single shaft to be mined for 50 years or longer. Waste production for a typical platinum mine shaft is approximately 98% of the total ore extracted (fig 1-3). The exploitation process requires an enormous amount of energy and water. Both are expensive and scarce commodities. The need for a frugal approach is essential in a sustainable and environmental responsible practice.



Closure

In entering the closure phase, the mining company is faced with a series of options. All are concerned with the management of waste and the exercising of the companies environmental liability and moral obligation. The mining industry is constantly criticised regarding environmental conservation. Government and influenced-and-affected parties are applying constant pressure on mining companies to comply with increasing stringent environmental standards and policies. An approach of environmental sensitive mining as well as the engagement on a social-responsible level is at least appropriate from a sustainable development point of view.



(RADEMEYER 2004)

General environmental legislation critic

Considering the Constitution of South Africa, Act 108 of 1996, mining companies are responsible for maintaining a healthy environment for the benefit of all users. Environmental legislation aims at specifying statutory standards and regulations pertaining to mining activity. The broad descriptions of these standards and regulations are often vague. Phrases such as:

- "...mining will not result in **unacceptable** pollution, **ecological degradation** or damage to the environment." (MPRDA Act 28 of 2002)
- "...the holder of mineral rights must **as far as it is reasonably practicable**, rehabilitate the environment affected by mining operation." (*ibid*)

allows for much disparity. Guidelines for rehabilitation are available from the Chamber of Mines of South Africa, but are often left at that and not actively implemented. It is often left to the judgment of the environmental officer to decide what is **unacceptable** and **reasonably practicable**.

(See page 4 for detail description of the legislation environment)

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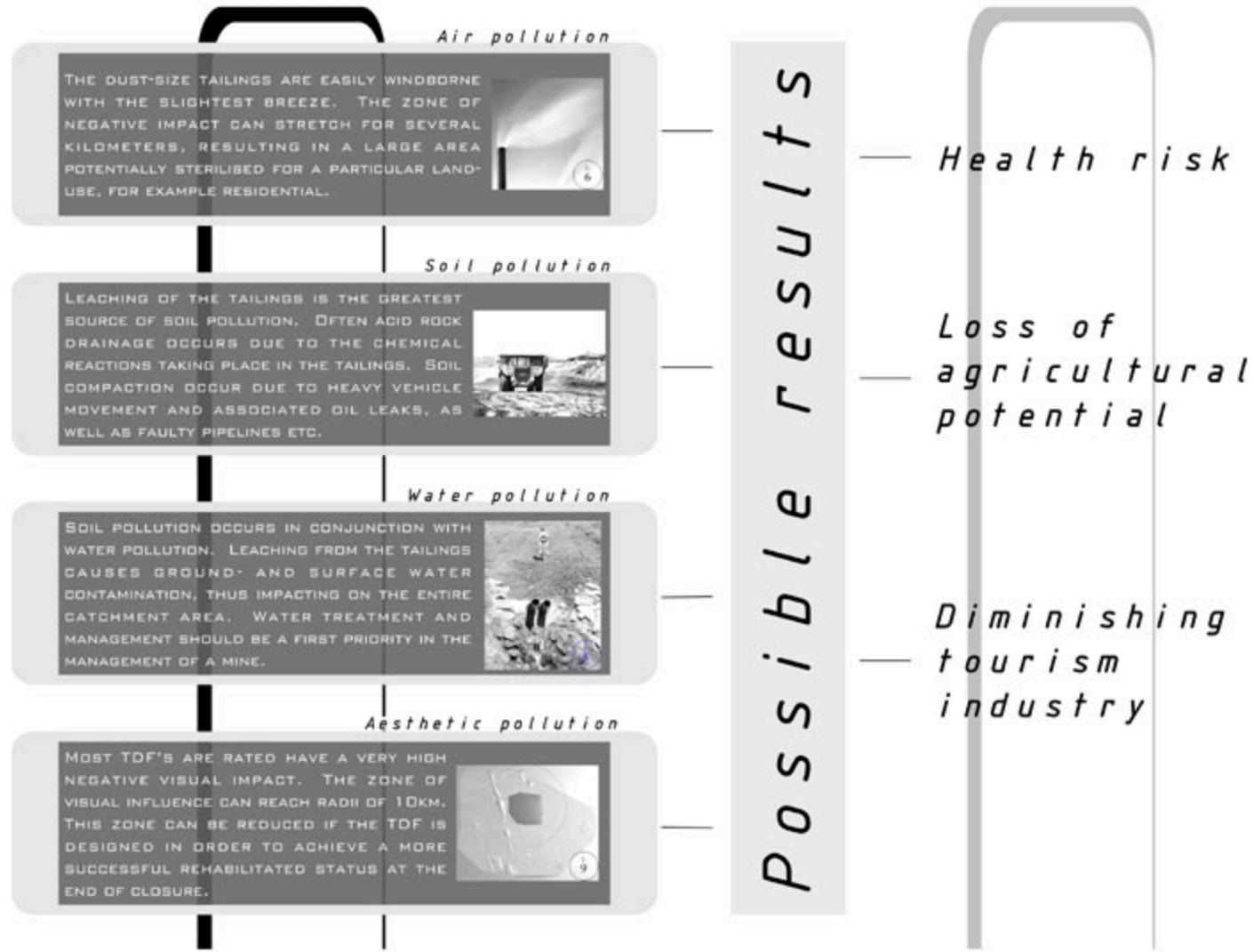
INTEGRATED PLANNING APPROACH

Introduction

Potential negative environmental and associated economic impacts are always present in an industry of this nature. In the past, the main challenge was to balance capital spent with capital earned in order to generate a profit from the business venture, in spite of the negative impact on the social and natural environments. Updated environmental legislation force mining companies to reconsider the potential environmental and subsequent economic impacts prior to exploitation. This has to go hand in hand with a realistic, yet creative end-land use plan on a regional as well as a local scale.

Environmental impacts

Economic impacts



LEGISLATION (Boswell 2004)

Introduction

Prior to 1994, environmental monitoring in the South Africa's mining industry was governed under separate legislation. Current legislation focuses on issues concerning social impact and sustainable development and is dictated by the requirements of the new constitution as well as an increasingly environmental aware public. The promulgation of the National Environmental Management Act 107 of 1998 (NEMA) is seen as a progressive step towards stringent but practicable environmental legislation to the benefit of all South Africans presently and in the future.

National Environmental Management Second Amendment Bill

- Published for comment in 2003
- Aims at amending the section on integrated environmental management (IEM) in NEMA and to regulate environmental impact assessment (EIA) and other management tools
- EIA's are currently regulated in terms of section 21, 22 and 26 of the Environment Conservation Act 73 of 1989 (ECA) and the associated Regulations 1182 and 1183. As soon as the Second Amendment Bill is accepted, EIA's will be regulated completely in terms of NEMA.
- The amendments to the Bill will also enable the Minister or MEC to request a particular company to compile an impact assessment report at any time. The minister has the authorisation to instruct the company to cease the operation activity either completely or partly and to rehabilitate the site. Alternatively, an environmental authorisation may be issued for that activity (s 24G).
- The Bill furthermore stipulates that associations of environmental assessment practitioners need to be registered in order to ensure that proper standards are maintained. The Bill aims at enhancing the quality of reports submitted for approval (s 24H).

National Environmental Management: Air Quality Bill

- Substituting the outdated Atmospheric Pollution Prevention Act 45 of 1965 (APPA)
- The overall objective of the bill is to reform the law regulating air quality in order to protect, restore and enhance the quality of air in South Africa
- Key features of the bill pertaining to mining operation include the following:
 - The bill embraces an ambient air quality management approach and introduces ambient air quality standards into the law.
 - The instituting of air quality officers at national, provincial and local levels to enforce the requirements of the act.
 - An air quality officer or authorising entity may require any person or company to submit an atmospheric impact report at any time.
 - The amended bill also provides for the control of dust by way of regulations.
 - The Minister or MEC may publish a 'list of activities' that may result in atmospheric emissions which have or are declared as significantly detrimental to the natural, social or economic environment, that poses a health risk or negatively impacts on cultural heritage.
 - The Minister or MEC may declare 'priority pollutants' and are authorised to publish a notice in the gazette requiring any blameworthy entity to prepare and implement a pollution prevention plan concerning the declared priority pollutants (s 24). The requirements for the pollution prevention plan will be prescribed by regulation.
 - Recognition programmes are provided for to recognise significant achievements in the area of pollution prevention (s 26)
- In order to meet the proposed clean air standards, it is required from business entities to upgrade outdated plant and equipment components on their own expense.

Environment Conservation Act Amendment Bill

Section 20 of the Environment Conservation Act 73 of 1989 deals with waste management. The current Act stipulates that the Minister of Water Affairs and Forestry should administer the operation of waste landfill sites and related control measures. This amendment transfers the administration from the Minister of Water Affairs and Forestry to the DEAT Minister to encourage and allow for a more integrated approach to the management of waste management facilities.

National Waste Management Strategies and Action Plans

- The objective of the National Waste Management Strategy (NWMS) is to deal with the full cycle of waste, from generation to final disposal.
- The goal is to reduce environmental impact in order to facilitate the country's socio-economic development and to improve healthy conditions and the quality of the environmental resources.
- The NWMS will require:
 1. The classification of the mining waste
 2. Consideration of waste- and site-specific issues
 3. Acceptable facility design, operation and closure plan for mining
 4. A detailed and continual review of the closure plan
- Mines will be required to implement cleaner technologies and to advance to new approaches considering the treatment and reduction of waste

National Water Act 36 of 1998

The Department of Water Affairs and Forestry (DWA) is the public trustee of the country's water resources and has the mandate to manage these in a sustainable manner. Important strategies that originated from the transformation in water resource management are:

1. National Water Recourses Strategy (NWRS)
 2. Water Pricing Strategy
 3. Waste Discharge Charge System (WDCS)
1. The NWRS focuses on the protection of ground and surface water resources via the implementation of two approaches entitled Resource-Directed Measures and Source-Directed Controls. This strategy has not yet been finalised
 2. The National Water Pricing Strategy deals specifically with the pricing of first tier water (i.e. water obtained from the actual source), rather than second and third tier water (i.e. water supplied in bulk and distributed through water boards or municipalities)
 3. The WDCS is based on the 'polluter pays' principle as supported by NEMA. It is a strategy relating to waste discharge and costs associated with disposing of waste that holds the potential to detrimentally impact on a water resource

Minerals Act 50 of 1991





Introduction

Considering the previous discussions on mining activities as well as waste generation and the potential impacts associated with it, it is clear that mining companies need to effectively exercise their environmental liability and moral obligation as dictated by legislative frameworks. It also becomes apparent that an adoption of a new approach towards waste management, rehabilitation programs and closure achievement, is essential.

The minimum satisfaction of laws and regulations are not alone sufficient, as the advancement of sustainable development relies upon creative problem-solving and the acknowledgement of possible opportunities.

Formulating a new approach

When a particular company enters the endeavour of mining, an approximate volume of waste is pre-determined and the appropriate procedure for deposition and accommodation is decided on. A rate of waste deposition is required in order to maintain a profitable rate of mineral extraction. According to this study an expectation concerning rate-of-deposition exists in order to attain the goal of viable economic return.

Once this is finalised and an appropriate site is allocated, different TDF designs are evaluated according to economic parameters and subsequently to environmental and possible social implications. The chosen TDF is accompanied by a rehabilitation plan intended for implementation after decommissioning (fig 1-10).

The newly formulated approach is founded on the following argument: It is evident that a TDF is designed to contain tailings/waste within the parameters of satisfying safety and stability standards. However, this can be defined as a short-term function concluding as the mine enters the closure phase. Following decommissioning the TDF undergo an alteration in function. It is no longer a tailings storage facility per se, but a permanent, hazardous landform in the landscape. Rehabilitation is often applied as what seems as an after-thought, thus explaining the poor success.

It can be hypothesised that if the TDF is designed with the aim of both storing tailings and functioning as a natural landform in its context, it will potentially increase the rehabilitation success, support a future alternative land-use and shorten the closure-certificate application period.

This hypothesis entails that major alterations concerning the geometry is required, but still satisfying safety and stability.

Research on this topic indicates that it is possible to construct a TDF with varying slope gradients, slope lengths, bench widths, etc. Final rehabilitation can result in a profile similar to adjacent landforms with a diverse slope configuration, varying microclimate conditions necessary to establish a diversity of floral species.

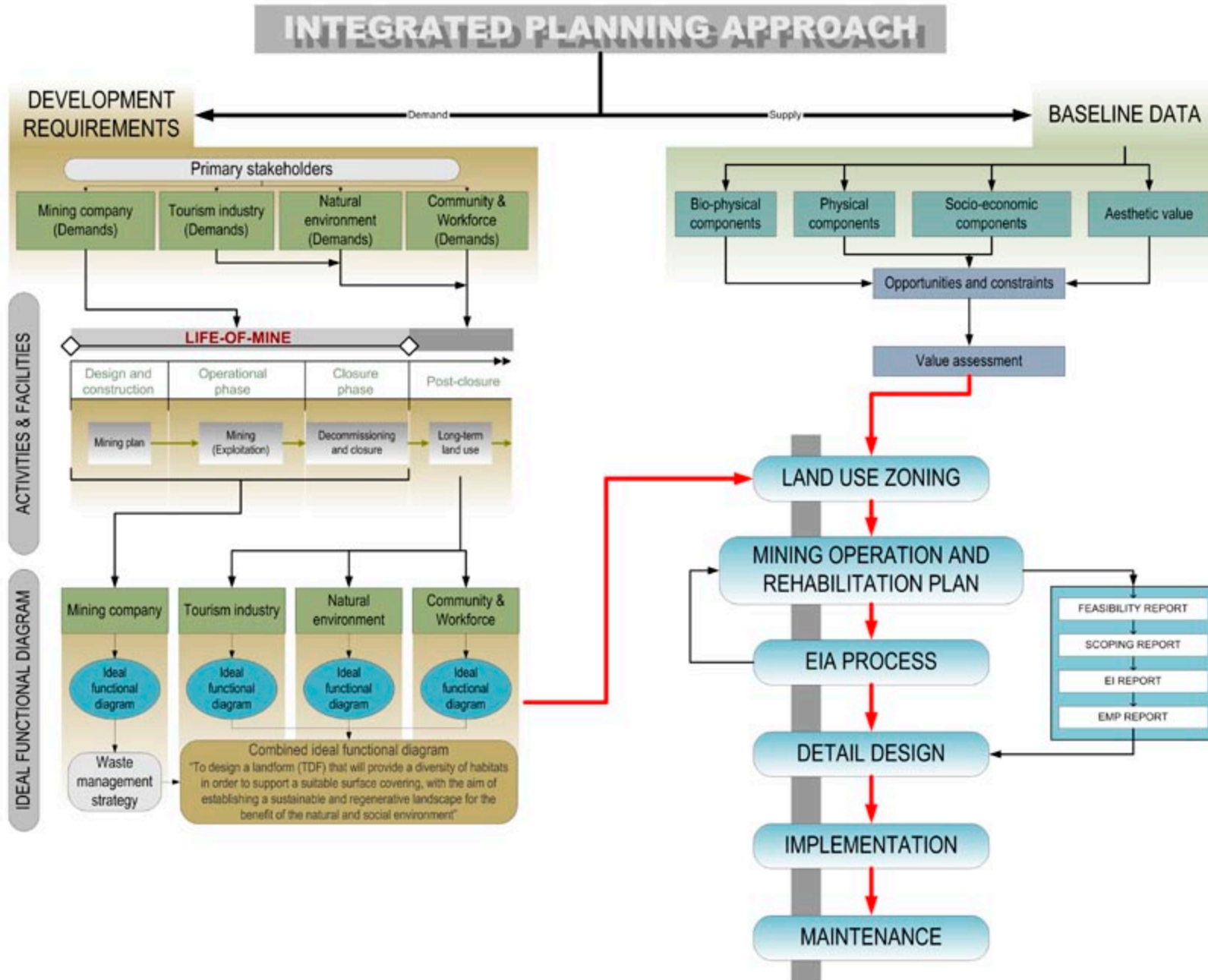
Project goal

*This project is concerned with the design of a **landform (TDF)** that will provide a diversity of **habitats** in order to support a suitable **surface covering**, with the aim of establishing a sustainable and regenerative **landscape** for the benefit of the **natural and social environment**. This should be a long-term goal determined prior to **construction**, re-assessed periodically during **operation** and accurately implemented **post-closure**, with the appropriate maintenance, until stability of the system is achieved.*

10 DESIGN AND ASSOCIATED REHABILITATION OPTIONS



(Adapted from Van Riet & Louw Landscape Architects 2002)



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Integrated planning approach

The integrated planning approach acknowledges both development requirements (demands) as well as environmental components (supply) as key objects in reaching a suitable compromise for the benefit of both aspects.

Primary stakeholders

Identification of primary stakeholders is proof of a holistic and integrative planning approach. It is necessary to identify each stakeholder's requirements in terms of the activities performed and facilities erected by the company endeavouring in mining.

Activities & facilities

The requirements of activities and facilities are determined for the life-of-mine. Each stakeholder is connected to a phase or phases over the life-of-mine where it finds most concern.

It is apparent that the mining company's greatest concern lies with the first three stages during mineral extraction and optimum operation of the associated infrastructure. Although the other stakeholders are influenced over the full cycle of the mine, this study focuses on the post-closure phase and the requirements of the concerned parties in order to implement a successful long-term land use.

Ideal functional diagram

The concerned mining company anticipates a waste management strategy that is in the best interest of its economical status.

Each of the other stakeholders has different requirements to be satisfied:

- The tourism industry relies on an aesthetic pleasing environment with recreational potential.
- The natural environment requires a pollution free condition in order to function aptly and to support the existing land-use of the terrain.
- The community is dependent on a healthy and safe environment that satisfies its basic needs such as security, food and employment.

It is evident that the tourism industry, natural environment, community and workforce share common interests. This is often in contrast with the objectives of the mining company and a compromise is necessary.

In order to conclude with an integrative ideal functional diagram, an assimilation of each stakeholder's requirements should dictate the formulation of a combined ideal functional diagram.

Baseline data

Baseline data assembly should be as comprehensive as possible. This enables the recognition of thoroughly researched opportunities and constraints present in the context of the proposed mining activity.

Value assessment

The value assessment aims at quantifying or providing a qualitative value to a subject. Each subject's value will be discussed in terms of the interest concerning all stakeholders.

Land use zoning

Land-use zoning is the convergence of development requirements and baseline data in an attempt to satisfy all stakeholders' needs. The result is an allocation of development zones as well as the identification of areas-of-concern with appropriate mitigation measures.

Mining operation and rehabilitation plan

Mining operation and rehabilitation programs should result in an iterative procedure with the EIA process. This process will continue until a satisfactory product is achieved, resulting in a strategy of least environmental impact.

Detail design, implementation and maintenance

Detail design results in the execution of the proposed development. Implementation should comply with on going monitoring of activities as well as periodic re-assessment of rehabilitation plans. A maintenance component and long-term commitment from the mining company is essential to ensure the success of rehabilitation.

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