

BOKAMOSO PHOTOVOLTAIC SOLAR ENERGY FACILITY NEAR LEEUDORINGSTAD, NORTH WEST PROVINCE

PLANT RESCUE, PLANT PROTECTION, RE-VEGETATION AND HABITAT REHABILITATION PLAN

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Prepared by:

Phala Environmental Consultants
Postnet Unit 470
Private Bag X1288
Potchefstroom
2520
Tel: 082 316 7749
Email: johan@phala-environmental.co.za
Web: www.phala-environmental.co.za

Prepared for:

Bokamoso Energy (Pty) Ltd.
4th Floor
Global House
28 Sturdee Avenue
Johannesburg
2196
Tel: +27 10 595 3333



EXECUTIVE SUMMARY

This document provides a management plan for plant rescue, plant protection, re-vegetation and habitat rehabilitation for the Bokamoso Photovoltaic Solar Energy Facility near Leeudoringstad, North West Province.

Section 2 provides a brief description of the site location relating to distribution, vegetation and landscape features, geology, soil and climate.

Section 3 provides a summary of the Acts that apply to the management of plant rescue, plant protection, re-vegetation and habitat rehabilitation. These are the Conservation of Agricultural Resources Act 43 of 1983, the Environmental Conservation Act 73 of 1989, the National Forestry Act 84 of 1998, the National Environmental Management Act 107 of 1998 and the National Water Act 36 of 1998.



Section 4 provides information on the responsibilities of certain entities of the project.

Section 5 provides information on the effect of clearing alien and invasive species on site.

Section 6 provides information on the effect of removing individuals of species of conservation concern.

Section 7 provides guidelines for search and rescue operations as well as the protection of plant species.

Section 8 provides a rehabilitation implementation strategy, including steps such as identifying sensitive habitats, compiling a photographic record of current conditions, the use of cleared plant material, seeding requirements and some general considerations.

Section 9 provides a description of rehabilitation measures, such as use of sand bags, fascine work, geojute netting and rolls and gabion baskets. This is a generic description and not all methods have to necessarily be used.

Section 10 provides a rehabilitation programme for different phases of the project.

Section 11 gives an outline of monitoring requirements for determining the success of the rehabilitation programme.

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1. INTRODUCTION

1.1 Overview

This document presents the Plant Rescue, Plant Protection, Re-vegetation and Habitat Rehabilitation Plan for the approved Bokamoso Photovoltaic Solar Energy Facility on a portion of the farm Matjesspruit 145, Registration Division HP near Leeudoringstad, North West Province. The Environmental Impact Assessment (EIA) process for the approved facility was undertaken by Environamics Environmental Consultants. In accordance with the Environmental Authorisation (EA), a Plant Rescue and Protection, Re-vegetation and Habitat Rehabilitation Plan has been compiled that will be included in the final EMPr.

1.2 Purpose

This plan addresses the need to mitigate all impacts leading to disturbed vegetation, loss of species and/or agricultural potential, disturbed soil surfaces, and generally bare soils prone to erosion and further degradation on the proposed development site. The plan overlaps to some degree with the Storm Water and Erosion Management Plan, and for successful rehabilitation, it is imperative that this plan is at all times used in conjunction with other EMPr's mentioned.

This plan, as part of the project EMPr, is a legally binding document that must be implemented to fulfil the requirements of relevant legislation. However, the management plan is an evolving guideline that needs to be updated or adapted as progress is made with the rehabilitation and re-vegetation of the project area, and successes and failures of procedures identified.

The objective of the plan is therefore to provide:

- Preventing the loss of species either directly or through future extinction and minimising impacts of development on population dynamics of species of conservation concern.
- Preserving the natural configuration of habitats as part of ecosystems, thus ensuring a diverse but stable hydrology, substrate and general environment for species to be able to become established and persist.
- Preserving or re-creating the structural integrity of natural plant communities.

- Actively aid the improvement of indigenous biodiversity according to a desirable end state according to a previously recorded reference state. This reference state, if healthy, will be dynamic and able to recover after occasional disturbances without returning to a degraded state.
- Improving the ecosystem function of natural landscapes and their associated vegetation.

Map 1: Locality Map

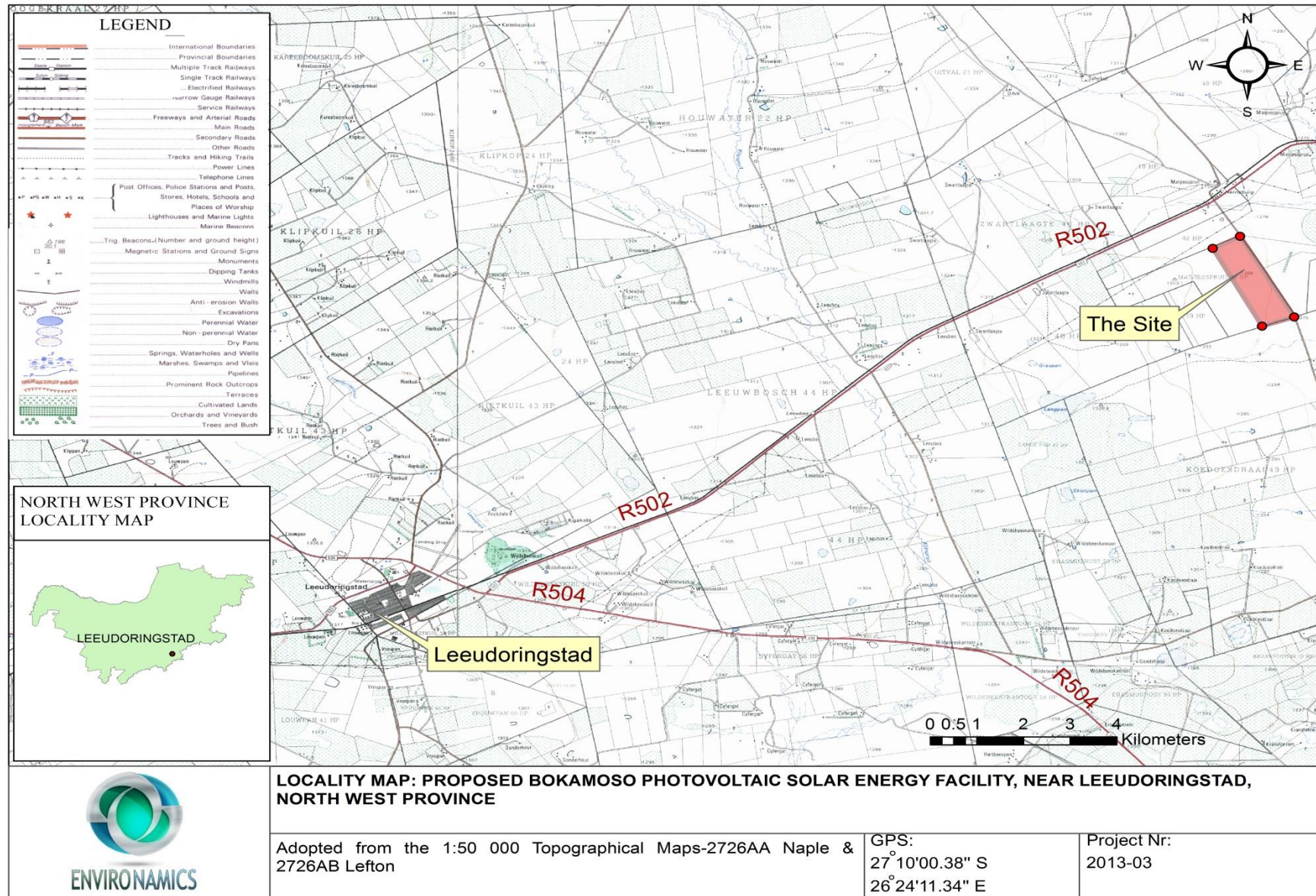


Photo 1: Bokamoso Aerial View



2. SITE CHARACTERISTICS

The site is situated at the Grassland Biome which is represented by the Vaal-Vet Sandy Grassland vegetation type. A brief overview of the Vaal-Vet Sandy Grassland vegetation type in which the site is located, follows:

Distribution: In South Africa the Vaal-Vet Sandy Grassland is present in the North-West Province and Free State Province. Vaal-Vet Sandy Grassland ranges from south of Lichtenburg and Ventersdorp to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort areas north of Bloemfontein. Altitude ranges from 1 220 – 1560 m for the entire vegetation type.

Vegetation and landscape features: Plains-dominated landscape with some scattered, slightly undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element are present. Dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *Themeda triandra* and the associated increase in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall.

Geology and soils: Aeolian and colluvial sand overlying sandstone, mudstone, and shale of the Karoo Supergroup (mostly the Ecca group) as well as older Ventersdorp Supergroup and basement gneiss in the north.

Climate: Warm-temperate, summer-rainfall climate, with overall mean annual precipitation of 530 mm. High summer temperatures. Severe frost (37 days per year on average) occurs in winter.

3 LEGISLATION AND STANDARDS

Relevant legislation:

- Conservation of Agricultural Resources Act 43 of 1983
- Environmental Conservation Act 73 of 1989
- National Forestry Act 84 of 1998
- National Environmental Management Act 107 of 1998
- National Water Act 36 of 1998

4 RESPONSIBLE PERSONS

Effective management of this plan during the construction and operational phases of the project will be dependent on a number of project personnel. These are listed below:

4.1 The Developer

This refers to the project proponent, Bokamoso Energy (Pty) Ltd. They will be responsible for the following:

1. Ensure that the requirements set out in this management plan are adhered to and implemented;
2. Allocate the responsibilities assigned to the Environmental Control Officer (ECO) to an independent suitably qualified individual prior to the start of construction activities on site; and
3. Provide all principal contractors working on the project with a copy of this management plan as part of tender contract documentation to allow the contractors to cost for its requirements within their respective construction contracts.

4.2 The Engineer

The engineer of the proposed development will be responsible for the overall implementation of the management plan during the construction phase of the project. To effectively implement the plant rescue, protection, revegetation and habitat rehabilitation plan, the engineer must be aware of the findings, mitigation measures and conclusions of the Final EIA report, the requirements of the EA, and this management plan.

4.3 The Environmental Control Officer (ECO)

The ECO is responsible for monitoring and verifying the implementation of the management plan during the construction phases of the project. To effectively implement the management plan, the ECO must be aware of the findings, mitigation measures and conclusions of the Final EIA Report, the EA, and this management plan.

4.4 The Contractor

The contractor, being any directly appointed company or individual undertaking the implementation of works, will be responsible for complying with the management plan at all times during the construction phase.

5 EFFECT OF CLEARING ALIEN VEGETATION

Invasive and Alien Plants (IAPs) gradually displace and suppress indigenous and/or herbaceous vegetation as their stands become bigger and denser. In addition, they use more water, hence desiccate the soil more, and may alter chemical properties of the soil – partially through secondary compounds released from their litter, partially from compounds released from roots. These altered soils suppress the germination and establishment of herbaceous species, leading to bare soil underneath dense IAP canopies. After clearing dense stands of invasive shrubs, soil surfaces are thus generally bare with topsoil exposed to erosion and often already somewhat capped and eroded.

6 EFFECT OF REMOVING INDIVIDUALS OF SPECIES OF CONSERVATION CONCERN

Species of conservation concern are declining either due to overexploitation or because their range of occupancy is limited and further infringed on by development. Most plant populations require a certain minimum number of individuals within a population or metapopulation to allow for sufficient genetic transfer between individuals. This prevents genetic erosion and hence weakening of the ability of individuals to persist in their environments. Similarly, where the distance between metapopulations is significantly increased due to fragmentation and the resultant loss of some populations, populations may suffer genetic decline due to restricted movement of pollen. Pollinators or other species that depend on a particular plant species for a specific microhabitat or food source may be equally affected because of the reduction of available resources. Therefore the aim

of plant rescue actions are always to maintain as many individuals of a plant population in as close proximity to the original habitat as possible to minimise loss of individuals and fragmentation of populations to prevent the creation of future extinction debts of the development.

7 PLANT SEARCH, RESCUE AND PROTECTION

Plant search and rescue activities must be initiated as the first stage of the rehabilitation process. The Specialist or ECO must identify within the construction footprint any viable plant material. Plant material to be rescued must be potted into bags using local soil. Planting rescued plants into rehabilitation areas can be an effective means of establishing indigenous species quickly. The following principles must be applied:

- Species can be removed from their original habitat with minimal damage to the plant, especially the roots.
- Plants for transplant should only be removed from areas that are going to be cleared.
- All plants removed are safely stored and treated according to their specific requirements prior to being transplanted again.
- They are relocated into a suitable habitat and protected from further damage and all disturbances to aid their re-establishment.
- Timing of planting activities is planned with the onset of the growing season.
- Steps are taken where necessary to aid the initial establishment of vegetation, including occasional watering.
- Rescued plant material must remain on site and not transported to off-site areas.
- Rescued plants must be relocated to an area on the same property / title deed.
- A system to identify rescue plant material and source area cross-referencing must be developed so that transplants are placed nearby to where they were sourced and not too distant areas.
- The removal, pruning or relocating of any endangered or protected plant species must be accompanied by a permit or licence issued by the relevant department.

Time of planting

- All planting shall be carried out as far as is practicable during the period most likely to produce beneficial results (i.e. during the peak growing season), but as soon as possible after completion of a section of earthworks.
- Drainage line rehabilitation preparation must be done during autumn, and planting of appropriate species in these areas should commence during early spring after the first rains.

8. REHABILITATION AND RE-VEGETATION

Successful rehabilitation can only be achieved with:

- A long-term commitment
- Practical, adaptive management
- Viable goals of desired outcomes

Prior to vegetation rehabilitation, all stakeholders involved should be consulted to determine:

- What the rehabilitation is ultimately aiming for– rehabilitation of cropping/grazing lands or rehabilitation of indigenous vegetation, after soil erosion and storm water management is in place and IAPs have been cleared?
- A clear definition of incompatible and compatible vegetation on and in the immediate surroundings of the development must be defined and maintained as such. No tree or shrubs shall be allowed to grow to a height in excess of the horizontal distance of that tree or shrub from the nearest newly developed structure or to grow in such a manner as to endanger the development or its operation.
- Who will take long-term ownership and hence responsibility for the rehabilitation and its subsequent monitoring and management? Continued monitoring of vegetation establishment and composition, as well as erosion detection will have to be coupled with continued follow-up maintenance of rehabilitation and erosion control from commencement of activity up to the decommissioning phase.

The ultimate objective for rehabilitation should focus on the stabilisation of soil erosion, retaining agricultural potential of transformed areas and /or the establishment of a dense and protective plant cover and the maintenance of habitats to enable vegetation to persist and flourish on rehabilitated areas indefinitely, ultimately relying only on environmental resources.

8.1 Identification and protection of environmentally sensitive areas

Sensitive sites and habitats must be identified prior to any construction activities taking place. No vegetation clearing, levelling, excavation or plant material removal is permitted without prior consent from the ECO. Areas highlighted as being environmentally sensitive from prior studies must be identified and the necessary fencing and protection of these areas initiated.

8.2 Comprehensive photographic record

In order for practical and attainable rehabilitation goals to be defined and met, it is recommended that a comprehensive photographic record of the entire length of all infrastructure components is compiled. This pre-construction photographic information would provide an accurate representation of the entire existing site and it would become a very valuable tool for the rehabilitation work, as it would serve as the basis for rehabilitation requirements, informing decisions on drainage, soil shaping, levels, plant choices and rehabilitation in general.

8.3 Cleared plant material

Surface plant material that is cleared during construction activities can be stockpiled and/or bagged to be used as mulch during rehabilitation. Mulching is the covering of the soil with a layer of organic matter of leaves, twigs, bark or wood chips. The main purpose of mulching is to protect and cover the soil surface as well as serve as a source of seed for re-vegetation purposes. The following principles should be adhered to:

- During site clearing the standing vegetation should not be cleared and mixed with the soil, but should be cleared separately, either mechanically or by hand using a brushcutter. The cleared vegetation should be stockpiled and used whole or

shredded to protect the soil in disturbed areas and promote the return of indigenous species.

- Mulch is to be harvested from areas that are to be denuded of vegetation during construction activities. No harvesting should take place outside the area to be disturbed by construction activities.
- Brush-cut mulch should be stored for as short a period as possible.
- Seed released from stockpiles should be collected for use in the rehabilitation process.
- Alien vegetation should not form part of the mulch and be disposed of separately.

8.4 Seed collecting

Indigenous seed should be collected from plants present on site and should be used immediately or stored appropriately and used at the start of the following wet season. Seed can be broadcast onto the soil, but should preferably be applied in conjunction with measures to improve seedling survival, such as scarification of the soil surface or simultaneous application of mulch. The following principles apply:

- Indigenous seeds may be harvested for purposes of re-vegetation in areas that are free of alien invasive plants, either at the site prior to clearance or from suitable neighbouring sites;
- Seed may be harvested by hand and, if necessary, dried or treated appropriately;
- Seed gathered by vacuum harvester, or other approved mass collection method, from suitable shrubs or from plant litter surrounding the shrubs, must be kept apart from individually harvested seed;
- No seed of alien or foreign species should be used or brought onto the site;

8.5 Commercial seeding

In some areas the natural regeneration of the vegetation may be poor and the application of seed to enhance vegetation recovery may be required. Mixed seed is available from commercial suppliers. A typical seed mix may be as follows (This information is provided as a guideline. Site specifics and re-vegetation requirements may require changes to these mixes.):

Table 1: Grass Species

Grass Species	Common Name	General Application (kg/ha)
<i>Eragrostis tef</i>	Teff	4
<i>Eragrostis curvula</i>	Weeping love grass	10
<i>Chloris gayana</i>	Rhodes grass	10
<i>Digitaria erianthe</i>	Smuts finger grass	2
<i>Cynodon dactylon</i>	Couch/kweek/star grass	2
<i>Paspalum notatum</i>	Lawn paspalum	2

8.6 General considerations

Progressive rehabilitation is an important element of the rehabilitation strategy and should be implemented where feasible.

- Once re-vegetated, areas should be protected to prevent trampling and erosion.
- No construction equipment, vehicles or unauthorized persons should be allowed onto areas that have been re-vegetated.
- Where rehabilitated sites are located within actively grazed areas, they should be fenced. Fencing should only be removed once a sound vegetation cover has been achieved.
- Any runnels, erosion channels or wash-aways developing after re-vegetation should be backfilled and consolidated to restore them back to a proper condition.

9. REHABILITATION MEASURES

Rehabilitation measures that may be affected on site include systems such as soil terracing, berm creation, grass blocks, fascine work, gabion basket work, reno mattresses, retaining block mechanisms, sand bags, boulder and rock placement, stone pitching, and grading. Decisions pertaining to plant material choices and specific vegetation utilisation for specific areas from an integral part of the process, as the hard landscape components work in conjunction with the soft landscape components. This section provides a description of these measures. Each area may require a different technique, but all possible should be considered and the most appropriate one for each case selected.

9.1 Sand Bags

These are to be made from biodegradable material ONLY. Geojute sacks or similar are acceptable. No plastic bags are to be utilised. A sand mix or rocky soil mix could be utilised to fill the bags. No contaminants may be put into the bags (i.e. cement material, soil with chemical spill or fuel etc.).

9.2 Terracing and soils stabilization

Rows of straw, hay or bundles of cut vegetation may also be used. In this instance, the hay, straw or vegetation is dug into the soil in contours, in order to help slow surface wash and capture eroded soil. The spacing between rows would be dependent on slope and the specific area.

9.3 Fascine work

Logs or branches removed during site clearing operations may be utilized to form the vertical peg supports which are driven into the ground, leaving approximately one third of the total length exposed. Thereafter horizontal members are fixed behind these pegs. Wooden logs or branches may be utilized, narrow netting or shade cloth, or even the geojute rolls, to create the horizontal members. The spacing of rows of fascine work will be site specific and these "open areas" may be further protected with small branches and brush gathered during site clearing activities. Fascine work must not be created in rigid blocks or grids, pegs should be alternately spaced in rows, to help prevent any water channelling occurring.

9.4 Geojute netting

Netting or matting may be utilised on slopes to assist with soil retention, weed control and vegetation establishment. The netting material helps protect the soil from wind and water erosion, and the required rehabilitation plant material can be installed by making small incisions for planting. The netting is biodegradable and will eventually break down and form a mulch layer.

9.5 Geojute rolls

These are long sections of Geojute “fabric” that are rolled into long cylindrical rolls. They are likewise filled with sand as described in Sand Bags above. These are effective on slopes and where a large area of clearing has been affected and erosion management is required. Geojute rolls will require some form of pegging to hold them in shape and in place. Short sticks obtained from alien invasive plant material removed during the construction process should be utilized for these purposes (neither plant material, nor seeds of any kind that could re-generate are to be utilized).

9.6 Detention ponds

Detention ponds should in no way block the water flow, but rather encourage the spread of the flow over a wider area, to help reduce velocity and encourage infiltration. Detention ponds should be vegetated with either wetland vegetation or grass – (site specific).

9.7 Drainage and stormwater pipes

High friction, semi permeable channels should be utilized where possible. A number of smaller storm water outfall points should be constructed, rather than one large outfall point. The design of drainage and storm water pipes should be to reduce flow velocity and avoid soil erosion. This can be achieved through the construction of water velocity dissipators below the pipe head wall. Rocks, boulders or concrete blocks may be utilized for these purposes, and they are set into the concrete apron below the headwall. Stone pitching may also be utilized.

9.8 Gabion baskets and reno mattresses

These represent engineered solutions to steep slopes and banks. They are utilised in areas where soil must be retained, and there are existing drainage and water problems. Gabion baskets are formed wire baskets, filled to engineering specifications with uniform size rocks, with minimal gaps between, and approximately 1m x 1m x 1m in dimension - although the specific shape and size may vary according to application. Reno mattresses are similarly filled but they are created as larger area flat baskets that cover a greater surface area, hence the term “mattress”. Often these two systems are used in combinations.

10. REHABILITATION PROGRAMME

The following table has been prepared as a guideline to the various activities required. The table provides general information and is to be read in conjunction with the Rehabilitation Plan detailed in the sections above.

Preconstruction actions

Table 2: Rehabilitation Preconstruction Actions

Action	Responsibility	Frequency
<i>Identify and protect sensitive areas</i>	ECO	Once-off
<i>Comprehensive photographic record of areas to be cleared</i>	ECO	Once-off
<i>Search and rescue</i>	ECO / Rehabilitation Specialist	Once-off

Construction Phase Actions

Table 3: Rehabilitation Construction Phase Actions

Action	Responsibility	Frequency
<i>Vegetation clearing, stockpiling of plant material & topsoil</i>	Contractor	On-going
<i>Seed collecting</i>	Contractor	On-going
<i>Landscaping</i>	Contractor	On-going
<i>Fence off rehabilitation areas</i>	Contractor	On-going
<i>Implementation of rehabilitation measures (terracing, fascine work, mulching, etc.)</i>	Contractor	On-going
<i>Planting rescued plants into rehabilitation areas, seeding, etc. to establish new vegetation.</i>	Contractor	On-going
<i>Photographic record of</i>	ECO	Once-off

<i>rehabilitation actions</i>		
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Post-construction phase actions

Table 4: Rehabilitation Post-Construction Actions

Action	Responsibility	Frequency
<i>Monitor site for erosion, alien plants, vegetation growth</i>	ECO / Rehabilitation Specialist	3-monthly and <i>ad hoc</i>
<i>Remediation in areas where rehabilitation is progressing poorly. If necessary, sow grass mix into bare patches.</i>	Contractor	<i>Ad hoc</i>

11. REHABILITATION MONITORING PROGRAMME

In order to monitor the impact of rehabilitation activities, monitoring must be undertaken. This section provides a description of a possible monitoring programme that will provide an assessment of the success of the rehabilitation activities.

Pre-construction and construction phase monitoring

The following monitoring is required during the construction phase of the project:

Table 5: Pre-Construction and Construction Phase Monitoring

<i>Monitoring action</i>	<i>Indicator</i>	<i>Timeframe</i>
<i>Photographs of area prior to construction</i>	Baseline condition / pre construction state	Prior to clearing during preconstruction / construction

Operational phase monitoring

The following monitoring is required during the operational phase of the project:

Table 6: Operational Phase Monitoring

<i>Monitoring action</i>	<i>Indicator</i>	<i>Timeframe</i>
<i>Document rehabilitation measures implemented and success achieved in problem areas</i>	Decline in vulnerable bare areas over time	Annually

Decommissioning Phase Monitoring

The following monitoring is required during the operational phase of the project:

Table 7: Decommissioning Phase Monitoring

<i>Monitoring action</i>	<i>Indicator</i>	<i>Timeframe</i>
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<i>Photographs of area prior to decommissioning</i>	Baseline condition / pre-decommissioning state	Prior to clearing infrastructure
<i>Photographs of area after clearing of infrastructure</i>	Baseline condition / post clearing	During and after clearing of infrastructure
<i>Document rehabilitation measures implemented and success achieved in problem areas</i>	Decline in vulnerable bare areas over time	3-monthly and <i>ad hoc</i> for 2 years. Potential for extension if revegetation is not to the satisfaction of the auditor

12. CONCLUSION

The information in this document is intended to provide various options that can be adapted for specific situations on the ground. The exact approach adopted for rehabilitation is dependent on local conditions and situations and is not meant to adhere strictly to a formula. The experience of the ECO and the construction crew are important for ensuring that a successful rehabilitation programme is implemented.

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