

# Mining Closure and Rehabilitation Plan

Application to mine silica sand over an approximate 4,09ha section of the Ifafa River on the KwaZulu-Natal south coast in the Umdoni Local Municipality.



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# 1 BACKGROUND AND INTRODUCTION

## 1.1 INTRODUCTION

An application to mine sand along a 4,09ha section of the Ifafa River has been submitted to the Department of Mineral Resources and Energy (DMRE) on behalf of T and T Marine (Pty) Ltd. IDM Environmental (IDME) has been appointed as the independent Environmental Assessment Practitioner (EAP) by T and T Marine (the applicant) to conduct a Basic Assessment (BA) for the proposed mining permit.

As part of this Basic Assessment and DMRE legislative assessment process, a Mining Closure and Rehabilitation Plan is required to be formulated and submitted to the Department. This is to ensure that an acceptable plan is in place – both before, during and post mining activities – which will guarantee that the affected site is adequately rehabilitated in accordance with the sustainable principals of Integrated Environmental Management, promoted by the National Environmental Management Act (No. 107 of 1998) (NEMA), that aims to prevent, minimise and mitigate against potential adverse long-term environmental and social impacts caused as a result of the relevant mining activities.

## 1.2 LOCATION OF PROJECT

The site of the proposed TT Marine Sand Mine is located along a portion of the Ifafa River, situated 500m west from the Ifafa Marina, within the Umdoni Local and Ugu District Municipalities respectfully (**Figure 1.1**). The Ifafa Marina and the proposed TT Marine Sand Mine Site are separated by the N2 Freeway.

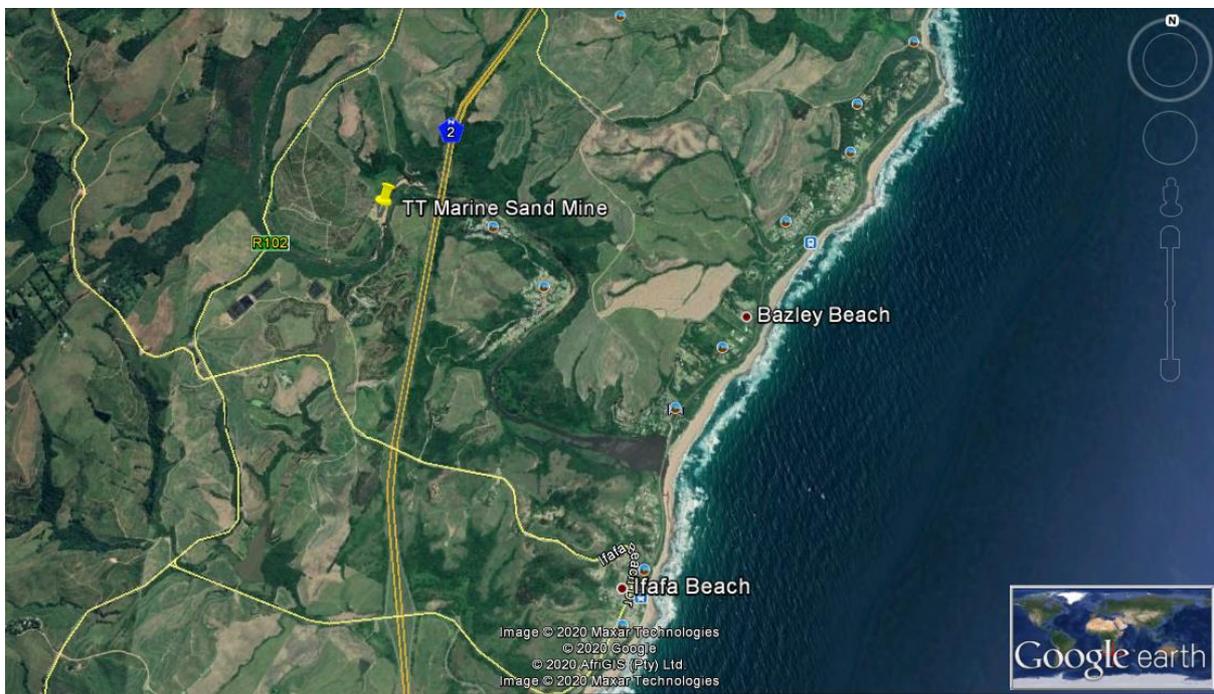


Figure 1.1: The proposed locality of the TT Marine Mine

### 1.3 MINE DESCRIPTION

The Mining Operational Plan ([Appendix 4](#)) identified two methods of mining that will be utilized for the proposed TT Marine Sand Mine. Mechanical mining will be utilized when the sand bar is exposed and accessible from the existing access point ramp. The mechanical mining method involves the use of various earth moving equipment such as an excavator which will be positioned into the sand bar that is exposed and lift the loose material and place it into an articulated dump truck (ADT). The ADT will traverse a fixed pathway along the sand bar and exit the river along an established access ramp. The second method of mining will be deployed during the flood season or at any point that it is deemed unsafe for vehicles such as the excavator to operate within the river course. This method of mining utilizes a floating barge system which will use a jet suction pipe to collect sand and deposit it on shore. This sand will then be deposited into the stockpiling area before being taken off site for sale.

### 1.4 LOCAL ENVIRONMENTAL CONDITIONS

The proposed TT Marine Sand Mine site is located 2,8km inland from the coast and approximately 27m above sea level. The mining site is completely surrounded by agricultural activities, mostly consisting of macadamia plantations. On the property itself exists worker accommodation as well as a roofed storage building for farming equipment. This building will be used for the storage of chemicals and fuel if required. The N2 freeway is located about 160m downstream from the proposed mining site and the nearest settlement is the Ifafa Marina which is located across the freeway. The proposed mining site is disturbed due to previous mining and agricultural activities.

The climate of the Ifafa region is subtropical in nature and is characterised by warm humid summers with mild and pleasant winters. The majority of rainfall falls in the spring and summer months due to increased convection and cloud formation. Ifafa receives on average, 818mm of rain per year. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Ifafa range from 22.3°C in July to 27.5°C in February.

A single vegetation community, the riparian vegetation community, is associated with the mine extent. Riparian vegetation associated with the Ifafa River has been transformed as a result of decades of anthropogenic activities and is not considered to be representative of the Critically Endangered KwaZulu-Natal Coastal Forests: Southern Mesic Coastal Lowlands Forest vegetation type which has been indicated for the area (Scott-Shaw and Escott, 2011). Disturbance as a result of agricultural and sand mining activities has resulted in the loss of indigenous riparian vegetation and in the proliferation of alien and invasive species within the riparian zone.

A single watercourse, the Ifafa River and associated riparian habitat, is considered to be at risk should the proposed continuation of sand mining activities be authorised. The portion of the Ifafa River associated with the mine extent is a lower foothill river characterised by a lower gradient, mixed-bed alluvial channel

with sand and gravel dominating the bed. The active channel of the river is approximately 40-60m wide and is characterised by extensive areas of sediment deposition.

*O. mossambicus* and *P. philander* were noted to be present within the system while, *M. capensis* was considered to be common and its prevalence is associated with the proximity of the Ifafa estuary. Also noted in the system is *M. salmoides*, the largemouth bass, an exotic and invasive species.

### **1.5 CLOSURE AND REHABILITATION PLAN PURPOSE**

This Closure and Rehabilitation Plan must be used to guide the different phases of the mine lifecycle as well as the final rehabilitation of the permit site. Mine rehabilitation must be viewed as an on-going process aimed at restoring the site to a pre-mining state. The aim of the Plan is, therefore, to ensure activities associated with mine lifecycle will be designed in a manner to prevent, minimise or mitigate against potential adverse long-term environmental and social impacts. The Closure and Rehabilitation Plan is required to be monitored by the mine's appointed Environmental Control Officer (ECO).

## 2 BASIS OF CLOSURE PLAN

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### 2.1 LEGAL OBLIGATIONS

South African mining and associated legislation and policy places ultimate responsibility for mitigating environmental and social damage as a result of mining operations on the applicant and mining companies themselves. This liability exists throughout the different phases of the mine, from commencement, during operations, post operations to mine closure. This includes compulsory legislative commitments for remediation and/or rehabilitation and ultimate close out. The key relevant legislation applicable to rehabilitation and closure includes the following:

- Constitution of the Republic of South Africa (108 of 1996) (Constitution);
- Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA);
- National Environmental Management Act (No. 107 of 1998) (NEMA);
- National Water Act (No. 36 of 1998) (NWA).

The following section provides a brief description of the legislation as it pertains to the closure of a sand mining operation.

#### 2.1.1 THE CONSTITUTION (ACT 108 OF 1996)

While the constitution does not address rehabilitation specifically, it does pave the way for environmental legislation in South Africa post-apartheid. The constitution enshrines environmental wellbeing as a fundamental human right that must be protected. In terms of Section 24 of the Constitution, it states:

*“Everyone has the right –*

- *to an environment that is not harmful to their health or well-being;*
- *to have the environment protected, for the benefit of present and future generations”.*

This must be achieved through reasonable legislative and other measures and ensures that environmental considerations are part of any mining process. The Constitution also provides rights pertaining to administrative justice, capacity or standing to institute legal proceedings and access to information. These all become relevant within the context of protection and management of the environment during all stages of the mine’s lifecycle.

#### 2.1.2 MINERALS AND PETROLEUM RESOURCES DEVELOPMENT ACT (NO. 28 OF 2002)

The MPRDA contains certain transitional measures with regards to mineral rights, prospecting permits, and mining authorizations. The legal framework for the regulation of the mining industry underwent transformation with the promulgation of the Minerals and Petroleum Resources Development Act 28 of 2002 (MPRDA), which came into effect on 1<sup>st</sup> May 2004. These requirements and a summary of other regulatory considerations are discussed in the following paragraphs.

In Section 37, the MPRDA confirms that the principles set out in the National Environmental Management Act 107 of 1998 (NEMA) apply to all prospecting and mining operations and that these operations must be carried out in accordance with the generally accepted principles of sustainable development. This is further supported by the stated objective of the MPRDA being to *“give effect to Section 24 of the Constitution by ensuring that the nation’s mineral and petroleum resources are developed in an orderly and ecologically sustainable manner while promoting justifiable social and economic development”*.

Section 38 stipulates that the general objectives of integrated environmental management must be applied in accordance with NEMA and this will include the assessment and management of impacts identified as part of the Environmental Management Plan (EMP) process laid out in Section 39.

R527 specifies that the EMP must include environmental objectives and specific goals for mine closure. The applicant for a mining permit/right must make prescribed financial provision for the rehabilitation or management of negative environmental impacts.

R527 provides principles for mine closure which state that the holder of a mining permit/right must ensure:

- **The closure of its mining operation incorporates a process which starts at the commencement of operation and continues throughout the life of the mine;**
- **Risks pertaining to environmental impacts are quantified and managed proactively, which includes gathering relevant information throughout the mine’s operations;**
- **Safety and health requirements of the Mine Health and Safety Act (MHSA) 29 of 1996 are complied with;**
- **Residual and possible latent environmental impacts are identified and quantified;**
- **The land is rehabilitated, as far as practicable, to its natural state, or to a predetermined and agreed standard or land use which conforms to the concept of sustainable development;**
- **Mining operations are closed efficiently and cost effectively;**
- **Key objectives for mine closure to guide project design development and management of environmental impacts are included in the EMP, which include broad future land use objectives, and proposed closure and rehabilitation costs.**

As with other environmental legislation, there is a provision in the MPRDA (Section 45) for the DMRE to direct an operation to investigate, evaluate, assess and report on the impact of any pollution or environmental degradation and take such measures as may be specified within a specified time period. If the operation fails to carry out such a direction, the DMRE can initiate the necessary actions and recover the costs from the applicant/mine company. In addition, Section 38 makes the owners of the mine severally liable for any unacceptable negative impacts or failure to comply with this Plan read with the EMP.

### 2.1.3 NATIONAL ENVIRONMENTAL MANAGEMENT AMENDMENT ACT (NO. 107 OF 1998)

NEMA is the overarching and enforceable body of environmental legislation in South Africa. This act paves the way for an EIA process to assess listed activities that may have a harmful impact on the environment. NEMA aims to establish overarching guidelines and principles to help facilitate environmental management in South Africa.

Sections 28 (1) and (3) of NEMA set out the duty of care principle, which is applicable to all types of pollution and imposes a duty of care to prevent, or where permitted, to minimize environmental degradation. It also provides examples of steps that must be taken to prevent environmental degradation, including the provision for rehabilitation in Section 28 (3) (f), which states that the measures may include measures to “remedy the effects of pollution and degradation”.

Section 2 of the Act lists a set of principles with which environmental management must comply and to which Section 37 (1) of the MPRDA refers directly as follows: “*The principles set out in Section 2 of the National Environmental Management Act (No.107 of 1998)*

- (a) *Apply to **all prospecting and mining operations**, as the case may be, and any matter relating to such operation; and*
- (b) *Serve as guidelines for the interpretation, administration and implementation of the environmental requirements of this Act.”*

Section 2 (b) of NEMA states that they “*serve as the general framework within which environmental management and implementation plans must be formulated*”.

The principles of Section 2 of NEMA that are particularly applicable to rehabilitation are:

- The precautionary principle (2 (4) (a) (vii)), which lays the onus on the applicant or (mine) operator to take a risk averse and cautious approach during decision making, that recognises the “*limits of current knowledge about the consequences of decisions and actions*”. Where uncertainty exists, action must be taken to limit the risk;
- The cradle-to-grave (or lifecycle responsibility) principle (2 (4) (e)) states that “*responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life cycle.*”;
- The polluter-pays principle (2 (4) (p)) is generally regarded as an important guiding principle for environmental management. and
- The project must comply with the requirements for sustainable development (2 (3)), which requires consideration of all relevant factors (2 (4) (a)). A holistic, integrated approach must be followed and the “*best practicable environmental option*”, (defined as being “*the option that provides the most benefit or causes the least damage to the environment as a whole*) must be selected.

#### 2.1.4 NATIONAL WATER ACT (NO. 36 OF 1998)

The provision of water in South Africa is divided into public water and private water, and its use is regulated by the National Water Act (NWA) (under the directorship of the Department of Water and Sanitation (DWS)). Various other acts also make provision for the management of water: the MPRDA regulations have general requirements for water management, the Conservation of Agricultural Resources Act (CARA) contains water management guidelines, and the Health Act is concerned with effective water management (Barnard, 1999).

It must be noted that, in terms of the NWA, it is an offence to pollute public and/or private water to render it unfit for the propagation of fish and aquatic life, including rainwater, seawater, and subterranean water. All water in South Africa is under the trusteeship of the national government (Baillie, 2006). Furthermore, development within a watercourse requires a water use license application, before a developer can proceed to construction (in this case the operator of a mine)

Section 19 of the Act sets out the principles for “*an owner of land, a person in control of land or a person who occupies or uses land*” to:

- Cease, modify or control any act or process causing pollution;
- Comply with any prescribed waste standard or management practices;
- Contain or prevent the movement of pollutants;
- Eliminate any source of pollution;
- Remedy the effects of the pollution; and
- Remedy the effects of any disturbance to the bed and banks of a watercourse.

Regulation 9 of GN R704 promulgated in terms of the NWA, which deals with temporary or permanent mine closure, provides that any person in control of a mine or related activity must at the cessation of mining operations and its related activities, ensure that all pollution control measures have been designed, modified, constructed and maintained so as to comply with the regulations contained in GN R704. Furthermore, the in-stream and riparian habitat of any water resource, which may have been affected or altered by the mine or activity, must be rehabilitated in accordance with the regulations contained in GN R.704.

#### 2.1.5 OTHER LEGAL OBLIGATIONS

Legal obligations relating to the closure of a mine are contained in the EMP prepared in respect of the activities that occur or are planned within the proposed mine permit area.

## 2.2 CLOSURE VISION

It was noted by the Centre for Environmental Rights (2017) that mine closures and rehabilitation in South Africa is often poorly managed and implemented which has resulted in environmental degradation with severe problems for South Africa. Therefore the closure vision of the TT Marine Sand Mine is to ensure that the mining area is left in a sustainable condition after mining ceases, which is not harmful to the health and safety of the surrounding communities and protects and enhances the local biodiversity and the natural landscape of the mining area and surrounds. It aims to break this trend of neglect.

### 2.2.1 CLOSURE OBJECTIVES

The following closure objectives are required to be implemented by the mine owner/operator to support the abovementioned closure vision for the proposed TT Marine Sand Mine:

- **Adhere to all statutory and other legal requirements (National and Local);**
- **Implement progressive rehabilitation measures where possible to ensure protection of the local environment;**
- **Maintain and minimize impacts to any functioning watercourses;**
- **To develop land-uses that are stable, sustainable and aesthetically acceptable on closure;**
- **Ensure safety & health of all stakeholders during closure and post closure and that communities using the site after closure are not exposed to unacceptable risks.**
- **Ensure that closure supports productive uses considering pre-mining conditions and are in agreement with commitments to stakeholders.**
- **Utilize closure strategies that promote a self-sustaining condition with little or no need for ongoing care and maintenance.**
- **Achieve agreed quality targets set by the Catchment Management Authority (CMA) and the Department of Water and Sanitation (DWS) as far as practical relative to impacts and reasonability to achieve.**

### 2.2.2 POST CLOSURE AND LAND USE

This Mine Closure and Rehabilitation Plan aims to create a sustainable land use in the long term, under normal land management practices. It is to restore those natural process as far as possible without the consistent need to intervene. After mining operations has ceased the stockpiling area, access road and access ramp to the River must be revegetated and rehabilitated. All invasive alien plants must further be removed. The aim is to return the mining area to a natural state.

### 3 CLOSURE ACTION PLAN

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A Closure Action Plan for the proposed TT Marine Sand Mine aims to create a stable environment, capable of supporting a vegetation community and preventing pollution, erosion and alien species dispersal. Aesthetics associated with the mine will be improved as a consequence of the establishment of natural riparian vegetation within the post-operational area. In order to gain the best possible rehabilitation outcomes from the resultant mining operation, different actions are required to occur at different phases/times within the lifecycle of the mine.

The following actions are required for the implementation of a successful Closure Action Plan:

#### 3.1 LAND PREPARATION FOR MINING ACTIVITIES

Land preparation occurs not during the closure and decommissioning phase, but involves the site establishment and preparation prior to mining activities. It is important to note that actions undertaken in this phase are crucial for the successful closure and rehabilitation of the mine during the end of its lifecycle.

The most important factors to bear in mind when preparing for applicable sand mining operations are:

- To limit the areas that will be impacted by the proposed mining development (this includes stockpiling areas, location of waste bins, vehicles, vehicle parking, equipment storage, loading areas, access points to the mining area, the storage of chemical toilets and the access road/tracks);
- To minimize potential future contact of toxic or polluting materials with the environment; and
- To maximize the recovery and effective storage of those mining profile materials that could be most useful during the rehabilitation process after mining has been completed (Chamber of Mines, 2007; Department of Minerals and Energy, 2008).

The following measures must be implemented during the site preparation and establishment phase:

- Mine planning must be designed in a way so as to ensure the area to be occupied by mine is minimized. The impacted area must be kept as small as practically possible and must be clearly defined and demarcated appropriately. This must be undertaken to prevent mining creep into surrounding areas;
- Sensitive areas (such as watercourses, riparian areas, sensitive vegetation, buffers etc) must be clearly demarcated no-go areas and must be avoided;
- All temporary infrastructure must be designed with closure in mind (ie: Infrastructure must be designed with ease of deconstruction in mind);

- The erecting of signage. This includes erecting of signage warning the public that mining activities are taking place on the property and the providing of a contactable number on this sign in the event of an emergency situation.
- The stockpiling of fertile topsoil for mine closure and rehabilitation (elaborated further in **Section 3.2**);
- Access to the mining area must as far as possible be further be controlled and restricted;
- There must be the placement of a portable toilet, bins (this must be secured and emptied regularly), spill kits and first aid kits on the mining site. The placement of these items must be undertaken so that they facilitate the mine closure phase;
- Preparing the existing track for movement of heavy vehicles. This to prevent erosion, uncontrolled runoff, the spread of alien plants and compaction during the subsequent phases. These impacts if not controlled will make mine closure an rehabilitation significantly more challenging;
- Facilitating the access point/s into the River. Uncontrolled movement into the River will make mine closure and rehabilitation significantly more challenging and will result in significant adverse impacts to the watercourse and riparian vegetation; and
- Preparing equipment and vehicles for operation. This to ensure there are no leaks or breakdowns that may cause pollution.

### **3.2 SOIL STRIPPING AND STOCKPILING**

Soil disturbance will be limited as far as possible to the stockpiling areas, access tracks and the storage of mining equipment and vehicles. The following measures must be undertaken (if required):

The striping of topsoil is an important aspect of rehabilitation as once the fertile topsoil is lost, it takes years to regenerate. The access track and stockpiling areas are already established and thus limiting stockpiling of topsoil is required. Limited further disturbance is required (if any). If soil stripping is required, the following must be undertaken:

- Soil stripping must remove all materials that are suitable for supporting plant growth;
- Soil stripping must occur to about 4m;
- Strip soils only when moisture content will minimise compaction risk;
- Use shovels and trucks in preference to the bowlscraper;
- Fertile topsoil must be stockpiled as per the below points.

The steps that must be taken during sand stockpiling (both of fertile topsoil and mined sand for sale) are as follows:

- Have separate areas for fertile top soil and areas for mined sand for sale
- Locate stockpile areas in areas where they will not have to be removed prior to replacement for final rehabilitation;

- Minimize the period of exposure of soil surfaces through dedicated planning;
- Limit access to the temporary stockpile areas to the existing gravel access road;
- Demarcate the temporary stockpile areas with an orange hazard fence (or similar) prior to the commencement of sand mining activities;
- Limit the number of stockpiles on site;
- Restrict extent of disturbance within the designated areas of disturbance;
- Ensure that the location is free draining to minimize erosion loss and waterlogging;
- Place silt fences / traps strategically on the periphery of the temporary stockpile areas in order to trap sediment carried by stormwater runoff before it is conveyed into the river channel.
- Ensure silt fences / traps are adequately maintained;
- Protect stockpiles, if required, from erosion using tarp or erosion blankets;
- Minimize compaction during stockpile formation;
- Ensure that the stockpiled sand is only used for the intended purposes
- During stockpiling, preferably the 'end-tipping' method must be adopted to keep the stockpiled soils loose;
- Limit the height of stockpiles to 2m;
- Soil stockpiles must be kept free of weeds and must be kept damp in order to avoid wind-blown sand; and
- An ECO must be appointed to monitor the site preparation and operation phases.

The removal of alien plants from stockpile areas must be undertaken in the following manner (please refer to **Section 2.5** for further information on the removal of invasive alien plants):

- Alien species removal is to take place manually, by hand as far as possible. The use of herbicides must be avoided. Should the use of herbicides be required, only herbicides which have been certified safe for use in aquatic environments by an independent testing authority must be considered. The ECO must be consulted in this regard.
- Care must be taken in order to avoid the disturbance of indigenous species during the removal of alien plants.
- Dispose of removed alien plant material at a registered waste disposal site.
- Remove vegetation before seed is set and released.
- Cover removed alien plant material properly when transported, to prevent it from being blown from vehicles.

Mining closure measures regarding stockpiles include:

- Remove all stockpiles from site. Sand must be sold or disposed of offsite;
- Utilise topsoil stockpiles for rehabilitation;

- Reshape and reprofile disturbed areas associated with the temporary stockpile areas to resemble pre-disturbance terrain units.
- Loosen disturbed and compacted soils to a depth of 100mm-300mm to assist with the re-establishment of vegetation.
- Stabilise areas at risk of erosion with 'soft' stabilization techniques as determined upon consultation with a suitably qualified specialist (e.g. geotextiles, fibre mats / nets / blankets / bags, brush mattresses, live staking etc.).
- Revegetate disturbed areas as soon as possible after the stabilizing of soils. Indigenous grass plugs can be used in combination with an indigenous grass seed mix for revegetation.
- The use of alien vegetation during rehabilitation activities must be strictly prohibited.
- Monitor the areas in order to ensure the successful establishment of vegetation.
- Monitor the decommissioned areas for erosion. Should erosion or sedimentation be noted, immediate corrective measures must be undertaken.

### **3.3 EROSION CONTROL**

Erosion control measures must include:

- Measures must be undertaken to prevent and manage erosion, regardless of the phase of the mine lifecycle.
- Where required, divert stormwater away from areas susceptible to erosion with the use of berms, sandbags etc
- Stabilising steep/unstable/erosion prone areas with 'soft' stabilization techniques (e.g. geotextiles, fibre mats / nets / blankets / bags, brush mattresses, sandbags, live staking etc.)
- Filling of erosion gullies and rills and the stabilization of gullies.
- Utilising sandbags in order to support riverbanks and prevent bank slump.

### **3.4 INFRASTRUCTURE REMOVAL**

Due to the mine's small scale, the operation will require no permeant infrastructure on site. Temporary toilets located on site will be removed, as well as any mining machinery and designated waste bins.

Mine access roads that are not needed for closure and post-closure uses at the site (e.g. security and monitoring or for agricultural purposes) will be closed and gravel removed.

There will also be the removal of all signage, fencing, traffic barriers, etc.

### **3.5 RE-VEGETATION**

The main aim when re-vegetation is to restore the area back to the pre-mining environmental state. This is a self-sustaining system with a natural nutrient cycle in place and with ecological succession initiated. Although the rehabilitated land may have variable land capability, including arable land capability for some areas, the main aim of this re-vegetation process is to establish a stable, sustainable grass cover. Re-vegetation must occur in the following areas:

- Stockpile areas;
- Access tracks which are no longer required;
- Access ramp into the River; and
- Any other area required (areas that are experiencing erosion or have been disturbed by mining related activities).

Areas requiring re-vegetation will be ripped, have topsoil spread across the area and replanting and re-establishment of vegetative cover.

The objectives for the re-vegetation of reshaped and top-soiled land are to:

- Prevent erosion;
- Re-establish eco-system processes to ensure that a sustainable land use can be established without requiring fertilizer additions; and
- Restore the biodiversity of the area as far as possible.

The Re-vegetation process will include the following steps:

- Ensure that any disturbed soils have been replaced correctly.
- Prepare the soil by adding lime and fertilizer and ploughing the area, followed by tillage to prepare the seed bed;
- Plant a grass seed mixture consisting of a range of indigenous or non-invasive naturalized species.
- The majority of plant species present in the un-mined areas will re-establish naturally, provided the soils are replaced correctly and the tillage is done correctly;
- Control and remove weeds where necessary;
- Repeat the procedure for the next growing season;
- Application of fertilizers where applicable;
- Grass needs regular defoliation if it is to be sustainable;
- Leave pasture to allow natural grasses to become re-established;
- Conduct annual monitoring (repeatable demarcated transect surveys);
- It is recommended that broadcast seeding or hydroseeding is utilized; and
- Should broadcast seeding be utilised, it is recommended that weed free straw or mulch is applied immediately after applying the seed, at a rate of approximately 4 tons per hectare, in order to assist in the germination and establishment of seedlings

Seed terrestrial buffer areas with indigenous tufted graminoid species with a high basal cover which will reduce the velocity and volume of runoff from hardened surfaces in the catchment before it reaches the wetland areas. Examples of indigenous graminoid species which may be utilised include:

- *Aristida junciformis*
- *Themeda triandra*;
- *Melinis repens*;
- *Melinis nerviglumis*;
- *Brachiaria serrata*; and
- *Tristachya leucothrix*.

Seed the ecotone on the boundary of the terrestrial buffer and wetland with graminoid species which are also able to withstand high moisture levels for limited periods. Examples of such species include:

- *Eragrostis capensis*;
- *Eragrostis racemose*;
- *Imperata cylindrica*;
- *Andropogon appendiculatus*; and
- *Setaria sphacelata*.

### **3.6 ALIEN PLANT CONTROL**

Alien invasive species tend to out-compete indigenous vegetation; this is due to the fact that they are vigorous growers that are adaptable and able to invade a wide range of ecological niches (Bromilow, 1995). Therefore, rehabilitation must involve control of invasive species. Alien species on site must be identified, categorized and removed, using one or a combination of methods.

Invasive alien plant species are difficult to control. Methods must be used that are appropriate for the species concerned, as well as to the ecosystem in which they occur. When controlling invaders, damage to the environment must be limited to a minimum. There are three basic methods by which encroachers or weeds are controlled:

Physical (mechanical):

- Uprooting (hand pulling);
- Cutting back;
- Chopping, slashing and felling; and
- Ring-barking (girdling)

Chemical:

- Foliar application;

- Stem notching and application;
- Stump treatment; and
- Soil treatment

Biological treatment:

- Which involves the use of host-specific natural enemies of weeds or invaders from the plant's country of origin, to either kill or remove the invasive potential of these plants.

The following additional measures are recommended in order to prevent the future introduction or spread of alien species, and to ensure the rehabilitation of transformed areas:

- There must be no planting of alien plants (e.g. black wattle, eucalyptus and pampas grass) anywhere within the mining area;
- Alien species must be removed from all areas disturbed as a result of mining activities. Alien vegetation which has encroached into watercourses as a result of surrounding disturbance must be removed.
- Alien species removal is to take place manually, by hand as far as possible. The use of herbicides must be avoided. Should the use of herbicides be required, only herbicides which have been certified safe for use in aquatic environments by an independent testing authority must be considered.
- Care must be taken in order to avoid the disturbance of indigenous species during the removal of alien plants.
- Dispose of removed alien plant material at a registered waste disposal site.
- Remove vegetation before seed is set and released.
- Cover the removed alien plant material properly when transported, to prevent it from being blown from vehicles.
- Follow up alien vegetation monitoring and clearing must be undertaken in accordance with timeframes specified by the alien and invasive species control program.
- Benefits to local communities as a result of the alien plant control programme must be maximized by not only ensuring that local labour is employed, but by also ensuring that cleared alien trees are treated as a valuable wood resource that can be utilized.

### **3.7 WATERCOURSE REHABILITATION**

The rehabilitation of the Ifafa River, riparian area, as well as the surrounding drainage lines and wetlands must be undertaken. The river section of the permit area will be rehabilitated by the following rainy season with flood waters depositing more sand across the mined area. The following measures are required:

- The extraction of sand from the riverbed must not compromise the flow of the river or divert the main flow of the river.

- The main flow of the river must not be hindered or diverted to increase the available sand resources for mining.
- Fuel, chemicals and other hazardous substances must preferably be stored offsite, or as far away as possible from the no-go areas. These substances must be stored in suitable secure weather-proof containers with impermeable and bunded floors to limit pilferage, spillage into the environment, flooding or storm damage.
- The applicant must inspect heavy machinery daily for leaks.
- Servicing of vehicles and refuelling must take place off site. However, if this is not possible, use bunded surfaces within designated areas at least 20m away from the edge of all delineated watercourses for servicing and re-fuelling vehicles
- The contractor is responsible for cleaning up any spillages (e.g. oil, fuel), immediately and must remove contaminated soil and dispose of it appropriately as per measures stated in the EMP.
- During the decommissioning phase, the river access ramp will be repaired and regressed/ re-vegetated to prevent erosion and to prevent runoff from the rehabilitated stockpile area.

## 4 POST CLOSURE MONITORING AND MAINTENANCE

The objective of the monitoring program will be to document the recovery of the site towards the closure land use goals, in accordance with the overall closure objectives stated in **Section 2.3**. Rehabilitation will require monitoring on a monthly basis for the first 6 months, thereafter every 6 months for two years.

The monitoring that will be required during the post-closure period is summarized below:

**Table 4.1: List of identified impacts requiring monitoring programmes**

Soil	Erosion
	Loss of top soil
	Contamination
	Compaction of soil
Ground and Surface Water	The disturbance of the Ifafa River
	The alteration of the bed, banks and flow characteristics of the Ifafa River
	Erosion and sedimentation
	Water quality impairment
	Fish movement and migration
Vegetation	Destruction of indigenous vegetation
	Alien Vegetation infestation
Wildlife	Disturbance/Harm
	Barrier to movement/ Hazard
	Habitat Destruction
Climate	Atmospheric Emissions
Air Quality	Dust Generation
	CO and CO2 Emissions
Traffic	Increased Traffic and Safety
Noise	Noise Disturbance
Visual	Visual aesthetics
Lighting	Lightening impacts
Waste	Litter

Whilst the Mine Manager must undertake to monitor activities on a daily basis, the ultimate responsibility for satisfying the monitoring requirements is the role of the Land Owner. The Environmental Control

Officer (ECO) shall be responsible for ensuring compliance of all aspects of monitoring in accordance with the roles and responsibilities designated in terms of the EMP.