A REHABILITATION AND REVEGETATION PLAN FOR THE PROPOSED DEVELOPMENT OF THE LICHTENBURG SOLAR PARK AND ASSOCIATED INFRASTRUCTUE ON PORTION 25 OF THE FARM HOUTHAALBOOMEN 31 IP AND PORTION 10 OF THE FARM LICHTENBURG TOWN AND TOWNLANDS 27 IP, NORTHWEST PROVINCE

April 2022

Prepared for: MATRIGENIX (PTY) LTD

Compiled by Dr BJ Henning

Document version 1.0

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DOCUMENT HISTORY

Report no	Date	Version	Status
L22 026E	April 2022	1.0	Final

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1 GENERAL INFORMATION AND BACKGROUND

AGES Limpopo (Pty) Ltd was appointed by MATRIGENIX (PTY) LTD to compile a rehabilitation and re-vegetation plan for the proposed development of a solar plant named as follows:

- Lichtenburg Solar Park.

The project site includes the proposed development of the Lichtenburg Solar Park and power line on Portion 25 of the Farm Houthaalboomen 31 IP and Portion 10 of the Farm Lichtenburg Town and Townlands 27 IP, Ditsobotla Local Municipality, Ngaka Modiri Molema District Municipality, Northwest Province.

The assignment is interpreted as follows: Compile a management plan to be implemented by the Environmental Control Officer (ECO) for the rehabilitation and revegetation of the proposed development site. The study will be done according to guidelines stipulated by the Department of Environment, Forestry and Fisheries (DEFF) and forms part of the Environmental Management Programme (EMPR) for implementation.

1.1 Information Sources

The following information sources were obtained:

1. All relevant maps through Geographical Information Systems (GIS) mapping, and information (previous studies and environmental databases) on the rehabilitation and revegetation of the site concerned.
2. Requirements regarding the management plan as requested by DEAT.
3. Information on the micro-habitat level was obtained through obtaining a first-hand perspective from the ecological study compiled by Henning (2022) was also utilized for this study.

1.2 Regulations governing this report.

1.2.1 National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) - Regulation No. R982

This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Gazette No. 38282 Government Notice R. 982 of 4 December 2014 (as amended). Appendix 6 – Specialist reports includes a list of requirements to be included in a specialist report:

1. A specialist report or a report prepared in terms of these regulations must contain:
    a. Details of

i. The specialist who prepared the report; and
ii. The expertise of that specialist to compile a specialist report, including a curriculum vitae.

b. A declaration that the specialist is independent in a form as may be specified by the competent authority.
c. An indication of the scope of, and purpose for which, the report was prepared.
d. The date and season of the site investigation and the relevance of the season to the outcome of the assessment.
e. A description of the methodology adopted in preparing the report or carrying out the specialized process.
f. The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure.
g. An identification of any areas to be avoided, including buffers.
h. A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.
i. A description of any assumptions made and any uncertainties or gaps in knowledge.
j. A description of the findings and potential implications of such findings on the impact of the activity, including identified alternatives, on the environment.
k. any mitigation measures for inclusion in the EMPr.
l. any conditions for inclusion in the environmental authorisation.
m. any monitoring requirements for inclusion in the EMPr or environmental authorisation
n. a reasoned opinion –
    i. As to whether the activity or portions thereof should be authorised and
    ii. If the opinion is that the activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr and where applicable, the closure plan.
o. A description of any consultation process that was undertaken while preparing the specialist report.
p. A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and

q. Any other information requested by the competent authority.

This Act also embraces all three fields of environmental concern namely: resource conservation and exploitation; pollution control and waste management; and land-use planning and development. The environmental management principles include the duty of care for wetlands / rivers and special attention is given to management and planning procedures.

1.3 Terms of reference

1.3.1 Objectives

- The main aim of the plan is to provide guidelines to be implemented after the construction phase of the development to ensure that previous impacts are rectified by rehabilitating or restoring the affected environment. This will include attempts at habitat re-creation, to restore the original land uses and biodiversity values.
- Provide management and rehabilitation guidelines to ensure that the biodiversity will form part of a sustainable environment after rehabilitation.
- Make recommendations in terms of revegetation ecological management and rehabilitation procedures for the general environment of the site and surrounding areas.

1.3.2 Limitations and assumptions

- To obtain a comprehensive understanding of the dynamics of rehabilitation and revegetation plan, monitoring should ideally be replicated over several seasons and over a few years. However, due to project time constraints such long-term studies are not feasible.
- The large study area did not allow for the finer level of assessment that can be obtained in smaller study areas. Therefore, data collection in this study relied heavily on data from representative sections, as well as general observations, generic data and a desktop analysis.

2 INTRODUCTION

Rehabilitation can be defined as the return of disturbed areas to a safe, stable, productive and self-sustaining condition that promotes biodiverse land use. Land rehabilitation techniques can be used to speed up the time required to restore the impacted area back to its original, or better, state. To re-create and maintain a sustainable environment it is important to plan how the areas to be impacted by the construction of the Lichtenburg PV Solar Park will be rehabilitated and revegetated.

A central purpose in rehabilitation planning should be to promote the ecological integrity of each site and surrounding landscapes. The application of ecological restoration principles requires that plans are developed consistent with regional or landscape level ecological objectives. At the local scale, this involves an examination of surrounding landscapes, in combination with determining predicted successional trends of vegetation communities appropriate to enhance local and regional ecosystems.

At the site level, emphasis is placed on rehabilitation techniques such as land-form replication and planting species that will promote site stability and sustainability. Re-vegetation should use indigenous species that contribute most to the compatibility of the local ecology and increase biodiversity.

The final goal of the rehabilitation planning process is a practical, achievable and adequately resourced rehabilitation programme. Rehabilitation of the disturbed areas should be done in such a way to ensure that the rehabilitation and revegetation on the site for the Lichtenburg Solar Park will be sustainable in the long term.

3 STUDY AREA

3.1 Location and description of activity

Matrigenix (Pty) Ltd is proposing the establishment of a renewable energy generation facility (Photovoltaic Power Plant) with associated infrastructure and structures, and power line on Portion 25 of the Farm Houthaalboomen 31 IP and Portion 10 of the Farm Lichtenburg Town and Townlands 27 IP, Ditsobotla Local Municipality, Ngaka Modiri Molema District Municipality, North-West Province (Figure 1). The proposed renewable energy generation facility will be Photovoltaic (PV) Power Plant with a maximum generation capacity up to 120 MW, at the point of connection (Export Capacity) with the Eskom connection infrastructure. The name of the facility will be LICHTENBURG SOLAR PARK.

The developed area (footprint) required for the proposed project will be up to 240 hectares. The Lichtenburg Solar Park will deliver the electrical energy to the Eskom's Watershed substation, located on the Remainder Portion of the farm Lichtenburg Town and Townlands 27 IP.

The proposed development (the Photovoltaic (PV) Power Plants and connection infrastructure) consists of the installation of the following equipment:

- Photovoltaic modules (mono-crystalline, poly-crystalline, or bi-facial modules)
- Mounting systems for the PV arrays (single-axis horizontal trackers or fixed structures) and related foundations
- Internal cabling and string boxes
- DC/AC inverters
- Medium voltage stations, hosting LV/MV power transformers
- Medium voltage receiving station(s)
- Workshops & warehouses
- One on-site high-voltage substation with high-voltage power transformers, stepping up the voltage to 132kV and one high-voltage busbar with metering and protection devices
- One on-site switching station, with one high-voltage busbar with metering and protection devices
- One (1) 132 kV powerline, to the Eskom Watershed substation, located on the Remainder Portion of the farm Lichtenburg Town and Townlands 27 IP.
- Battery Energy Storage Systems (BESS), with a footprint up to 10 ha, next to the on-site high-voltage substation, within the PV plant footprint / fenced areas

- Electrical system and UPS (Uninterruptible Power Supply) devices
- Lighting system
- Grounding system
- Internal roads
- Fencing of the site and alarm and video-surveillance system
- Water access point, water supply pipelines, water treatment facilities
- Sewage system
- Interventions on the Eskom Watershed Substation.

During the construction phase, the site may be provided with additional activities which will be removed at the end of construction.

- Water access point, water supply pipelines, water treatment facilities
- Prefabricated buildings
- Workshops & warehouses

The connection may also entail interventions on the Eskom grid, according to Eskom's connection requirements/solution. The aerial map of the site is presented in Figure 2.

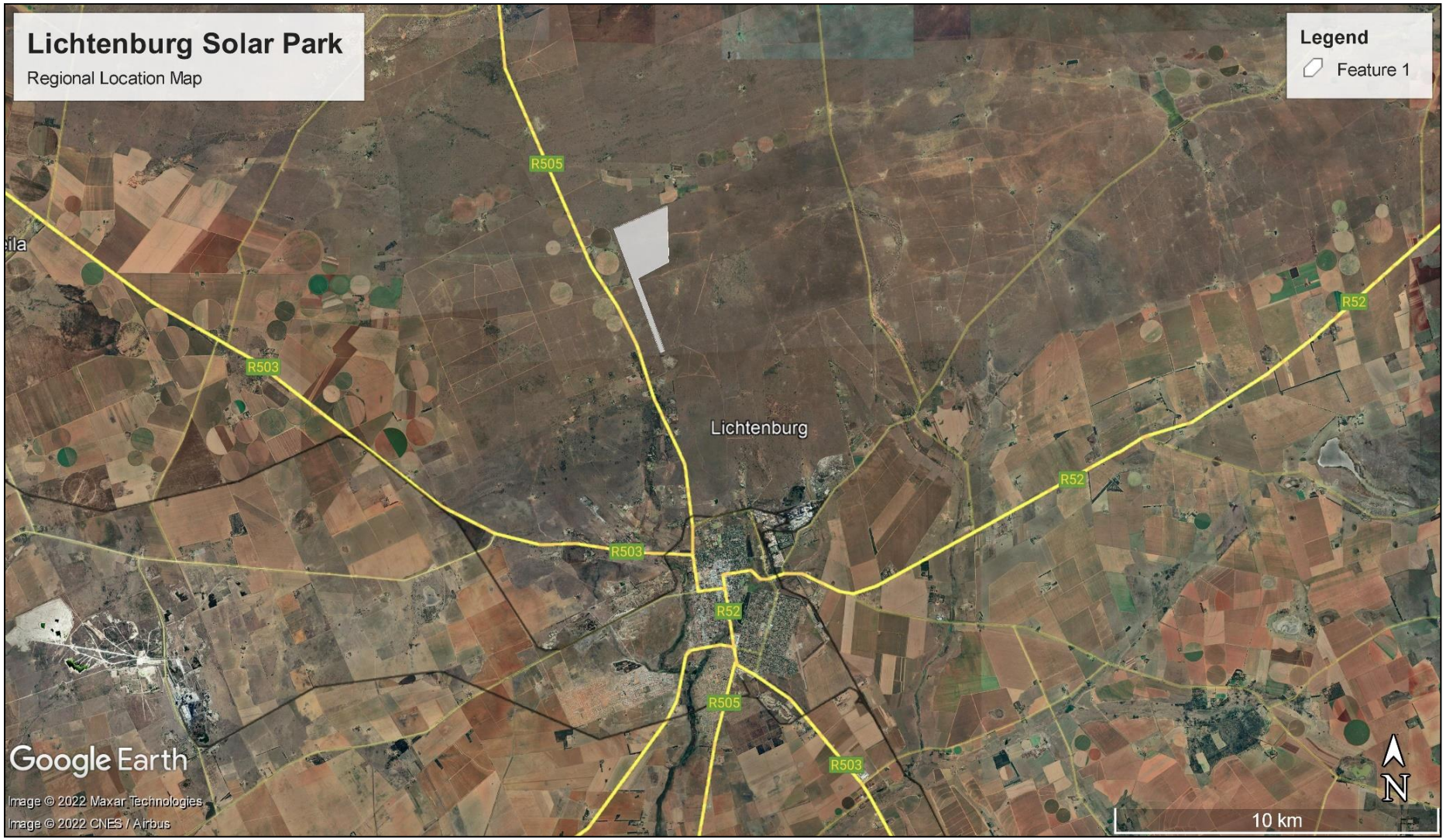

Figure 1. Regional location Map of the project area

Figure 2. Aerial Map of the project area

4 REHABILITATION MEASURE PRINCIPLES TO BE IMPLEMENTED FOR THE LICHTENBURG SOLAR PARK

The Environmental Rehabilitation process at the construction site should form an integral part of site development, operation and post-construction activities. A Rehabilitation Specialist and/or Environmental Control Officer (ECO) should therefore be appointed and be available on-site as part of the rehabilitation management / construction team. The ECO should form an integral part of the management team, attending regular site meetings, receiving Project Meeting Minutes and being kept fully updated regarding the closure plan and site rehabilitation process. **The ECO must be appointed according to conditions of the Environmental Authorization.**

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, sandbags, 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. For example, the utilisation of plants with substantial roots for bank stabilisation purposes.

4.1 Identification and Protection of Environmentally Sensitive Areas

The on-site Environmental Control Officer and/or Rehabilitation Specialist should be fully aware of the scale and extent of the rehabilitation operations. No further vegetation clearing, levelling, excavation, topsoil removal or plant material removal is to be permitted without prior consent from the ECO and Rehabilitation Specialist based on the rehabilitation plan for the site unless instructed by them. Care must be taken during rehabilitation to avoid the natural drainage areas adjacent to the construction site. No vegetation clearance, topsoil collection or movement of machinery and vehicles should be allowed here as to keep the ecological integrity of the drainage areas and banks intact.

4.2 Comprehensive Photographic Record

For practical and attainable rehabilitation goals to be defined, it is recommended that a comprehensive photographic record of the entire property be created. Video footage may also be useful in compiling such a record. A photographic record of the entire property should be kept as it could become a very valuable tool for the Rehabilitation Works in future. The photographic record should include photographs of the site before development, during the construction phase and during rehabilitation activities.

Photographs must be taken of the site before construction commences and must be kept as a data base. Points from where photographs are taken must be recorded and coordinates be detailed for future reference. Photographs should be taken on the same dates, each year at the same time of day. (E.g., 1 February, 1 July and 1 December at 8:00 in the morning). This would serve as the basis for rehabilitation requirements during the actual rehabilitation process, informing decisions on drainage, soil shaping, levels, plant choices and rehabilitation in general. It can also serve as a verification report to authorities and land administrators regarding the legislative processes, sustainable approach and progressive improvement.

4.3 Search and Rescue Activities

Search and Rescue activities must be initiated as part of the rehabilitation process. Where rehabilitation actions will commence, viable, transplantable plant species can be identified by the ECO Rehabilitation Specialist, removed and stored in a potential ‘on-site’, self-sustaining nursery, to be re-used in rehabilitation activities in future.

Plant material that is to be “rescued” must be potted up into bags utilising local soil obtained from the previously stored topsoil heap. Adequate root systems per plant material type must be carefully excavated and retained for plant material to remain viable. Search and Rescue activities would include the removal of grass clumps, smaller transplantable shrubs and trees and endangered species such as geophytes and succulents should be placed into bags using local soil.

Animals like small mammals, reptiles and birds encountered during rehabilitation must be captured or moved by a specialist and released in a safe area. No animals may be poached at the property or adjacent areas. Many animals are protected by law and poaching, or other interference could result in a fine or jail term.

4.4 Cleared Indigenous Plant Material

Where construction or rehabilitation activities are to commence in a specific area, certain indigenous plant material from the construction footprint area could be collected and bagged to be used in re-vegetation or as mulch during rehabilitation. To protect drainage areas and small streams as well as erosion prone areas, encroachers such as sickle bush could be cut and used to “brush pack” these problem areas to protect it. This will also restrict movement of animals and humans over sensitive erosion probe areas until pioneer vegetation has established.

4.5 Removal of Overburden

Removal of Overburden (or spoil material) means the total removal of soil and rock material from the site up to natural surrounding ground level. Overburden may be used to backfill excavated areas. Where overburden remains after backfilling excavated areas to natural ground level, this needs to be transported off-site by the contractor to a location approved by the Engineers.

In addition to the removal of excess rock and soil from the site, all other construction-related materials (bricks, concrete, steel rods, machinery etc.) also must be taken off-site after cessation of construction activities.

4.6 Stormwater Management: The Sustainable Drainage System

Stormwater management objectives should include the following:

- Minimise the Threat of Flooding: This remains a key objective of any stormwater management system. However, the challenge when contemplating design of stormwater management systems is to consider the following:
    - To mimic pre-development responses to storms
    - To reduce the volume of runoff by promoting infiltration
    - To reduce the peak flows and increase the time-to-peak through detaining the runoff and releasing it at a gradual rate.
    - Where necessary, to construct means to contain flood waters and safely convey them out of the urban area.
- Protection of Receiving Water Bodies, which include the following:
    - Rivers / streams.
    - Groundwater.
    - Wetlands.

A “receiving water body” is not necessarily the system into which stormwater is discharged directly but can also be a natural system located further downstream in the catchment. Every endeavour should be made to achieve the following:

- Maintain natural flow regimes and seasonality.
- Prevent deterioration in water quality.
- Prevent erosion or sedimentation of natural wetlands or rivers.
- Preserve natural river channels, wetlands and vegetation, and preclude engineering interventions that may alter their physical and ecological characteristics.

The need to design appropriate stormwater management systems at the dam overflow should be an opportunity to preserve or, if possible, improve natural freshwater ecosystems that have suffered degradation because of past activities, and in some cases, to create additional freshwater habitats that will contribute to the availability of appropriate, high-quality river and wetland habitat that mimics the natural condition.

- Promote Multi-Functional Use of Stormwater Management Systems: Resources such as land and water are becoming increasingly scarce and multiple use of these must be strived for. Stormwater systems provide a wide range of opportunities for multi-functionality.
- Development of Sustainable Environments: Developers should think beyond their short-term involvement with the project and consider the sustainability of the stormwater management system that is to be implemented. All relevant factors that will impact on future operation and maintenance should be considered. Maintenance requirements should be minimised as far as possible to maximise the available local authority funding, personnel and equipment. Responsibilities for maintenance must be resolved with the relevant local authority department at an early stage of the design. The possibility of developing public/private partnerships should be explored with local authorities (e.g., division of funding of capital versus maintenance costs between public and private sectors). Environmental policies such as promoting the use of locally indigenous vegetation in planting programmes will also reduce the long-term maintenance requirements of the development.

4.7 Compaction Rehabilitation Measures (ripping and / or scarifying)

Soil compaction, especially where construction vehicles operate, is often an effect of high traffic areas on development sites. It can become a major problem and can be recognized by:

- Excess surface moisture and slow drying soils due to deeper compaction preventing the percolation of water through the soil profile.
- Water runoff due to surface compaction preventing penetration and absorption (ponding of water), especially on banks and sloping surfaces.
- Large clear or sparsely covered areas devoid of a good vegetative cover due to hardened topsoil layers.

Ripping and / or scarifying mean the loosening of compacted soils by hand or appropriate machinery. The removal of overburden by excavator will loosen some of the upper compacted soils to some degree. Soils are to be loosened to a depth not less than 500mm. Slope angles should not exceed 18º incline angles (unless where specifically required in which case slope stabilization methods must be implemented). Re-shaped land must resemble the pre-construction landscape as closely as possible. Ripping/Scarifying should preferably be done before the rainy season. Do not rip and/or scarify areas under wet conditions, as the soil will not loosen. Compacted soil can also be decompacted by "Rotary Decompactors" to effectively aerate soils for vegetation establishment.

4.8 Erosion control and rehabilitation

Erosion control will need to be undertaken to ensure the successful landscape and rehabilitation of the site. Specific soil management practices need to be implemented to prevent erosion and sedimentation as stipulated below:

4.8.1 Erosion prevention

During the construction phase, clearing of the site will leave soil exposed and can cause erosion. The following list provides a guide to preventing erosion on construction sites:

- Programming: Install erosion control measures before construction commences. Schedule construction activities to minimize land disturbance.
- Land clearing: minimize the extent and duration of land clearing.
- Stormwater and run-off systems: install temporary drains and minimize concentrated water flows. Control stormwater velocity where necessary with temporary energy dissipater structures. Divert run-off around trench excavations or disturbed areas.
- Rehabilitation: revegetate or stabilize all disturbed areas as soon as possible. Indigenous trees can be planted in the buffer zone of the proposed development to enhance the aesthetic value of the site and stabilize soil conditions.
- Services: coordinate the provision of site services to minimize disturbance.
- Stockpiles: locate stockpiles away from concentrated flows and divert run-off around them.

4.8.2 Prevention of sedimentation

Erosion is likely to occur on site, with sediment export being an inevitable risk. Measures must be employed to capture sediment and reduce the amount of sediment that leaves the site. The generation of dust, litter and debris need to be minimized. A regular site maintenance schedule needs to be introduced. Sediment control devices need to be installed to capture mobilized sediment. The following sediment control devices are suggested:

- Grass filter strips: it encourages sediment to settle as water passes over a vegetated area.
- Sediment filters: use materials such as fine mesh or geo-fabric to filter run-off prior to discharge.
- Sediment traps: temporary sedimentation basins.
- Drop inlet filters: e.g., hay bales and silt fences, which prevent sediment entry into the drainage system.

4.9 Pollution prevention

Stored material that has been poorly located or left unprotected can be a source of pollutants. The following measures need to be taken to prevent pollution to the soils and water resources in the larger area:

- Stockpile location: locate stockpiles and material storage 30m or more away from drainage lines and identified riparian zone habitat.
- Stockpile construction: minimize the number and size of stockpiles. Construct stockpiles with a height to width ratio of less than 2:1. Surround unstabilised stockpiles and batters with silt fences or drainage systems that will collect and treat uncontaminated water.
- Stockpile maintenance: cover any stored material to protect it from rainfall.
- All stockpile areas should be rehabilitated after construction phase has concluded.

4.10 Littering prevention

Uncontrolled littering can be a source of pollution. The following measures need to be taken to mitigate against littering:

- Litter storage and housekeeping: maintain a high standard of housekeeping. Store all litter carefully so it cannot be washed or blown into stormwater drainage systems.
- Rubbish bins: provide bins for construction workers and staff at appropriate locations, particularly where food is consumed and at drop off and pick up points.

- Daily site clean-up: clean-up site of all litter daily.
- Rubbish disposal: dispose of scrap materials (*e.g.*, off-cuts and scrap machinery components) in a responsible manner.

4.11 Building activity associated impacts.

Dust concrete, solvents, steel fillings, fuel and other wastes are all produced during building construction and can cause impacts to the riparian zones. Take the following mitigation measures:

- Materials storage: store building materials under cover or contained areas.
- Site cleaning: clean the repair or construction site daily. Do not use water for cleaning the site.
- Leakage containment and treatment: ensure that oil, fuel or solvent leakages cannot enter the stormwater system.
- Temporary filters: fit temporary inlet pit filters near wash-down areas to prevent pollutant entry into the drainage system.

4.12 Plant species management principles

4.12.1 Re-vegetation

Revegetation is the process of vegetation establishment and care, as part of the process of reclamation, rehabilitation, or restoration. The biggest challenge of rehabilitation is to establish a sustainable ecosystem that is self-productive and able to survive without continued anthropogenic interventions (irrigation, fertilization, or re-seeding). After the construction on a landscape has ceased, processes of self-restoration are often slow (decades), and the final community of plants may not be the most desirable. Re-vegetation may be achieved by three main techniques, namely planting of trees and shrubs, direct seeding, or by self-regeneration.

Topsoil must be used wisely to achieve successful re-vegetation. Analysing the chemical properties of the soil can be helpful in directing possible soil amendments and guiding species selection. A well-prepared site will provide the most suitable conditions for plant germination, survival and long-term re-vegetation success.

Plant species that have been rescued or removed and relocated to the temporary nursery could be used in replanting rehabilitation areas. Additional plant material (indigenous trees) as required should be sourced from local indigenous nurseries and specifications regarding plant sizes, heights and the installation process of these plants should be developed by the On-Site ECO and Rehabilitation Specialist. Standard horticultural best practice would apply, with specific reference to the fact that

the plant material would have to be in good condition, free from pests and diseases (any such plant would have to be removed from the site), well-formed and well rooted, potting materials are weed free and with sufficient root cover. Groundcovers and sedges are often supplied in trays, and the same standards would apply.

- A grass seed specification for reseeding the rehabilitated areas is included in Section 5. Re-grassing should be undertaken (as far as possible) during the summer months, as germination and establishment is best at this time of year. Spring rains are also conducive to good germination results, and as such rehabilitation programmes should take these factors into consideration.
- There are two methods for seeding, hand broadcasting and hydroseeding. The methods utilised will be site specific and the On-Site ECO and Rehabilitation Specialist will determine them.
- In certain areas grass runners may be required, and grass sods where instant cover is necessary.

Re-vegetation (grassing) should occur immediately after topsoil reinstatement. Seeding on site can be done by hand. The contractor must follow up, monthly until such time as 80% success of vegetation cover has been achieved.

4.12.2 Plant species management

The following general management measures and guidelines should be implemented during the development:

- Vegetation removal should be kept to a minimum during any future construction activities and only vegetation on the footprint areas should be removed. The unnecessary impact on the surrounding vegetation types and agricultural land should be avoided as far as possible.
- Vegetation to be removed as it becomes necessary rather than removal of all vegetation throughout the site in one step.
- No vegetation to be used for firewood.
- All-natural areas impacted during construction must be rehabilitated with locally indigenous plant species.
- Construction areas must be well demarcated.
- The few taller than 3m indigenous trees along the proposed site provide resting/perching sites for larger birds like vultures, birds of prey, arboreal reptiles and mammals that might occur/pass through the area and must be preserved. The larger trees should be protected as far as possible and be incorporated as part of the landscaping in the area.

- Limit pesticide use to non-persistent, immobile pesticides. Apply in accordance with label and application permit directions.
- When possible, construction activities and excavation activities should be scheduled for the low rainfall season (winter).
- The developer should advise the construction team in all relevant matters to ensure minimum destruction and damage to the environment. The developer should enforce any measures that he/she deem necessary. Regular environmental training must be provided to construction workers.

4.12.3 Control of alien invasive plant species (AIS)

The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) holds landowners legally responsible for the control of invasive alien plants on their properties.

Control involves killing the plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion. Weeds and invader plants will be controlled in the manner prescribed for that category by the Conservation of Agricultural Resources Act or in terms of Working for Water guidelines. Goals for addressing the problem of Invasive Alien Species (IAS) on the construction site should include:

- Prevention: Keeping an IAS from being introduced onto the ecosystem. Ideally, this usually means keeping alien plants from entering the site.
- Early detection: Locating IAS before they have a chance to establish and spread. This usually requires effective, site-based inventory and monitoring programmes.
- Eradication: Killing the entire population of IAS. Typically, this can only be accomplished when the organisms are detected early.
- Control: The process of long-term management of the IAS' population size and distribution when eradication is no longer feasible.

Weed control begins with preventing their spread. Ensure that rehabilitation works do not contribute to the distribution of weeds by:

- Limit soil disturbance to minimise the exposure of bare ground.
- Use mulches and establish plant growth as quickly as possible to protect bare ground.
- Avoiding the importation or movement of soils or plant matter that could contain weed seeds, for example using straw mulch.

- Avoid re-using weed infested topsoil if possible.
- Ensure all materials and equipment are clean and weed free. This means that equipment must be washed when it is moved from one site to another, and between different parts of a site if weeds grow in one part of the site. This is important for trenching operations, to ensure weeds are not spread along the length of a trench.
- Use fertilisers conservatively to avoid creating the conditions for weed establishment by over-fertilising.

Scientists and field workers use a range of methods to control invasive alien plants. These include (Appendix A):

- Mechanical methods - felling, removing, or burning invading alien plants.
- Chemical methods - using environmentally safe herbicides.
- Biological control - using species-specific insects and diseases from the alien plant's country of origin. To date 76 bio-control agents have been released in South Africa against 40 weed species.
- Integrated control - combinations of the above three approaches. Often an integrated approach is required to prevent enormous impacts.

The following basic principles apply to the control of AIS on the proposed development site during the rehabilitation process:

- The Contractor is responsible for the control of weeds and invader plants within the construction site for the duration of the construction phase. Alien invasive tree species and weeds should be eradicated.
- Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented.
- Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish.
- Institute a monitoring programme to detect alien invasive species early before they become established. In the case of weeds, before seeds are released.
- During site visits several exotic weeds have established on site. These invasive plants should be monitored and eradicated as soon as they appear on the property.

4.13 Fire Hazard

Wildfires can be started by people and acts of nature and are often associated with slash and burn activities, which in times of drought, can pose great hazards and negligence often plays a major role. Factors affecting the impact of vegetation fire hazards are:

- Vegetation dryness (moisture content and amount of living vegetation).
- Changes in weather variables that influence spread and intensity of fires.
- Availability of combustibles; and
- Long term drought in the dry season.

The following management guidelines should be implemented on the site:

- The grass cover along the boundary fences of the adjacent properties should be kept short (30 cm) to minimise the fire hazards.
- Adequate precautions must be taken to ensure fires are not started on-site.
- Do not permit any fires or open flames anywhere on the site, except at designated areas.
- Cleared vegetation must not be burned on the site.

4.14 Fauna

- Rehabilitation should be done to ensure that fauna which occurred around the solar farm return to the area after rehabilitation.
- If pesticides or herbicides are used, products should be chosen responsibly. Storage, administering and disposal must be done according to prescribed methods. Pollution of drainage channels must be prevented.
- Restoration/rehabilitation actions will need the implementation of a faunal monitoring program. It will serve as a barometer for management to recognise positive changes and trends in biodiversity of the development area during and after closure.
- The objectives of such a programme may include:
    - Assessment of future improvement/deterioration of the faunal biodiversity of the area (thus a measure of success of environmental management).
    - Increase accuracy of present status determination (actual species present vs. expected species) of area with every survey.
    - Determination of both temporal and spatial trends in faunal biodiversity on the area.

    - Assist in future management of area by providing recommendations and guidelines regarding future activities and rehabilitation.

- Biodiversity management actions during closure should include controlling and monitoring of numbers of alien invasive fauna numbers by eradication, habitat modification, resource limitation and public education.
- Young nutrient rich growth may entice herbivores to rehabilitated areas. The increased grazing pressure may decrease the rate of rehabilitation. Herbivore-proof fencing or brush packing may be required around the rehabilitation zones in the early stages to protect seedlings from grazers if grazing pressure is found to significantly affect growth.
- Revegetation programs will include consideration of the possibility of reconstructing fauna habitats. Old salvage logs from cleared areas will be replaced after construction where possible, to provide habitat for fauna.
- Key fauna species will be identified and targeted for re-colonisation where appropriate. Edible seed-bearing plants, perennial grasses and sedges may be seeded or planted to encourage re-colonisation by fauna.

5 REHABILITATION AREAS AND SITE SPECIFICATIONS

5.1 General

From the previous specialist assessments for the solar parks, some general guidelines for the rehabilitation sites are recommended. Management of stormwater runoff from the development is critical to maintaining the integrity of the rehabilitated system. An increase in hardened surfaces from the surrounding areas, will not only increase the potential volume of water entering the riparian zone but also decrease the time taken for this accumulated flow to reach the system. The increase velocity and volume of water has a far greater capacity to erode and damage the riparian zone and channel banks of the site.

The design and construction of the solar plants should aim to meet the following criteria to ensure the on-going ecological integrity of the ecosystem in the vicinity of the infrastructure construction.

5.2 Site specific measures

- Ensure that all current activities consider the development site boundaries. No vehicles are to enter or drive through any areas not demarcated for the development unnecessarily.
- Demarcate all development boundaries with pegs and danger tape.
- Edge effects of pre-construction and construction activities, including erosion, sedimentation, and alien/weed control, need to be strictly managed.
- Stormwater on site should be addressed in a detailed stormwater management plan compiled by a hydrological engineer.

5.3 Surface Rehabilitation

- All disturbed surface areas will be re-shaped to resemble the surrounding natural topography. Surfaces will be ripped / scarified, and re-vegetated with indigenous grass species. The grass species to be used is stipulated in this document as part of the plant species plan.
- As far, as is practical, implement concurrent rehabilitation processes to limit degradation of soil biota.
- Terrestrial invasive removal programs must be maintained throughout the proposed development as well as in the aftercare and maintenance phases.
- The ripped areas should be revegetated with grass species according to the seeding specification.

5.4 Spoil Areas

Soil material at the spoil areas will be used in the re-shaping of disturbed areas. All other excess material such as building material will be moved off site to natural ground level. Where required, topsoil will be reinstated prior to re-vegetation of these areas with natural grass species as specified.

5.5 Construction site management

The following guidelines should be implemented as part of the rehabilitation process, during construction:

- The construction footprint width must be kept to a minimum.
- A sequential construction strategy will be followed, i.e.
    - Construction will be immediately followed by rehabilitation.
    - Soils must be replaced in same sequence as excavated.
- Soil surfaces will not be left open for lengthy periods to prevent erosion.
- Storm water management measures will be implemented.
- Appropriate erosion and sediment control measures should be implemented.
- Vegetation and soil should be retained if possible and should be removed immediately ahead of construction/earthworks in a specific area.
- Remove only the vegetation where essential for the continuation of construction. Do not allow any disturbance to the adjoining natural vegetation cover or soils.
- Any alien invasive plants that have grown up on disturbed areas are to be removed before reinstating topsoil.
- Compacted areas (including temporary access tracks) are to be ripped/scarified (along contour) to a depth of 150 mm prior to the replacement of topsoil.
- Ensure that no unnatural depressions remain that could act as channels for preferential water flow.
- Monitor site for signs of erosion and take remedial action where problems occur.
- Planting/grassing is required where cleared areas require stabilization and/or erosion protection or if topsoil replacement was inadequate for natural regrowth.
- Planting shall, as far as possible, utilize indigenous species common to the area (e.g., *Cynodon dactylon*) by means of sodding, planting of runners or seeding.
- The Contractor must ensure that all structures, equipment, materials, and facilities used or created on site for or during construction activities are removed once the project has been completed. The surface will be ripped / scarified; topsoil reinstated and re-vegetated with grass species as specified.

5.6 PLANT SPECIES PLAN

5.6.1 Search and Rescue Activities

Search and Rescue activities could be initiated as part of the rehabilitation process. Where rehabilitation actions will commence, viable, transplantable plant species must be identified by an ECO/Rehabilitation Specialist, removed, and stored in an 'on-site', self-sustaining nursery, to be re-used in rehabilitation activities in future.

Plant material that is to be "rescued" must be potted into bags utilising local soil obtained from the previously stored topsoil heap. Adequate root systems per plant material type must be carefully excavated and retained for plant material to remain viable. Search and Rescue activities would include the removal of grass clumps, smaller transplantable shrubs and trees and endangered species such as geophytes and succulents should be placed into bags using local soil.

5.6.2 Cleared Indigenous Plant Material

Where construction or rehabilitation activities are to commence in a specific area, certain indigenous plant material from the construction footprint area could be collected and bagged to be used in re-vegetation or as mulch during rehabilitation. To protect erosion prone areas, encroachers such as sickle bush could be cut and used to "brush pack" these problem areas to protect it. This will also restrict movement of animals and humans over sensitive erosion probe areas until pioneer vegetation has established.

5.6.3 Re-vegetation

Revegetation is the process of vegetation establishment and care, as part of the process of reclamation, rehabilitation or restoration. The biggest challenge of rehabilitation is to establish a sustainable ecosystem that is self-productive and able to survive without continued anthropogenic interventions (irrigation, fertilization or re-seeding). After the construction on a landscape has ceased, processes of self-restoration are often slow (decades), and the final community of plants may not be the most desirable. Re-vegetation may be achieved by three main techniques, namely planting of trees and shrubs, direct seeding, or by self-regeneration. Topsoil must be used wisely to achieve successful re-vegetation. Analysing the chemical properties of the soil can be helpful in directing possible soil amendments and guiding species selection. A well-prepared site will provide the most suitable conditions for plant germination, survival and will promote long-term re-vegetation success.

Plant species that have been rescued or removed and relocated to the temporary nursery could be used in replanting rehabilitation areas. Additional plant material (indigenous trees) as required should be sourced from local indigenous nurseries and specifications regarding plant sizes, heights and the installation process of these plants should be developed by the On-Site ECO and Rehabilitation Specialist. Standard horticultural best practice would apply, with specific reference to the fact that the plant material would have to be in good condition, free from pests and diseases (any such plant would have to be removed from the site), well-formed and well rooted, potting materials are weed free and with sufficient root cover. Groundcovers and sedges are often supplied in trays, and the same standards would apply.

- A grass seed specification for reseeding the rehabilitated areas is included below. Re-grassing should be undertaken (as far as possible) during the summer months, as germination and establishment is best at this time of year. Spring rains are also conducive to good germination results, and as such rehabilitation programmes should take these factors into consideration.
- There are two methods for seeding, hand broadcasting and hydroseeding. The methods utilised will be site specific and the On-Site ECO and Rehabilitation Specialist will determine them.
- In certain areas grass runners may be required, and grass sods where instant cover is necessary.
- A typical grass seed mixture (hand sowing) that could be implemented for rehabilitation activities will include: (specification 4-5kg/ha).

    - *Eragrostis tef* (Tef).
    - *Eragrostis curvula* (Weeping Love Grass).
    - *Digitaria eriantha* (Smutsvinger).
    - *Cynodon* spp. (Bermuda kweek).
    - *Panicum maximum* (Witbuffel).
    - *Chloris gayana* (Rhodes grass)
    - *Paspalum notatum* (Bahia Grass).

Re-vegetation (grassing) should occur immediately after topsoil reinstatement. Seeding on the site can in most cases be done by hand. The contractor is to guarantee a success rate of 80% for all re-seeded areas and follow up will be conducted monthly until such time as 80% success of vegetation cover has been achieved.

5.6.4 Control of alien invasive plant species (AIS)

The following basic principles apply to the control of AIS on the development site during the rehabilitation process:

- The Contractor is responsible for the control of weeds and invader plants within the construction site for the duration of the construction phase. Alien invasive tree species and weeds should be eradicated.
- Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented.
- Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish.
- Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds.

6 MAINTENANCE AND MONITORING

Several methods exist to monitor rehabilitated areas to scientifically prove that a self-sustainable ecosystem has developed or show a positive trend towards successful rehabilitation. This will prove that environmental degradation and biological diversity have been mitigated and restored where it has been negatively impacted upon. The important aspect to keep in mind is that it is not only a visual inspection, but measurable information gathering *e.g*., water samples, soil samples, vegetation diversity, biomass, basal cover, species composition etc. The monitoring data must be of such a standard that meaningful conclusions can be made, and a trend indicated. Good record keeping is essential. All illegal invader plants and weeds shall be eradicated as required in terms of Sections 119 to 126 of The National Environmental Management Act, 1998 (Act No. 107 of 1998).

Monitoring should take place on regular time intervals to establish if the revegetation strategy was successful. The site must be monitored for at least two years (bi-annually) to observe any possible invasion by alien species and, if they appear, they must be controlled as is appropriate. Also, to monitor and correct possible erosion, storm water and siltation problems. Soil sampling and analysis should be done every two years to monitor the development of the soil and need for supplementary fertilization.

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APPENDIX A. PLANT SPECIES LISTS FOR SITE

Vegetation units
Woody species
Vachellia erioloba
Asparagus laricinus
Diospyros lycioides
Ehretia rigida
Grewia flava
Hermbstaedtia linearis
Ozoroa sphaerocarpa
Searsia lancea
Searsia pyroides
Grasses
Aristida congesta
Aristida junciformis
Aristida scabrivalis
Brachiaria nigropedata
Brachiaria serrata
Cymbopogon excavatus
Elionorus muticus
Eragrostis biflora
Eragrostis chloromelas
Hyparrhenia hirta
Loudetia flavida
Melinis repens
Pogonarthria squarrosa
Schizachyrium jeffreysii
Sporobolus iocladus
Themeda triandra
Trachypogon spicatus
Trichoneura grandiglumis
Triraphis andropogonoides
Tristachys leucothrix
Dwarf shrubs, forbs & succulents
Achyranthes aspera
Athrixia elata
Berkheya onopordifolia
Boophane distycha
Bulbostylis burchellii
Chamaechrista comosa
Cichorium intybus
Cleome maculata
Commelina africana
Conyza bonariensis
Dicerocarium eriocarpum
Dicoma anomala
Elephanthorhiza elephanthina

Vegetation units
Gnidia capitata
Gomphrena celasoides
Haplocarpa scaposa
Helichrysum cerastoides
Helichrysum kraussii
Hermbstaedtia odorata
Hypoxis iridifolia
Hypoxis rigidula
Indigofera cryptantha
Ipomoea omnaeyi
Lantana rugosa
Ledebouria revoluta
Nidorella hottentotta
Oxalis depressa
Parinari capensis
Rhynchosia monophylla
Salvia runcinnata
Scabiosa columbaria
Scilla natalensis
Senecio inornatus
Solanum incanum
Solanum panduriforme
Tephrosia filipes
Triumfetta sonderi
Wahlenbergia caledonica
Walafrida densiflora
Zinnia peruviana