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DONAWAY
ENVIRONMENTAL

PLANT PROTECTION AND HABITAT REHABILITATION PLAN

The Construction of the Beta Photovoltaic Solar Energy Facility near Hertzogville, Free State Province

PROJECT DETAILS

Project title:	**Plant Protection and Habitat Rehabilitation Plan -** The Construction of the Beta Photovoltaic Solar Energy Facility near Hertzogville, Free State Province
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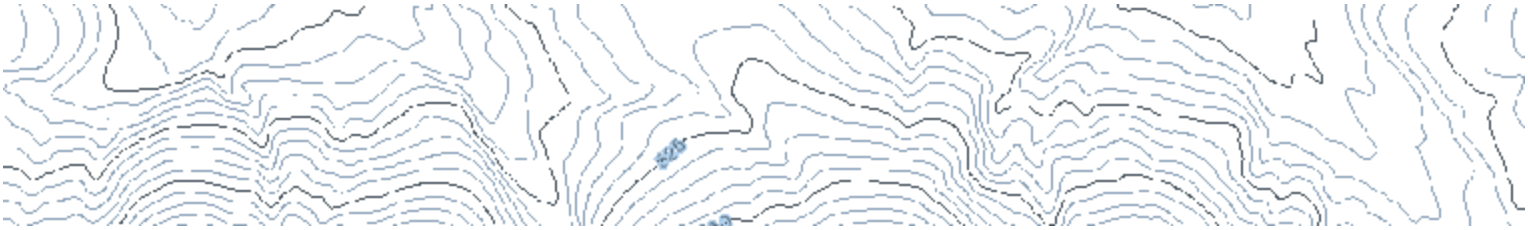

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EXECUTIVE SUMMARY

PROJECT BACKGROUND

Beta Solar Power Plant (RF) (Pty) Ltd is in the process of developing a photovoltaic solar facility and associated infrastructure on the farm Talana 1241, Registration Division Boshof, Free State Province, situated within the Tokologo Local Municipality area of jurisdiction. The site is located approximately 18km east-southeast of Hertzogville. The total footprint of the project will approximately be 115 hectares (including supporting infrastructure on site). The site was identified as being highly desirable due to its suitable climatic conditions, topography (i.e., in terms of slope), environmental conditions (i.e., agricultural potential, geology and archaeology), proximity to a grid connection point (i.e., for the purpose of electricity evacuation), as well as site access (i.e., to facilitate the movement of machinery, equipment, infrastructure and people during the construction phase).

The project will form part of the Department of Mineral Resources and Energy (DMRE) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme. The REIPPP Programme aims to secure 14 725 Megawatts (MW) of new generation capacity from renewable energy sources, while simultaneously diversifying South Africa's electricity mix. According to the 2021 State of the Nation Address, Government will soon be initiating the procurement of an additional 11 800 MW of power from renewable energy, natural gas, battery storage and coal in line with the Integrated Resource Plan 2019 and fulfilling their commitments under the United Nations Framework Convention on Climate Change and its Paris Agreement which include the reduction of greenhouse gas emissions. Eskom, our largest greenhouse gas emitter, has committed in principle to net zero emission by 2050 and to increase its renewable capacity.

The Environmental Impact Assessment (EIA) process for the approved facility was undertaken by Environamics Environmental Consultants. In accordance with the Environmental Authorisation (EA), this Plant Protection and Habitat Rehabilitation Plan will be included in the final EMPr.

APPROACH AND CONTENT

Section 1 & 2 provides a brief description of the site location relating to distribution, vegetation, landscape feature, climate and precipitation.

Section 3 provides information on the responsibilities of certain entities of the project.

Section 4 provides information on the effect of clearing vegetation and the protection of vegetation.

Section 5 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 6 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 7 provides a rehabilitation programme for different phases of the project.

Section 8 gives an outline of monitoring requirements for determining the success of the rehabilitation programme.

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ACRONYMS

DEA	Department of Environmental Affairs (National)
DEAT	Department of Environmental Affairs and Tourism
DFFE	Department Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
DM	District Municipality
EA	Environmental Authorisation
ECA	Environment Conservation Act (No. 73 of 1989)
ECO	Environmental Control Officer
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ha	Hectares
IPP	Independent Power Producer
km	Kilometre
kV	Kilovolt
MW	Megawatt
NEMA	National Environmental Management Act (No. 107 of 1998)
OHS	Occupational Health and Safety
PV	Photovoltaic
RE	Renewable Energy
REDZ	Renewable Energy Development Zone
REIPPP	Renewable Energy Independent Power Producer Procurement Programme
SEF	Solar Energy Facility
SPP	Solar Power Plant
ToR	Terms of Reference

1. INTRODUCTION

1.1. Project Background

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The project will form part of the Department of Mineral Resources and Energy (DMRE) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme. The REIPPP Programme aims to secure 14 725 Megawatts (MW) of new generation capacity from renewable energy sources, while simultaneously diversifying South Africa's electricity mix. According to the 2021 State of the Nation Address, Government will soon be initiating the procurement of an additional 11 800 MW of power from renewable energy, natural gas, battery storage and coal in line with the Integrated Resource Plan 2019 and fulfilling their commitments under the United Nations Framework Convention on Climate Change and its Paris Agreement which include the reduction of greenhouse gas emissions. Eskom, our largest greenhouse gas emitter, has committed in principle to net zero emission by 2050 and to increase its renewable capacity.

1.2. Project Location

The proposed Beta SPP is located approximately 18km east-southeast from the town of Hertzogville, bordering the R708 Regional Road.

Please refer to **Figure 1.1** below, Locality Map.

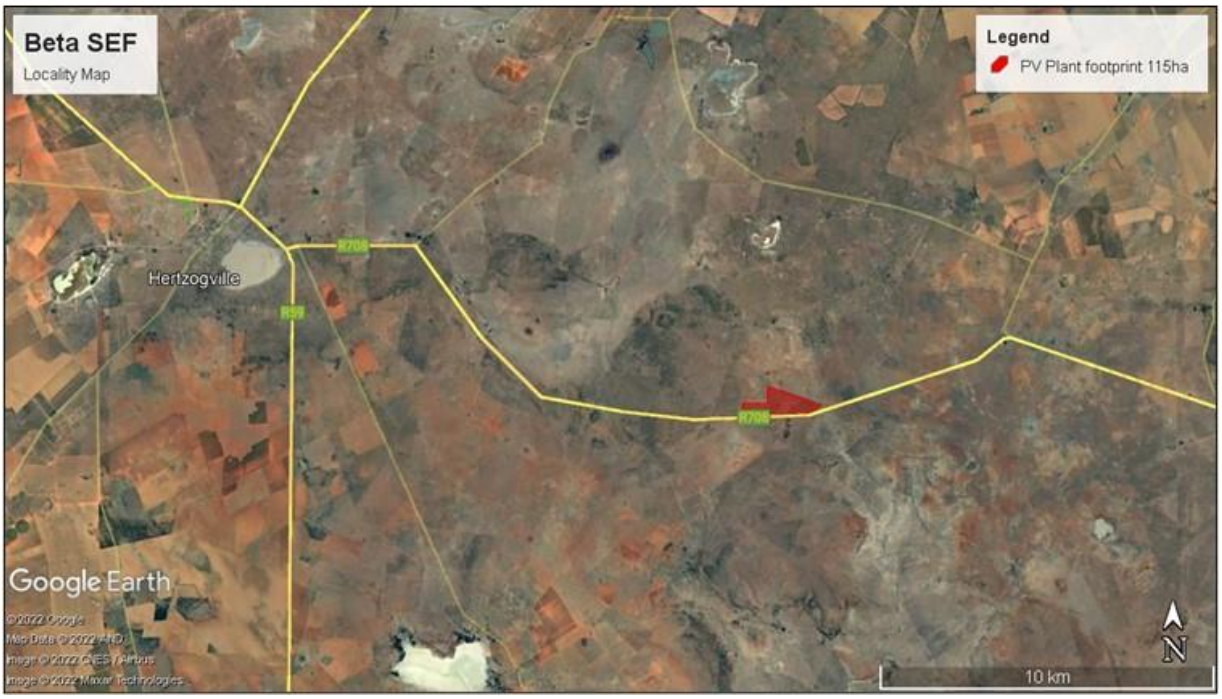

Figure 1: Locality Map.

1.3. Purpose of the Plant Protection and Habitat Rehabilitation Plan

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 management plans.

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.

1.4. Applicable legislation

The legislation listed below should be read in conjunction with this report:

- 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

1.5. Project Team and Experience

The project team will consist of Johan Botha.

Johan Botha graduated with an Honours degree in 2011 from the North West University in the field of Environmental Sciences specialising in Geography and Environmental Management and has since been involved in the environmental management of substations, powerlines and solar PV plants together with Visual Impact Assessments (VIA), Social Impact Assessments (SIA) and management plans mostly in the field of Renewable Energy. All the above-mentioned experience accumulated the necessary skills to conduct vegetation management plans.

2. SITE CHARACTERISTICS

The site is located within the *Western Free State Clay Grassland* vegetation type. Distribution - Free State Province: Regions covering part of the western Bloemfontein District (south), Boshof (southwest), Hertzogville (west), Wesselsbron (north) and Brandfort (east) and consisting of three main areas, of which the southern and middle sections are separated by a slightly elevated area (dolerite hills) between Hertzogville, Boshof and Soutpan. The Vet River Valley separates the middle and northern sections and all three sections are separated from one another by belts of Gh 10 Vaal-Vet Sandy Grassland. Altitude 1 200–1 420 m.

Vegetation & Landscape Features Restricted to flat bottomlands which support dry, species-poor grassland with a high number of salt pans embedded. Dwarf karoo shrublands surround the playas in disturbed habitats.

Climate Seasonal rainfall concentrated from November–March with a mean annual precipitation of 450mm. Cool temperate regime with mean annual temperature of 16–17°C. Occurrence of frost frequent.

Important Taxa Graminoids: Aristida adscensionis (d), A. bipartita (d), Cynodon dactylon (d), Eragrostis chloromelas (d), E. lehmanniana (d), Panicum coloratum (d), Themeda triandra (d), Aristida congesta, Cymbopogon pospischilii, Digitaria eriantha, Eragrostis bicolor, E. curvula, E. micrantha, E. obtusa, E. plana, E. superba, E. trichophora, Heteropogon contortus, Setaria nigrirostris, Tragus berteronianus, T. koelerioides, T. racemosus. Herbs: Berkheya onopordifolia var. onopordifolia, Chamaesyce inaequilatera, Gnaphalium declinatum, Indigofera alternans, Kohautia cynanchica, Nidorella microcephala, Platycarpha parvi¬folia, Salvia stenophylla, Selago paniculata, Stachys spathulata. Geophytic Herbs: Bulbine narcissifolia, Oxalis depressa. Succulent Herb: Tripteris aghillana var. integrifolia. Low Shrubs: Lycium cinereum (d), Pentzia globosa (d), Amphiglossa triflora, Aptosimum elongatum, Berkheya annectens, Felicia filifolia subsp. filifolia, F. muricata, Gnidia polycephala, Helichrysum dregeanum, Melolobium candicans, Nenax microphylla, Rosenia humilis, Selago saxatilis. Succulent Shrub: Hertia pallens.

Conservation Least threatened. None conserved in statutory conservation areas. Almost 20% already transformed for maize and wheat cultivation. A species of Prosopis appears as occasional invasive alien. Erosion very low (38%), low (30%) and moderate (28%).

Remarks The vegetation of the salt pans embedded within this grassland unit is treated as a separate vegetation unit AZi 10 Highveld Salt Pans.

3. RESPONSIBLE PARTIES

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

3.1. The Developer

This refers to the project proponent, Beta Solar Power Plant (RF) (Pty) Ltd. They will be responsible for the following:

- Ensure that the requirements set out in this management plan are adhered to and implemented;
- 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
- 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.

3.2. The Engineer

The engineer will be responsible for the overall implementation of the management plan during the construction phase of the project. To effectively implement the 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.

3.3. The Environmental Control Officer (ECO)

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

3.4. 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.

4. ROMOVAL AND PROTECTION OF VEGETATION

4.1. Effect of clearing alien vegetation

Invasive and alien plants 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 and partially from compounds released from roots. These altered soils suppress the germination and establishment of herbaceous species, leading to bare soil underneath dense invasive and alien plant 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.

4.2. Effect of removing individual 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.

4.3. Plant search, rescue and protection

Although no species of conservation concern were found on site, species may establish on or around site in time. 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.

5. REHABILITATION AND RE-VEGETATION

This sec 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.

5.1. 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.

5.2. 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.

5.3. 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 brush cutter. 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.

5.4. 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 of 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.

5.5. 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)
Eragrostis tef	Teff	4

Eragrostis curvula	Weeping love grass	10
Chloris gayana	Rhodes grass	10
Digitaria erianthe	Smuts finger grass	2
Cynodon dactylon	Couch/kweek/star grass	2
Paspalum notatum	Lawn paspalum	2

5.6. 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.

6. 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.

6.1. 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.).

6.2. Terracing and soil stabilisation

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.

6.3. 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.

6.4. Geojute netting

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).

6.5. 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).

6.6. 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).

6.7. 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.

6.8. 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.

7. REHABILITATION PROGRAMME

The following tables 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.

7.1. Preconstruction actions

Table 2: Rehabilitation Preconstruction Actions

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

7.2. Construction Phase Actions

Table 3: Rehabilitation Construction Phase Actions

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

7.3. Post-construction phase actions

Table 4: Rehabilitation Post-Construction Actions

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

8. 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.

8.1. 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

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

8.2. Operational phase monitoring

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

Table 6: Operational Phase Monitoring

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

8.3. Decommissioning Phase Monitoring

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

Table 7: Decommissioning Phase Monitoring

Monitoring action	***Indicator***	***Timeframe***
Photographs of area prior to decommissioning	Baseline condition / pre-decommissioning state	Prior to clearing infrastructure
Photographs of area after clearing of infrastructure	Baseline condition / post clearing	During and after clearing of infrastructure
Document rehabilitation measures implemented and	Decline in vulnerable bare areas over time	Bi-annually and *ad hoc* for 2 years. Potential for extension if revegetation is

success achieved in problem areas		not to the satisfaction of the auditor

9. 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.

10. REFERENCES

Ludwig, J. and Tongway, D. 1997. A landscape approach to landscape ecology. Chapter 1 in Ludwig, J., Tongway, D., Freudenberger, D., Noble, J. and Hodgkinson, K (eds) (1997) Landscape Ecology Function and Management: Principles from Australia's Rangelands, CSIRO, Melbourne.

Ludwig, J., Tongway, D., Freudenberger, D., Noble, J. and Hodgkinson, K (eds) (1997) Landscape Ecology Function and Management: Principles from Australia's Rangelands, CSIRO, Melbourne.

Magurran, A.E. 1988. Ecological Diversity and its Measurement. University Press, Cambridge, Great Britain.

Mueller-Dombois, D. and Ellenberg, H. 1974, Aims and Methods of Vegetation Ecology, John Wiley and Sons, New York.

Mucina, L. & Rutherford, M.C. 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Tongway, D.J. and Hindley, N.L. 2005. LANDSCAPE FUNCTION ANALYSIS: PROCEDURES FOR MONITORING AND ASSESSING LANDSCAPES With special reference to Mine sites and Rangelands. CSIRO Sustainable Ecosystems, PO Box 284, Canberra ACT 2601, ISBN 0 9751783 0 X

Whisenant, S.G. (1999). Repairing Damaged Wildlands: A process-orientated, landscape-scale approach. Cambridge University Press. Cambridge Zar, J.H. 1996, Biostatistical Analysis, 3rd ed., Prentice-Hall, New Jersey.