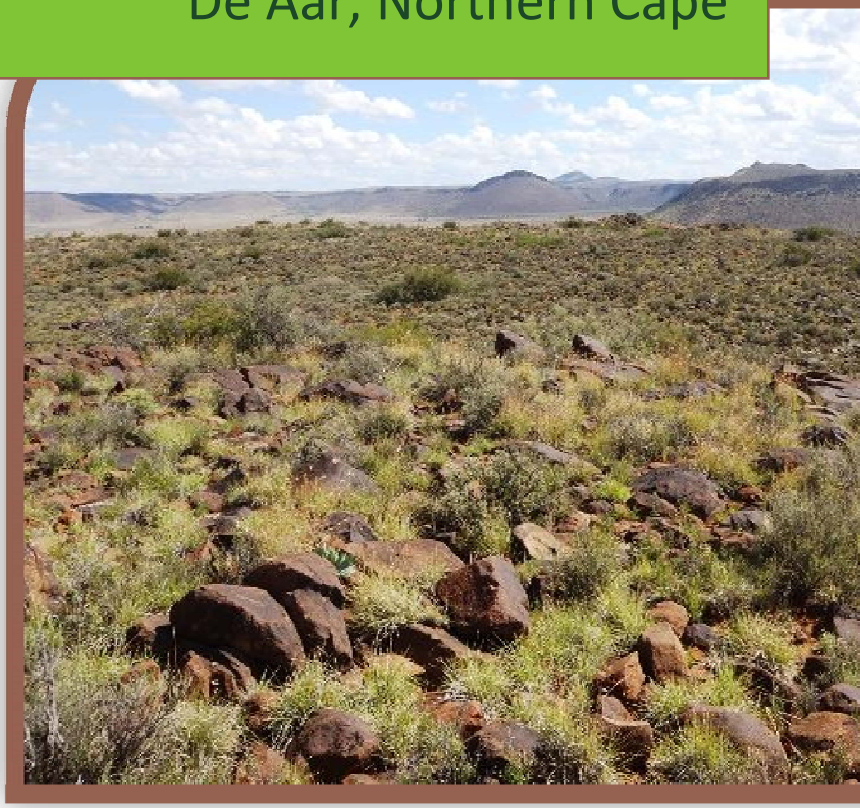
Appendix 9
Plant Rescue Plan

PLANT RESCUE PLAN

Longyuan Mulilo Maanhaarberg Wind Energy Facility, De Aar, Northern Cape



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Executive Summary

This document provides a management plan for the rescue of listed plants for the Longyuan Mulilo Maanhaarberg Wind Energy Facility, De Aar, Northern Cape.

The first section provides a summary of the Acts that apply to listing of plants on site. It also provides a summary of the approach used for listing threatened plants in South Africa and responsible people are explained.

The next section provides a list of all the species of concern that have been recorded to date on site, followed by images and information on each species found on site so that they may be easily identified in the field by the parties responsible for implementing the rescue plan.

Conservation principles for the handling of species of conservation concern are outlined. This provides a framework for the actions required for transplanting rescued plants.

The next section provides detailed steps for the rescue and handling of listed plants. Responsible entities are also identified for each step.

The final section gives an outline of monitoring requirements for determining the success of the plant rescue operation.

Contents

Overview

This document presents the Plant Rescue Plan for the authorised Longyuan Mulilo Maanhaarberg wind energy facility on the farms Smauspoort 130 and Zwartkopjes Portion 2 of 131 near De Aar, Northern Cape. The Environmental Impact Assessment (EIA) process for the authorized facility was undertaken by DJ Environmental Consultants. In accordance with the Environmental Authorisation (EA), a Plant Rescue Plan has been compiled and will be included in the EMPr.

Purpose of the Plant Rescue Plan

The purpose of the plant rescue plan is:

- provide guidance on search and rescue of species of conservation concern.

Legal framework

National Environmental Management: Biodiversity Act, 2004 (Act No.10 of 2004)

In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).
- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

Chapter 4 of the Act relates to threatened or protected ecosystems or species. According to Section 57 of the Act, "Restricted activities involving listed threatened or protected species":

- A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7.

Such activities include any that are “of a nature that may negatively impact on the survival of a listed threatened or protected species”.

National Forests Act (Act 84 of 1998)

Regulations published for the National Forests Act (Act 84 of 1998) as amended, provide a list of protected tree species for South Africa. According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that '*no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister*'.

Northern Cape Nature Conservation Act, No. 9 of 2009

This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. The Act provides lists of protected species for the Province. Of particular relevance to the current site are the species within the following families and genera: *Amaryllidaceae*, *Asclepiadaceae*, *Iridaceae*, *Aloe* except *Aloe ferox*, *Mesembryanthemaceae* and *Orchidaceae*. All species protected under the provincial legislation need to be specified on any clearing permit applications for the site.

Listing of Red and Orange List plant species

South Africa has adopted the IUCN Red List Categories and Criteria to provide an objective, rigorous, scientifically founded system to identify Red List species. A published list of the Red List species of South African plants (Raimondo et al. 2009) contains a list of all species that are considered to be at risk of extinction. This list is updated regularly to take new information into account, but these are not published in book/paper format. Updated assessments are provided on the SANBI website (http://redlist.sanbi.org/). According to the website of the Red List of Southern African Plants (http://redlist.sanbi.org/), the conservation status of plants indicated on the Red List of South African Plants Online represents the status of the species within South Africa's borders. The global conservation status, which is a result of the assessment of the entire global range of a species, can be found on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species: http://www.iucnredlist.org. The South African assessment is generally used for projects within the South African territory.

Historical occurrences of threatened plant species were obtained from the South African National Biodiversity Institute (http://posa.sanbi.org) for the quarter degree square/s within which the study area is situated. Habitat information for each species was obtained from various published sources. The probability of finding any of these species was then assessed by

comparing the habitat requirements with those habitats that were found, during the field survey of the site, to occur there.

Responsible persons

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

The Developer

This refers to the project proponent, Longyuan Mulilo De Aar Wind Power. 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.

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 plan, the engineer must be aware of the findings, mitigation measures and conclusions of the Final EIA report, the requirements of the EA, the EMPr, and this management plan.

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.

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.

Species of concern that occur on site

This section provides an outline of the existing status of the site with respect to the occurrence of any species of concern or any other plant species that are deemed worthy of rescue prior to construction. The purpose is to provide an indication of the identity of such species and their probable location on site.

Listed species observed on site

Two protected and/or listed plant species were encountered on site, sometimes within the footprint of proposed infrastructure and other times in nearby areas. These two species are as follows:

- Protected trees: the species, *Boscia albitrunca* (pictured above), was encountered in various places on site.
- Red / Orange List plant species: the species, *Boophone disticha*, listed as Declining, was encountered relatively regularly on site, in some places within the footprint of proposed infrastructure.
- Species protected according to Provincial Act: a number of succulent or geophyte plants were seen on site that are protected according to Northern Cape Nature Conservation Act, No. 9 of 2009, including *Aloe broomii*, *Stapelia olivacea*, *Adromischus trigynus*, *Stomatium* sp., *Haworthia* sp. and *Anacampseros albidiflora, Albuca setosa*, *Drimia intricata*, *Ornithogalum* sp. nov., *Kleinia longiflora*, *Pachypodium succulentum* and *Euphorbia caterviflora*.

Guide to species for rescue

This section provides images of species that are anticipated to require rescue to aid in the identification of such species on site.

Boscia albitrunca

Boophone disticha

Aloe broomii

Stomatium sp.

Stapelia olivacea

***Haworthia* sp.**

Adromischus trigynus

Conservation principles for species of conservation concern

This section provides some basic principles of conservation of species of conservation concern that may affect the removal of plants from the wild and the translocation of these plants into new suitable habitats.

Principles

- *In situ* conservation is preferable to *ex situ* conservation. Removing a population from its natural habitat and placing it under artificial conditions results in the erosion of the inherent genetic diversity and characteristics of that species.
- In order to ensure the persistence of a population, it is imperative that the ecological processes maintaining that population persist.
- Translocation of Red Data species is an unacceptable conservation measure since the translocated species may have undesirable ecological effects. For example, alterations to habitat by translocated species may be harmful to other species and translocations may lead to transmission of pathogens or parasites (Hodder & Bullock, 1997). Translocation may result in rapid changes in the species itself (Conant, 1988). Translocations are expensive and rarely successful (Griffith et al., 1989). Success entails not only survival of the translocated individuals but also establishment of a self-sustaining, viable population able to reproduce and adapt to changing environmental conditions (Milton et al., 1999).
- Suitable habitat adjacent to known populations of Red List plant species has a high probability of being colonized.

The implications of these principles are as follows:

- Rescued plants, if re-planted back in the wild, should be placed as close as possible to where they were originally removed.
- Re-planting into the wild must cause as little disturbance as possible to existing natural ecosystems.

Potential for relocation of plants

Plant relocation must take into account the principles of conservation set out in the next section of this report.

- *Boophone disticha* is a bulb and will readily transplant as will any of the other geophytes seen on site.
- Most of the succulent plants seen on site are small and will easily transplant.
- *Boscia albitrunca* is more difficult to transplant, but may be cultivated off-site using truncheons from removed plants. These can be used to some degree in rehabilitation efforts. Most trees and shrubs are not suitable for translocation on account of their deep rooting systems. The loss of these individuals must be accepted as an outcome of the development.

Plant rescue plan

This section provides details on the actions that are required to rescue any listed plant species from the path of development and what steps are to be taken to house them temporarily and then to place them back into suitable habitats.

Plant rescue activities required

Before construction commences at the site, the following actions must be taken:

Action	*Responsible person*
Initial identification of all listed species that may occur within the project area. This is largely covered in this report and in the walk-through survey report, but can be supplemented by observations on site by the ECO prior to construction.	Botanist / ECO
The footprint of proposed development must be marked out prior to breaking ground. (It is assumed that this will follow a phased approach and that not all areas will be marked simultaneously. An example would be pegging out the route of a section of road to be constructed prior to earth-moving equipment beginning work on construction. While this section is being developed, the survey team will be pegging out the next section of road.)	Contractor / Engineer / Developer
Identification of all listed species that may occur within marked out areas (within the footprint of proposed infrastructure). The pegged out area must be walked and any listed species recorded.	ECO / qualified botanist
Search and rescue operation of all listed species within the development footprint. For each individual plant that is rescued, the plant must be photographed before removal, tagged with a unique number or code and a latitude longitude position recorded using a hand-held GPS device. The plants must be planted into a container to be housed within a temporary nursery on site or immediately planted into the target habitat. If planted into natural habitat, the position must be marked to aid in future	Qualified botanist / horticulturalist

monitoring of that plant.	
Rescued plants housed in temporary nursery may be used in one of two ways: (1) transplanted into suitable natural habitats near to where they were rescued, or (2) used for replanting in rehabilitation areas. Receiver sites must be matched as closely as possible with the origin of the plants and, where possible, be placed as near as possible to where they originated.	ECO / qualified botanist
For the protected tree,* Boscia albitrunca*, if any individuals are to be destroyed, the following steps must be taken: one or more truncheons must be taken from the individual to be destroyed. These must be treated with growth hormone powder on the cut end and planted in a growth medium. Once established, these must be planted into rehabilitation areas close to the site where they were originally removed.	Horticulturalist
Any listed plants close to the development servitude that will remain in place must be marked clearly and may not be defaced, disturbed, destroyed or removed. They should be cordoned off with construction tape or similar barrier and marked as no-go areas.	ECO / qualified botanist
ECO to give permission to clear vegetation only once all search and rescue operations have been completed.	ECO
The ECO should monitor construction activities in sensitive habitats to ensure that impacts within these areas are kept to a minimum.	ECO
The collecting of plants by unauthorized persons should be prevented and signs stating so should be placed at the entrance to the site.	Developer

Monitoring requirements

The following monitoring activities are recommended as part of the plant rescue plan:

- Preconstruction walk-through survey to list the identity and location of all listed and protected species. This walk-through survey has already been undertaken. The report provides an indication of the number of individuals of each listed species that are likely to be impacted by the proposed development. Subsequent changes to infrastructure positions results in areas that have not been properly searched and it is unknown whether these areas will impact upon listed species or not.
- Construction phase monitoring by the ECO to determine whether any listed species will be affected and provide a full account of the number of individuals of each species that are affected.
- Post-construction monitoring of plants relocated during search and rescue to evaluate whether the intervention was successful or not. This should be undertaken on a three-monthly basis for two years after transplanting in order to evaluate the success thereof.

References / further reading

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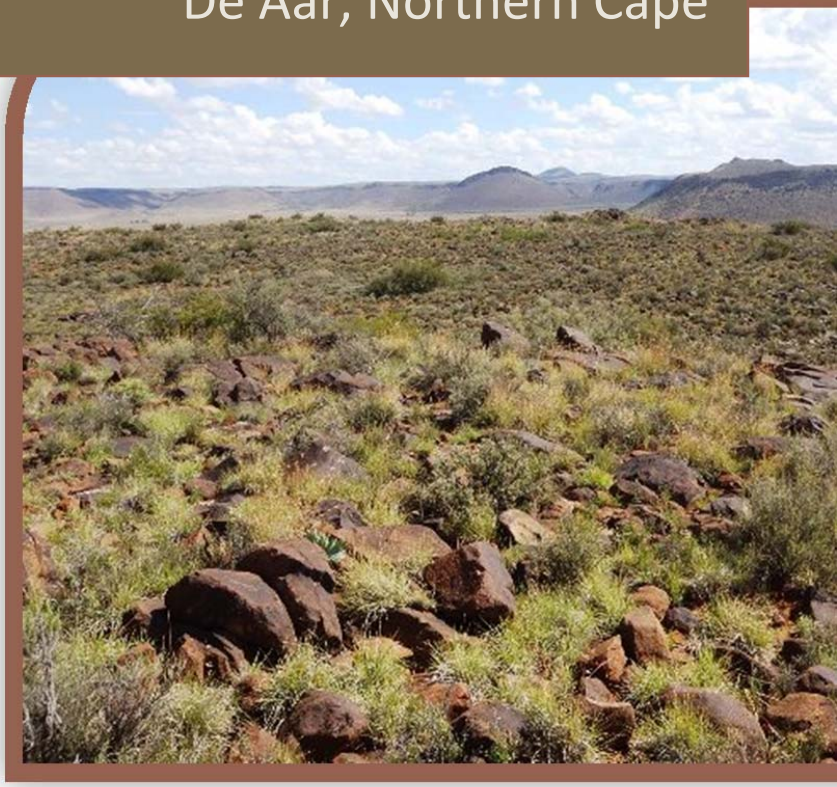
Appendix 10
Vegetation Rehabilitation Plan

VEGETATION REHABILITATION PLAN

Longyuan Mulilo Maanhaarberg Wind Energy Facility, De Aar, Northern Cape



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Executive Summary

This document provides a rehabilitation management plan for the vegetation of the Longyuan Mulilo Maanhaarberg Wind Energy Facility, De Aar, Northern Cape.

The first section provides a summary of the purpose of the document and the people responsible for implementing it.

The next section provides a summary of the project components and the likely rehabilitation implications for each component.

The next section provides a summary of the current status of the vegetation on site, including which habitats are considered to be sensitive. This is followed by a discussion of potential constraints to successful rehabilitation on site.

The next section provides a rehabilitation implementation strategy, including steps such as identifying sensitive habitats, compiling a photographic record of current conditions, search and rescue activities, use of cleared plant material, seeding requirements and some general considerations.

The next section 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.

A rehabilitation programme is provided in the next section for different phases of the project.

The last section gives an outline of monitoring requirements for determining the success of the rehabilitation programme.

Contents

Overview

This document presents the Vegetation Rehabilitation Plan for the approved Longyuan Mulilo Maanhaarberg wind energy facility on the farms Smauspoort 130 and Zwartkopjes Portion 2 of 131 near De Aar, Northern Cape. The Environmental Impact Assessment (EIA) process for the approved facility was undertaken by DJ Environmental Consultants.. In accordance with the Environmental Authorisation (EA), a Vegetation Rehabilitation Plan has been compiled and will be included in the EMPr.

Purpose of the Vegetation Rehabilitation Plan

The site contains natural vegetation with biodiversity value and is currently used for live-stock grazing purposes. The purpose of the vegetation rehabilitation plan is to ensure that any areas that were cleared of vegetation or that were impacted in some way by construction activities on site are rehabilitated in such a way as to achieve the following:

- re-establish vegetation cover with suitable plant species so that remaining biodiversity features and prior land-use options are not compromised,
- reduce the risk of soil erosion in order to achieve long-term stability of the landscape,
- restore some ecosystem function to areas that are to be rehabilitated.

Responsible persons

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

The Developer

This refers to the project proponent, Longyuan Mulilo De Aar Wind Power. They will be responsible for the following:

1. Ensure that the requirements set out in this rehabilitation 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.

The Engineer

The engineer of the proposed development will be responsible for the overall implementation of the rehabilitation 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 rehabilitation plan.

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 rehabilitation plan.

The Contractor

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

Proposed activities on site

This section provides an outline of the proposed activities on site in terms of the likely impacts expected from different project components. The purpose is to provide an indication of the type of rehabilitation activities that will be required.

Project components

The main infrastructure components to be constructed are as follows (see Figure on next page):

1. internal access roads,
2. turbine foundations,
3. crane pads,
4. construction yards,
5. overhead power lines,
6. substations.

Each of these are anticipated to have different types of impacts on natural vegetation and will require different rehabilitation efforts.

Internal access roads

Approximately 56.4 km of new roads are expected to be constructed. The running width of this is expected to be a minimum of 4 m, but the overall loss of vegetation will be wider than this to accommodate slope-offs to the road body, road-side drainage and cut-and-fill areas. Upon completion of construction, there will be an area of disturbance adjacent to the roads on both sides that will require re-vegetation. It is estimated that approximately 1 ha per kilometer of road will require rehabilitation.

The internal roads will include thirteen watercourse crossings, where culverts will be used to allow water-flow under the new road surface.

Turbine foundations

This will consist of a solid cement foundation of circular shape with a radius of 16 m and a foundation foot of 201m^2. This structure will be permanent. The turbine foundation will be

surrounded by the crane pad, so no specific post-construction rehabilitation will be required for the turbine foundation.

Crane pads

Crane pads will be levelled at each turbine site. The proposed dimensions are approximately 50 x 50 m and the maximum height difference across the width / length of the crane pad is 0.75m. This means that, due to the steep topography at the location of many of the turbine positions, a lot of cut and fill may be required to produce a crane pad of the required dimensions. It is likely that there will be a significant area around the crane pads that will be damaged by the required cut and fill and that this area may be significantly steep.

Construction yards

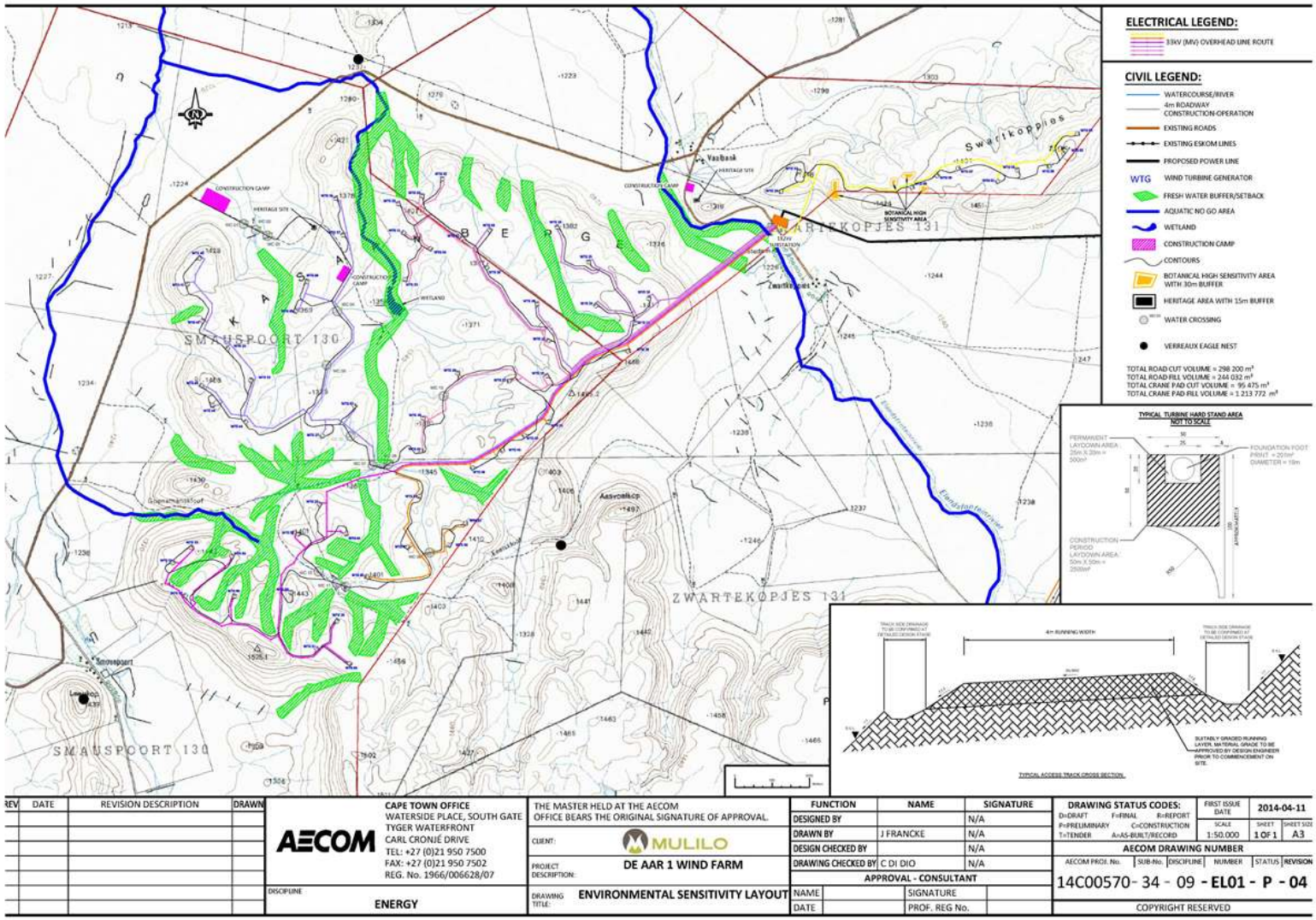
Three construction yards will be required that will contain staff welfare facilities, storage facilities, general stores and skips. It is anticipated that the required area to be cleared will be according to space requirements only and that no additional area will be cleared. It is therefore not expected that the area surrounding the construction yards will be significantly affected and that only minor rehabilitation will be required in these areas. However, disturbance associated with these areas is likely to persist for a long period of time.

Overhead power lines

These will consist of pole structures at regular intervals that are aligned reasonably close to the proposed road network. Disturbance associated with the construction of the overhead power lines will be largely restricted to the base around each pole structure. This will be relatively limited in extent.

Substation

A single site is required for the substation / control building, which will also have an Eskom switching / metering station adjacent to it. This area will be permanently cleared, but only to the extent required for the infrastructure thereon. It is therefore not expected that the area surrounding the substation / control building and switching / metering station will be significantly affected and that only minor rehabilitation will be required in these areas.



REV	DATE	REVISION DESCRIPTION	DRAWN

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DISCIPLINE: ENERGY

THE MASTER HELD AT THE AECOM OFFICE BEARS THE ORIGINAL SIGNATURE OF APPROVAL.

CLIENT: MULILO

PROJECT DESCRIPTION: DE AAR 1 WIND FARM

DRAWING TITLE: ENVIRONMENTAL SENSITIVITY LAYOUT

FUNCTION	NAME	SIGNATURE
DESIGNED BY		N/A
DRAWN BY	J FRANCKE	N/A
DESIGN CHECKED BY		N/A
DRAWING CHECKED BY	C DI DIO	N/A
APPROVAL - CONSULTANT		
NAME		SIGNATURE
DATE		PROF. REG No.

DRAWING STATUS CODES:
D=DRAFT F=FINAL R=REPORT
P=PRELIMINARY C=CONSTRUCTION
T=TENDER A=AS-BUILT/RECORD

FIRST ISSUE DATE: 2014-04-11
SCALE: 1:50.000
SHEET: 1 OF 1
SHEET SIZE: A3

AECOM DRAWING NUMBER

AECOM PROJ. No.	SUB-No.	DISCIPLINE	NUMBER	STATUS	REVISION
14C00570	34	09	EL01	P	04

Current status of vegetation on site

This section provides an outline of the existing status of the site with respect to natural vegetation. The purpose is to provide a context for the rehabilitation plan.

Ecosystem context

The site occurs within a relatively arid region and therefore requires rehabilitation methods that are different to those that would be used in more mesic areas. Rehabilitation methods that rely on agricultural techniques such as the application of fertilizer and the planting of alien species are not appropriate. The major implication is that active rehabilitation outside of the wet season may lead to very poor results on account of the dry conditions and low rainfall.

Site conditions

The site consists of low mountains interspersed by drainage valleys and surrounded by flat lowlands. The mountain areas are relatively rugged and rocky with shallow soils and high surface rock cover. The vegetation in these mountainous areas is primarily a grassy karroid dwarf shrubland with occasional low shrubs.

There is some microhabitat diversity on site, including stony areas (the major habitat on site), flat rock shelves, scarp slopes with large round boulders, scree slopes with loose rocks, and flat areas with deeper soils and lower rock cover.

Within the mountains, the drainage valleys and low-lying areas are flat and have deeper soils and low rock cover. The nature of these areas is driven more by fluvial processes. The vegetation in these areas tends to have higher grass cover with a higher incidence of taller shrubs in places. Erosion due to storm-water flow is an obvious issue in these areas, as observed on site, and can lead to loss of large volumes of soil and the formation of deep gulleys.

The lowland plains below the mountains are flat and covered by a very even karroid dwarf shrubland vegetation. The vegetation and habitat conditions are much more uniform and there is little variation from one place to another.

Proposed infrastructure affects primarily the rocky mountain areas on site. The proposed wind turbines are all sited within such areas. Internal access roads cross all habitats, as do internal

power lines. The on-site sub-station / control buildling, as well as the power lines connecting the sub-station to the Eskom Hydra sub-station are mostly within the lowland plains.

Vulnerable ecosystems and habitats

Some habitats are more vulnerable to disturbance than others and are therefore more likely to become problematic areas with respect to rehabilitation. In addition, some parts of the site will be subject to greater levels of disturbance than others, which will promote problematic conditions to a greater extent. The most sensitive habitats are as follows:

- drainage lines and watercourses;
- areas with deeper soils, including primarily valley bottom areas;
- areas prone to increased runoff following construction, for example road margins;
- areas of prolonged disturbance, for example, construction camps and laydown areas.

Potential constraints to successful rehabilitation

This section provides an outline of key risks and constraints to successful rehabilitation. These include the following:

- scale of clearing,
- climate harshness and unpredictability,
- disease and pests,
- weeds,
- seed availability,
- soil management,
- landform stability,
- ecosystem connectivity,
- ecosystem resilience.

Scale of clearing

Over the area of the entire project, the scale of clearing and the amount of rehabilitation that is required is relatively dispersed, but not a great area. It is estimated that approximately 1 ha of rehabilitation is required per kilometer of road constructed. This, in combination with areas around each crane pad site and along the edges of other infrastructure components will add up to approximately 100 ha in total. The risks are therefore moderate and it is expected that some problems will be encountered.

Climate harshness and unpredictability

The proposal area is in a semi-arid area where rainfall is unpredictable and the amount of rainfall is limited. These are expected to be significant constraints to successful rehabilitation. Any seeding or planting that is required will have to take place from the beginning of the rainy season and not in the dry winter period. Unfortunately, the rainy season is also associated with the hottest parts of the year, which will add to the stresses experienced by any plants attempting to become established, especially if associated with periods of drought. These conditions are likely to be a constraint to successful rehabilitation.

Diseases and pests

The project study area does not show visual evidence of being significantly impacted upon by diseases or pests. The vegetation on site appears to be in relatively good health and condition. There are indigenous animals on site that could potentially pose hazards to rehabilitated areas, for example, porcupines could dig up bulbs or aardvark could dig burrows in soft ground, etc., but these are considered to be natural ecological processes that could add variation to rehabilitated areas. These potential hazards are not expected to pose high risks to rehabilitated areas and no particular measures are proposed to limit them.

Weeds

The project study area has very low incidence of weeds on site and no invasive alien species were observed during the walk-through survey. There are, however, various species from surrounding areas that could become established on site. The rehabilitated and disturbed areas are most at risk because they provide the best conditions for the establishment of weeds and invasive plants. The potential risks are considered to be moderate, but controllable with the rigorous implementation of the Alien Invasive Plant Management Plan.

Seed availability

There is no native seed available from the current project site, but it should be possible to collect seed. Alternatively, indigenous seed is commercially available for various grass species. It is common practice to use a seed mix when sowing in areas for re-vegetation. The main risks associated with this approach are that seed available is usually for combinations of species that are not necessarily present or dominant on site. The risks are, however, considered to be relatively low for successful rehabilitation of disturbed areas since a combination of methods can be employed to encourage growth of indigenous vegetation.

Soil management

Topsoil is arguably the single most important rehabilitation resource in the project area. Topsoil and subsoil that currently occurs in areas to be cleared must be recovered to be used in rehabilitation areas. A potential problem is the fact that the soil is very shallow in many parts of the study area, which means that there is a limited supply of useable topsoil that can be used for rehabilitation. Topsoil must be carefully managed and stockpiled to ensure that it does not become degraded. The success of this process is one of the biggest risks associated with successful rehabilitation of disturbed areas.

Landform stability

The existing slope of the areas that will require rehabilitation varies from flat to very steeply inclining. Particular attention will have to be paid to maintaining surface stability during the early stages of rehabilitation. Minimizing surface water runoff from any small catchment areas that currently exist or that will be created from construction activities will be an important strategy, especially when these occur at elevated points in the landscape. Possible strategies that can be employed include the following:

- development and implementation of a comprehensive storm-water runoff management plan will ensure that rehabilitated areas will not be affected by surface water runoff from the development during and after construction;
- spreading a thin layer of cleared vegetation debris from cleared areas over re-contoured topsoil;
- shallow contour scarification and re-contoured rehabilitation surfaces;
- establishment of temporary shade-cloth fencing at strategic points within rehabilitated areas to minimize the impact from strong winds.

Rehabilitation implementation strategy

The rehabilitation process should form an integral part of site and construction activities. The ECO, who will be responsible for ensuring that the Rehabilitation Plan is implemented, must be appointed and on-site at project inception. This person should form an integral part of the project team.

The following descriptions outline the various stages and processes of the Rehabilitation Programme:

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.

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.

Search and rescue activities

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. This must include all plants specified in the Plant Rescue Plan, but can also include any plant material that could be used in rehabilitation. Plant material to be rescued must be potted into bags using local soil. Search and rescue will include removal of grass clumps, small shrubs, truncheons and cuttings and seed harvesting. Planting rescued plants into rehabilitation areas can be an effective means of establishing indigenous species quickly. The following principles must be applied:

- plants for transplant should only be removed from areas that are going to be cleared;

- Perennial grasses, shrubs, succulents and geophytes are all potentially suitable candidates for transplant;
- 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 to distant areas;
- Rescued plant material must remain on site and not transported to off-site areas.

The initial search and rescue can be followed up with searches undertaken during clearing operations in order to rescue any additional plant material unearthed, such as bulbs, tubers and sub-surface root systems.

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.

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;

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.):

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

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.

Description of rehabilitation measures

Rehabilitation measures that may be effected 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.

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. cementitious material, soil with chemical spill or fuel etc.).

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.

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 channeling occurring.

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.

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).

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).

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.

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.

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

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

Construction phase actions

Action	Responsibility	*Frequency*
Vegetation clearing, stockpiling of plant material & topsoil	Contractor	Ongoing
Seed collecting	Contractor	Ongoing
Landscaping	Contractor	Ongoing
Fence off rehabilitation areas	Contractor	Ongoing
Implementation of rehabilitation measures (terracing, fascine work, mulching, etc.)	Contractor	Ongoing
Planting rescued plants into rehabilitation areas, seeding, etc. to establish new	Contractor	Ongoing

vegetation.		
Photographic record of rehabilitation actions	ECO	Once-off

Post-construction phase 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
Monitoring floristic data collection	Botanist	Annually for 3 years, then triennially

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.

Note: Monitoring requirements of the Alien Invasive Management Programme and Plant Rescue Plan are also applicable, but are not repeated here.

Pre-construction and construction phase monitoring

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

Monitoring action	*Indicator*	*Timeframe*
Photographs of area prior to construction	Baseline condition / pre-construction state	Pre-construction

Operational phase monitoring

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

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

Concluding remarks

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.

References / further reading

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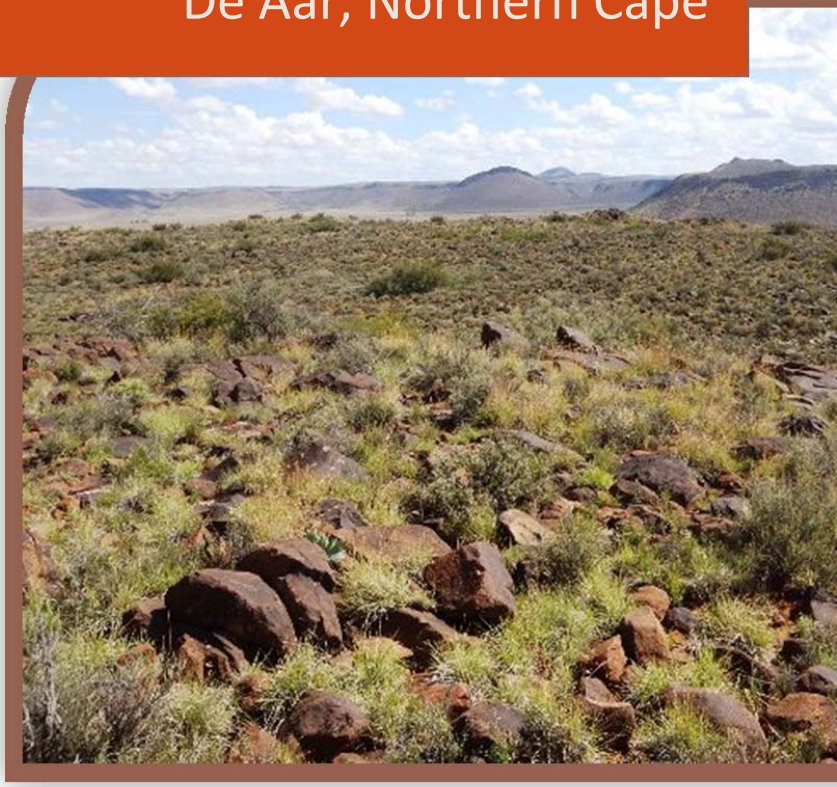
Appendix 11
Alien Invasive Plant Management Plan

ALIEN INVASIVE PLANT MANAGEMENT PLAN

Longyuan Mulilo Maanhaarberg Wind Energy Facility, De Aar, Northern Cape



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Executive Summary

This document provides a management plan for invasive alien plants for the Longyuan Mulilo Maanhaarberg Wind Energy Facility, De Aar, Northern Cape.

The first section provides a summary of the Acts that apply to management of alien plants on site. These are the Conservation of Agricultural Resources Act (Act No. 43 of 1983), the National Environmental Management: Biodiversity Act, 2004 (Act No.10 of 2004) and the Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947).

The next section provides a summary of the status of invasive alien plants on site. None were found to occur there, but a number of plants known from the general geographical area could potentially occur there. More detailed information is provided for nine species that are considered to have a high probability of invading the site under the right conditions.

The next section provides control guidelines, including specific measures that should be taken during different phases of the project to ensure that alien plants do not become established on site.

The next section provides a brief guide to control methods, including mechanical, chemical and biological control, as well as the advantages and disadvantages of each.

The next section provides some guidelines for habitat management to ensure that invasive alien plants do not become established on site.

The next section provides an outline of safety standards and guidelines, specifically for the handling of herbicides as well as for the use of Personal Protective Equipment.

The last section gives an outline of monitoring requirements for early detection of invasive alien plants on site as well as to evaluate the success of clearing operations. The monitoring covers all phases of the project from construction to decommissioning.

Contents

Overview

This document presents the Alien Management Plan for the approved Longyuan Mulilo Maanhaarberg wind energy facility on the farms Smauspoort 130 and Zwartkopjes Portion 2 of 131 near De Aar, Northern Cape. The Environmental Impact Assessment (EIA) process for the approved facility was undertaken by DJ Environmental Consultants. In accordance with the Environmental Authorisation (EA), an Alien Management Plan has been compiled that will be included in the final EMPr.

Purpose of the Alien Management Plan

The purpose of the alien management plan is:

- to ensure that alien plants do not become established on site;
- to ensure that alien plant species do not become dominant in all or parts of the landscape;
- to implement a monitoring programme to detect the presence of alien plant species as well as to monitor the success of the alien management plan.

Legal framework

Conservation of Agricultural Resources Act (Act No. 43 of 1983)

In terms of the amendments to the regulations under the Conservation of Agricultural Resources Act (Act No. 43 of 1983), all declared aliens must be effectively controlled. Landowners are legally responsible for the control of invasive alien plants on their properties. In terms of this Act 198 alien species were listed as declared weeds and invaders and ascribed to one of the following categories:

- Category 1: Prohibited and must be controlled.
- Category 2 (commercially used plants): May be grown in demarcated areas provided that there is a permit and that steps are taken to prevent their spread.
- Category 3 (ornamentally used plants): May no longer be planted. Existing plants may be retained as long as all reasonable steps are taken to prevent the spreading thereof, except within the flood line of watercourses and wetlands.

National Environmental Management: Biodiversity Act, 2004 (Act No.10 of 2004)

The National Environmental Management: Biodiversity Act (NEMBA) regulates all invasive organisms in South Africa, including a wide range of fauna and flora. Regulations have been published in Government Notices R.506, R.507, R.508 and R.509 of 2013 under NEMBA. According to this Act and the regulations, any species designated under section 70 cannot be propagated, grown, bought or sold without a permit. Below is an explanation of the three categories :

- Category 1a: Invasive species requiring compulsory control. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
- Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
- Category 2:Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Cat 2 plants to exist in riparian zones.
- Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Cat 3 plants to exist in riparian zones.

It is important to note that alien species that are regulated in terms of the Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA) as weeds and invader plants are exempted from NEMBA. This implies that the provisions of the CARA in respect of listed weed and invader plants supersede those of NEMBA.

Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947)

According to Government Notice No. 13424 dated 26 July 1992, it is an offence to "*acquire, dispose, sell or use an agricultural or stock remedy for a purpose or in a manner other than that specified on the label on a container thereof or on such a container*".

Contractors using herbicides need to have a valid Pest Control Operators License (limited weeds controller) according to the Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947). This is regulated by the Department of Agriculture, forestry and Fisheries.

Responsible persons

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:

The Developer

This refers to the project proponent, Longyuan Mulilo De Aar Wind Power. 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.

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 alien management 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.

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.

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.

Current status of alien species on site

This section provides an outline of the existing status of the site with respect to alien invasive plant species. The purpose is to provide an indication of the likelihood of alien plant becoming established on site and the likely identity of such species.

Vulnerable ecosystems and habitats

Invasive alien plants threaten three main components of the landscape:

- agricultural potential of the land;
- biodiversity value of the land;
- water quality and quantity.

Some habitats are more vulnerable to invasion by alien plant species than others and are therefore more likely to become problematic areas with respect to management of alien plant species. In addition, some parts of the site will be subject to greater levels of disturbance than others, which will promote conditions suitable for invasion by alien plant species. Although any part of the site could become invaded by alien plants, the areas on site that are most likely to be problematic from the point of view of invasion by alien plants are as follows:

- drainage lines and watercourses;
- areas with deeper soils, including primarily valley bottom areas;
- areas immediately adjacent to any disturbance due to construction activities;
- areas prone to increased runoff following construction, for example road margins;
- areas of prolonged disturbance, for example, construction camps and laydown areas.

Alien species observed on site

A detailed walk-through survey of the site was undertaken which covered the basic footprint of the proposed infrastructure. During this survey, no declared alien invader plant species were found on site and few exotic species were found on site. The general lack of disturbance of natural vegetation is the main reason for this. The project will introduce disturbance into this landscape that may promote conditions that will lead to the introduction and/or spread of invasive exotic species.

Alien species observed in the general area

Based on a literature and database search, the following alien invasive plant species have been previously recorded in the general geographical area and could potentially become established on site (The species highlighted in bold have all been observed in the area around De Aar and the study site and therefore have greater potential to invade the site under favourable conditions.):

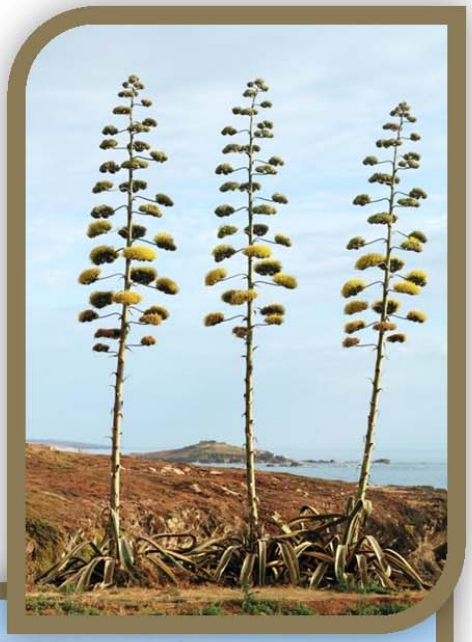
Botanical name	Common name	CARA Category
Agave americana	American agave	Proposed*
Argemone ochroleuca	Mexican poppy	1
Atriplex lindleyi subsp. *inflata*	Sponge-fruit saltbush	3
Atriplex nummularia subsp. *nummularia*	Old man saltbush	2
Datura ferox	Large thorn apple	1
Echinopsis spachiana	Torch cactus	1
Eucalyptus camaldulensis	Red river gum	2
Harrisia martini	Moon cactus	1
Melia azeradach	Syringa	3
Nicotiana glauca	Wild tobacco	1
Opuntia aurantiaca	Jointed cactus	1
Opuntia ficus-indica	Sweet prickly pear	1
Opuntia fulgida	Rosea cactus	1
Opuntia imbricata	Imbricate prickly pear	1
Opuntia stricta	Australian pest pear	1
Pennisetum setaceum	Fountain grass	1
Populus deltoides	Match poplar, cottonwood	Proposed*
Populus nigra var. *italica*	Lombardy poplar	Proposed*
Populus X canescens	Grey poplar	2
Prosopis glandulosa* var. *torreyana	Honey mesquite	2
Prosopis velutina	Velvet mesquite	2
Pyracantha angustifolia	Yellow firethorn	3
Salix babylonica	Weeping willow	2
Salsola kali	Russian tumbleweed	
Schinus molle	Pepper tree	Proposed*
Tamarix ramosissima	Pink tamarisk	1
Xanthium spinosum	Spiny cocklebur	1
Xanthium strumarium	Large cocklebur	1

*"Proposed" is for those species that have been proposed to be included as Declared Weeds, but do not currently have that status.

Guide to alien invasive plants most likely to occur on site

This section provides some information on the alien invasive plant species that are most likely to occur on site. This will assist in recognizing these species. All the species below have been previously recorded in areas surrounding De Aar.

Agave americana



Common name: American agave

Status: Declared invader (Proposed)

Impact: Invades dry habitats, rocky outcrops, drainage lines. Agave Americana forms an impenetrable barrier because the leaves are tipped with a spine. The plant is still used as a barrier. Cultivated worldwide as an ornamental plant.

Control: Can be controlled with the direct injection of concentrated MSMA into the bole. When the plants have dried out they can be cleared by burning. Physical removal is restricted to the use of bulldozers.

Datura ferox

Common name: large thorn apple

Status: Declared weed (Category 1)

Impact: Invades wastelands, cultivated lands, roadsides, riverbanks, riverbeds. Declared as weeds not only because they are poisonous, but also because of their tall and aggressive growth habit. Difficult to control and contaminate crops such as maize. One seed per 10 kg can cause rejection of maize crop.

Control: Being deep germinators, these weeds are not adequately controlled by many pre-emergence herbicides. In annual crops, it is best to delay treatment as long as possible in order to catch late germinating individuals.

Echinopsis spachiana

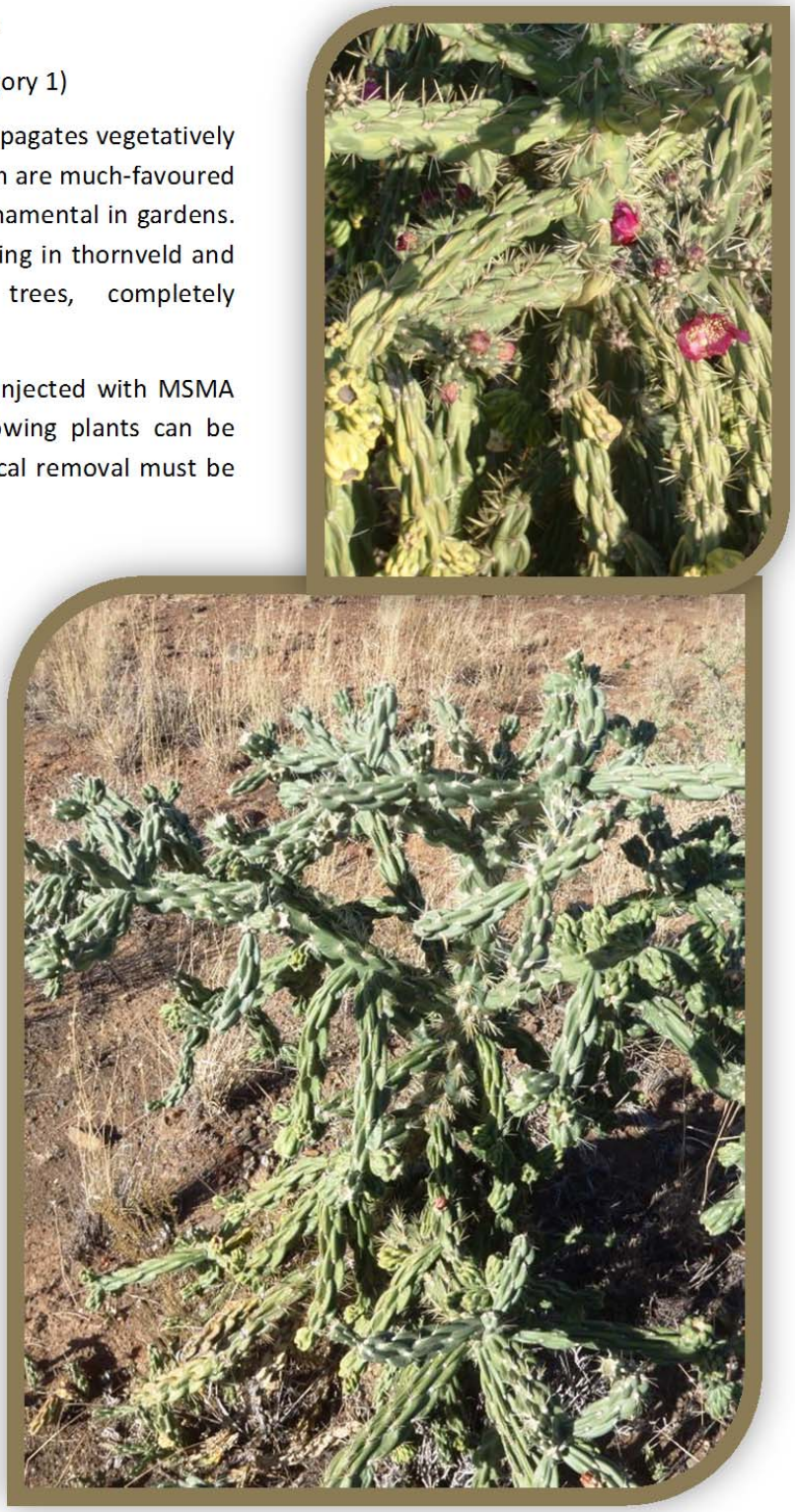
Common name: torch cactus

Status: Declared weed (Category 1)

Impact: Invades dry savanna and karoo. It grows in sandy, gravelly soils and is covered in tufts of sharp spines. Competes for moisture in savanna and arid areas. It will grow under trees, removing moisture and preventing animals from accessing the shade. The spines can cause injuries to animals.

Control: No herbicides are registered for this particular cactus (preferable not to use herbicides for the current project), but it is likely to be susceptible to those methods used on other cacti (see other species listed below).

Harrisia martinii



Common name: moon cactus

Status: Declared weed (Category 1)

Impact: Invades savanna. Propagates vegetatively and by means of seeds, which are much-favoured by birds. Cultivated as an ornamental in gardens. It sprawls over valuable grazing in thornveld and can climb over small trees, completely smothering them.

Control: Can be sprayed or injected with MSMA or alternatively, actively growing plants can be sprayed with triclopyr. Physical removal must be total as small stem sections can root and form new plants. The plant can be kept in check by biocontrol agents, such as the Cactoblastis moth and a cochineal insect, *Dactylopius opuntiae*.

Nicotiana glauca

Common name: wild tobacco

Status: Declared weed (Category 1)

Impact: Invades roadsides, road cuttings, wasteland, riverbanks, riverbeds. Can become a large woody shrub. The seed capsules contain hundreds of tiny seeds, which are easily transported by water. Is highly tolerant of arid conditions and is common in the beds of rivers that only flow occasionally. Can cause poisoning of livestock. Evidently well-known for poisoning ostriches.

Control: Should be controlled when small. There are no specific herbicide registrations for this species, but it should be susceptible to the usual herbicides. For the current project, the use of herbicides should preferably not take place. Any plants seen can be physically removed (by hand or with a spade).

Opuntia ficus-indica

Common name: Sweet prickly pear

Status: Declared invader (Category 2)

Impact: Invades savanna and dry grassland. Propagates easily from the leaf-pads or cladodes. Even a small piece lying on the ground can produce roots and flourish.

Control: Chemical control is possible with several herbicides, such as MSMA and glyphosphate. However, continues to be kept under control by the use of the Cactoblastis moth and a cochineal insect, *Dactylopius opuntiae*. Special control measures are rarely required. Cochineal insects are not very mobile so isolated plants must be inoculated manually by placing an infected cladode on top of the plant to be controlled.

Opuntia imbricata

Common name: imbricate prickly pear

Status: Declared weed (Category 1)

Impact: Invades Kaoo, dry savanna and grassland. Each piece that breaks off the main plant is capable of rooting and producing a new plant. If the plant is cut down, all pieces must be collected and destroyed. Ease of growth, rapid spread and unpleasant spines result in infested areas becoming inaccessible

Control: Chemical control is restricted to the spraying or injecting of MSMA or glyphosphate, but it is time-consuming and costly. The introduction of cactoblastis as a biocontrol agent has greatly reduced the problem.

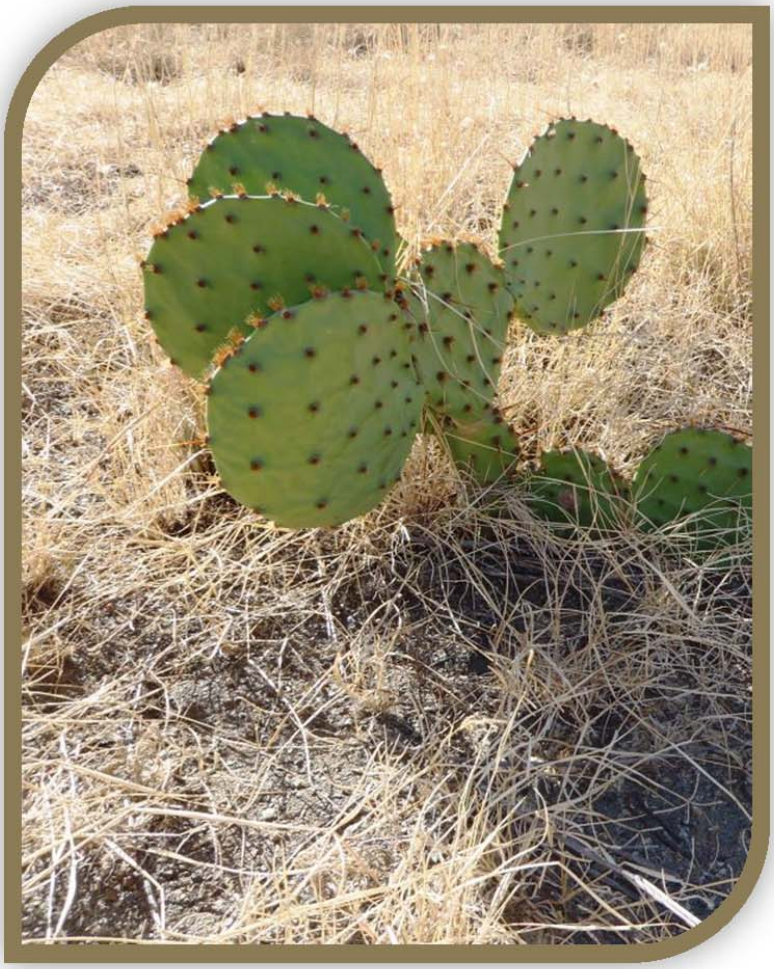
Opuntia stricta

Common name: Australian pest pear

Status: Declared weed (Category 1)

Impact: Invades savanna and dry grassland. Propagates easily from the leaf-pads or cladodes. Even a small piece lying on the ground can produce roots and flourish.

Control: Chemical control is possible with several herbicides, such as MSMA and glyphosphate. However, continues to be kept under control by the use of the Cactoblastis moth and a cochineal insect, *Dactylopius opuntiae*. Special control measures are rarely required. Cochineal insects are not very mobile so isolated plants must be inoculated manually by placing an infected cladode on top of the plant to be controlled.



Prosopis glandulosa* var. *torreyana

Common name: honey mesquite

Status: Declared invader (Category 2)

Impact: Invades riverbeds, riverbanks, drainage lines and sometimes open veld in semi-arid to arid areas. Seed pods are eaten by livestock and game and thereby spread. The plant is extremely tolerant of drought, high temperatures and overgrazing. It forms dense thickets, thereby excluding natural vegetation.

Control: Control is difficult because plants damaged by inadequate removal, resprout from dormant buds just below ground level, resulting in a dense multi-stemmed shrub. Cut-stump, foliar and soil-applied herbicide registrations exist, but with either chemical or physical control, follow-up treatments are always necessary.

Control guidelines

This section provides an outline of the overall approach that should be adopted at the site in order to minimize the probability of invasive alien plants becoming established and ensuring that any outbreaks are managed quickly to ensure that they do not become a long-term problem on site. The establishment of any dense infestations will be expensive to eradicate and will require more complex control measures than would be necessary for low density invasions.

Prevention

A prevention strategy should be considered and established, including regular surveys and monitoring for invasive alien plants, effective rehabilitation of disturbed areas and prevention of unnecessary disturbance of natural areas. Prevention could also include measures such as washing the working parts and wheels of earth-moving equipment prior to it being brought onto site, visual walk-through surveys every three months and other measures, as listed in the section below ("Habitat management").

Early identification and eradication

Monitoring plans should be developed which are designed to catch Invasive Alien Plant Species shortly after they arrive in the project area. Keeping up to date on which weeds are an immediate threat to the site is important, but efforts should be planned to update this information on a regular basis. When new Invasive Alien Plant Species are spotted an immediate response of locating the site for future monitoring and either hand-pulling the weeds or an application of a suitable herbicide should be planned. It is, however, better to monitor regularly and act swiftly than to allow invasive alien plants to become established on site.

Containment and control

If any alien invasive plants are found to become established on site, action plans for their control should be developed, depending on the size of the infestations, budgets, manpower considerations and time. Separate plans of control actions should be developed for each location and/or each species. Appropriate registered chemicals and other possible control agents should be considered in the action plans for each site/species. The key is to ensure that no invasions get out of control. Effective containment and control will ensure that the least

energy and resources are required to maintain this status over the long-term. This will also be an indicator that natural systems are impacted to the smallest degree possible.

Construction phase activities required

The following management actions are required to minimize soils and vegetation disturbance during the construction phase, as well as reducing the probability that invasive alien plants will become established on site:

Action	***Frequency***
The Environmental Control Officer (ECO) is to provide permission before any natural vegetation is to be cleared for development.	Daily / when required
Clearing of vegetation must be undertaken as the work front progresses. Mass clearing is not to be permitted unless the entire cleared area is to be rehabilitated immediately thereafter.	Weekly
Should revegetation not be possible immediately, the cleared areas must be protected with packed brush or appropriately battered with fascine work (fixing horizontal branches along the ground using vertical pegs to create resistance to down-slope flow of water/materials). Alternatively, jute (Soil Saver) may be pegged over the soil to stabilize it.	Weekly
Organic matter used to encourage regrowth of vegetation on cleared areas should not be brought onto site from foreign areas. Brush from cleared areas should be used as much as possible. Arid areas generally have low organic content in the soil and the use of manure or other soil amendments should not be used as this would encourage invasion.	Weekly
Care must be taken to avoid the introduction of alien invasive plant species to the site. Particular attention must be paid to imported material such as building sand or dirty earth-moving equipment. Stockpiles should be checked regularly and any weeds emerging from material stockpiles should be removed.	Weekly
ECO to survey site once a month to detect aliens and have them removed.	Monthly
Alien vegetation regrowth must be controlled throughout the entire site during the construction period.	Monthly
The alien plant removal and control method guidelines should adhere to best practice for the species concerned. Such information can be obtained from the Working for Water website as well as herbicide guidelines.	Monthly

Clearing activities must be contained within the affected zones and may not spill over into adjacent no-go areas. No-go areas should be clearly demarcated prior to construction.	Daily

Operational phase activities required

The following management actions are aimed at maintaining non-invaded areas clear of invasive alien species as well as reducing the abundance of any aliens on site:

Action	*Frequency*
Surveys for alien species should be conducted regularly. All aliens identified should be cleared.	Every 3 months for 2 years and biannually thereafter.
Revegetation with indigenous, locally occurring species should take place in areas where natural vegetation is slow to recover or where repeated invasion has taken place.	Biannually, but revegetation should take place at the beginning of the rainy season.
Areas of natural vegetation that need to maintained or managed to reduce plant height or biomass, should be controlled using methods that leave the soil protected.	When necessary
No alien species should be cultivated on site. If vegetation is required for aesthetic or other purposes, then non-invasive locally occurring species should be used.	When necessary

Decommissioning phase activities required

The following management actions are aimed at preventing invasion by invasive alien species of revegetated areas created during decommissioning activities.

Action	*Frequency*
All damaged areas shall be revegetated upon completion of activities.	Once-off
Revegetation with indigenous, locally occurring species should take place in disturbed areas. Reseed with locally sourced seed of indigenous grass species that were recorded on site prior to construction.	Once off, with annual follow-up revegetation, if necessary

Maintain alien plant monitoring and removal programme for 3 years after rehabilitation.	Biannually for 3 years

Control methods

This section provides an outline of existing control measures that have published for the various alien plant species that could potentially occur on site. The section is a summary of control measures – there are more detailed publications for control measures. Some of these publications are referenced.

There are various means of managing invasive alien plants:

Mechanical control

This entails damaging or removing the plant by physical action. Different techniques could be used, e.g. uprooting, felling, slashing, mowing, ringbarking or bark stripping. This control option is only really feasible in sparse infestations or on small scale, and for controlling species that do not coppice after cutting. Species that tend to coppice, need to have the cut stumps or coppice growth treated with herbicides following the mechanical treatment. Mechanical control is labour intensive and therefore expensive, and could cause severe soil disturbance and erosion. For the current project, hand-pulling or manual removal using hand tools (in this case cut-stumping) will be the most appropriate methods since there are no existing dense stands of invasive alien plants.

Advantages	Disadvantages
Effective method in areas with low infestation.	Not an effective method for dense infestations, as the cost of clearing is extremely high, with little or no impact.
High job creation and associated poverty	Time consuming.

alleviation potential.	
No contamination of water with herbicides.	If no herbicides are used then the manual control techniques must be very well executed to ensure success.

Chemical control

Chemical control should only be used as a last resort, since it is hazardous for natural vegetation. It should not be necessary if regular monitoring is undertaken, which should be effective for controlling invasive alien plants.

Chemical control involves the use of registered herbicides to kill the target weed. Managers and herbicide operators must have a basic understanding of how herbicides function. The use of inappropriate herbicides and the incorrect use of the appropriate herbicides are wasteful, expensive practices and often do more harm than good, especially when working close to watercourses. Some herbicides can quickly contaminate fresh water and/or be transported downstream where they may remain active in the ecosystem.

Contractors using herbicides are required to have a permit according to Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947).

Herbicides are either classified as selective or non-selective. Selective herbicides are usually specific to a particular group of plants, e.g. those specified for use on broad leaf plants, but should not kill narrow-leaf plants such as grasses. Non-selective herbicides can kill any plant that they come into contact with and are therefore not suitable for use in areas where indigenous vegetation is present.

Chemical application techniques include foliar (leaf) application, stem applications (basal stem, total frill, stem injections) and stump applications (cut stump, total stump, scrape and paint):

Advantages	Disadvantages
Complements mechanical control methods, increasing the effectiveness of control activities.	May kill non-target plants or species. This is a very important consideration and poses risks for remaining natural areas on site.
Achieve results over short period (within 6 weeks of application).	Herbicides are expensive.
Large areas can be treated quickly.	The use of herbicides may contaminate sites used for drinking water, for washing and for fishing, and can therefore threatened human and animal health.

	Specialized training and certification is required for use of herbicides.

Biological control

Biological weed control consists in the use of natural enemies to reduce the vigour or reproductive potential of an invasive alien plant. Biological control agents include insects, mites, and micro-organisms such as fungi or bacteria. They usually attack specific parts of the plant, either the reproductive organs directly (flower buds, flowers or fruit) or the seeds after they have dropped. The stress caused by the biological control agent may kill a plant outright or it might impact on the plants reproductive capacity. In certain instances, the reproductive capacity is reduced to zero and the population is effectively sterilized. All of these outcomes will help to reduce the spread of the species.

To obtain biocontrol agents, provincial representatives of the Working for Water Programme or the Directorate: Land Use and Soil Management (LUSM), Department of Agriculture, Forestry and Fisheries (DAFF) can be contacted.

Advantages	Disadvantages
Most environmentally friendly and most sustainable of all control methods.	Generally slow, especially initially.
Usually does not require high or long-term maintenance.	Low levels of infestation, with occasional outbreaks, will remain a feature of systems under biological control.
Relatively low cost implication over the long term.	Any use of chemicals around biocontrol agent colonies may adversely affect the potency of this control method.
	Cannot be used where the biocontrol agent would threaten commercial populations of the target species that may exist nearby.
	Biocontrol agents are not available for all target species.

Habitat management

The best way to prevent invasion by alien invasive plant species is to manage the natural vegetation in such a way as to reduce the opportunity for these plants becoming established. The general principle is to not disturb any areas beyond the footprint of the proposed infrastructure and to also ensure that the natural processes that maintain vegetation patterns are not disrupted.

Post-removal follow-up and rehabilitation

Re-establishment of indigenous vegetation needs to be undertaken to reduce the probability of re-emergence of invasive alien plants and to reduce the risk of soil erosion where the soil surface is poorly vegetated. In most soils, the seeds and other propagules of the plants of the former natural habitat still survive. So natural regeneration without the need for planting may be possible in many cases. However, if natural regeneration is not likely due to the length of time since disturbance or if the soil has been disturbed to such a degree that seeds and propagules no longer survive then planting or seeding may be required. Rehabilitation should follow these steps:

1. Monitor cleared areas on a regular basis (monthly during construction and three-monthly during operation) for emergent seedlings of invasive alien species and remove these (hand pulling or chemical control).
2. All areas of exposed soil should immediately be protected by placing packed brush on the slope, or creating erosion control barriers using branches, sticks or logs placed horizontally across the slope at 1m intervals (the steeper the slope the closer the barriers should be placed to one another). If topsoil has been lost, rehabilitation of indigenous vegetation will be a difficult and expensive process.
3. If the soil remains relatively undisturbed and the area has some indigenous vegetation left intact, the natural regeneration process of the indigenous vegetation on the site should be managed. This involves regular follow-up to remove emerging invasive alien plants and protecting the area from other forms of disturbance (heavy grazing, trampling, disturbance by vehicles, etc.) while the vegetation re-established naturally.
4. If required, indigenous vegetation can be planted on the cleared areas. This can be in the form of a seed mix or plants rescued from previous clearing.

Safety standards and guidelines

Safety is of the utmost importance when working with invasive alien plant control. Staff are likely to be working in remote areas with potentially dangerous equipment and chemicals. Proper safety training and equipment is therefore required.

Herbicide safety

Herbicides must be stored in a dedicated storeroom.
The Herbicide Storeroom needs to comply with national Occupational Health and Safety standards. Some important safety rules are as follows:

- A herbicide storeroom must have adequate ventilation. If the air is stagnant or there is a smell of herbicides when opening up the storeroom then it is a good indication that there is not enough ventilation.
- Clean water needs to be available in close proximity to the storeroom.
- The floor must be non-porous. This is important because when the floor is cleaned (which must be done regularly), no residue of herbicides must remain. Place herbicide containers on wooden pallets to increase ventilation and make mopping up after spillage easier.
- 'No Smoking' and 'No Fire' signs should be posted on the door of the storeroom as well as a sign stating that it is a chemical store and who the responsible person is for the store.
- Keep the storeroom locked to prevent herbicide getting into the wrong hands.
- A spill kit needs to be kept in the storeroom to mop up any spill. The spill kit must contain a bucket with sand and a spade. The sand is to be placed on the spill to absorb the liquid. Once the sand has absorbed the spill, it is to be collected and disposed of where it cannot contaminate the environment. It is preferable to keep contaminated sand in a container and dispose of it with empty containers at a certified chemical recycling plant.
- Obtain the Material Safety Data Sheet from the supplier of the herbicide and ensure that you are familiar with the product before using it. Keep the Material Safety Data Sheet in the storeroom in case of an emergency.
- Always store herbicides in the original labelled container to avoid confusion with other products. Do not store other products in the store, such as protective clothing, food, etc., as they can become contaminated.
- All empty herbicide containers, or herbicides that have reached their expiry date, need to be safely disposed of. This can be done at a registered chemical recycling company. It

is important that all empty containers are spiked before disposal. This ensures that they cannot later be used for carrying drinking water, food, etc.

- The contact number for the nearest Poison Control Centre should be posted nearby.

Personal Protective Equipment (PPE)

The use of Personal Protective Equipment (PPE) by staff controlling invasive alien plants in the field is required by law. The PPE specifications differ for the different types of control. Mechanised control includes the use of chainsaws and brush cutters and will therefore require slightly different PPE from someone using manual control (slasher, knapsack sprayer, etc.). PPE required for manual control is as follows:

Item	*Specification*
Overall	100% cotton, two-piece overalls are best for absorbing perspiration, they last longer and are cooler.
Rubber gloves	Standard, wrist-length rubber gloves are sufficient.
Leather gloves	Standard wrist-length leather gloves are appropriate.
Safety boots	Gumboots or standard safety boots, which support the ankles, are sufficient. Steel toecaps are recommended for workers that are working with heavy equipment or large trees.
Hat	If working with large trees, on steep gradients or if any other safety risk may be present, then wearing a hardhat is advisable. Otherwise a wide-brim hat can be used to protect the worker from the sun.
Safety glasses	Large, clear safety glasses, which allow air to pass through, are acceptable.
Face mask	A face mask which covers the nose and mouth is essential when mixing herbicides and for foliar spraying.

Monitoring programme

In order to monitor the impact of clearing activities, follow-ups and rehabilitation efforts, monitoring must be undertaken. This section provides a description of a possible monitoring programme that will provide and assessment of the magnitude of alien invasion on site as well as an assessment of the success of the management programme. Based on the detailed pre-construction walk-through survey in which no declared alien invasive plant species were found on site, the baseline condition prior to construction is assumed to be one in which no alien plants are present.

In general, the following principles apply for monitoring:

- Photographic records must be kept of areas to be cleared prior to work starting and at regular intervals during initial clearing activities. Similarly, photographic records should be kept of the area from immediately before and after follow-up clearing activities. Rehabilitation processes must also be recorded.
- Simple records must be kept of daily operations, e.g. area/location cleared, labour units and, if ever used, the amount of herbicide used.
- It is important that, if monitoring results in detection of invasive alien plants, that this leads to immediate action.

Construction phase monitoring

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

Monitoring action	*Indicator*	*Timeframe*
Document alien species present on site	Alien species list	Pre-construction & monthly thereafter
Alien plant distribution	Distribution maps, GPS co-ordinates	Monthly
Document and record alien control measures implemented	Record of clearing activities	6-monthly
Review alien control success rate	Decline in abundance of alien plant species over time	Annually

Operational phase monitoring

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

Monitoring action	*Indicator*	*Timeframe*
Document alien species distribution and abundance on site	Alien species distribution maps	Annually
Document alien plant control measures implemented & success rate achieved	Records of control measures and their success rate.	Annually
Document rehabilitation measures implemented and success achieved in problem areas	Decline in vulnerable bare areas over time	Annually

Decommission phase monitoring

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

Monitoring action	*Indicator*	*Timeframe*
Monitor newly disturbed areas where infrastructure has been removed to detect and quantify any aliens that may become established for 3 years after decommissioning and rehabilitation.	Alien plant surveys and distribution map	Biannually until natural vegetation has recovered sufficiently to resist invasion
Monitor re-vegetated areas to detect and quantify any aliens that may become established for 3 years after decommissioning and rehabilitation.	Alien plant surveys and distribution map	Biannually for 3 years
Document alien plant control measures implemented & success rate achieved	Records of control measures and their success rate.	Annually for 3 years

References / further reading

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Marrs, R.H., Frost, A.J., Plant, R.A. & Lunnis, P. (1993). Determination of buffer zones to protect seedlings of non-target plants from the effects of glyphosate spray drift. Agriculture, Ecosystems and Environment, 45, 283-293.

www.dwaf.gov.za/wfw/Control/docs/controltables.doc: The Working for Water Programme's website.

Appendix 12
Fauna Groundtruthing Survey Report

Faunal ground truthing survey at developmental footprints

For the proposed Maanhaarberg WEF near De Aar, Northern Cape

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September 2014

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For:	Faunal ground truthing at WEF construction footprints

Declaration of independence:

Animalia Zoological & Ecological Consultation CC has no connection with the developer. Animalia Zoological & Ecological Consultation CC is not a legal or financial subsidiary of the developer; remuneration for services by the developer in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal and the consultancy has no interest in secondary or downstream developments as a result of the authorization of this project.

Applicable Legislation:

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004; Especially sections 2, 56 & 97)

NORTHERN CAPE NATURE CONSERVATION ACT (ACT 9 OF 2009; Especially Schedules 1 & 2 – Specially Protected Species and Protected Species)

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Figure 1: Map overview of the proposed developmental footprint (white) of the Maanhaarberg WEF. Development site boundaries in black.

1 OBJECTIVES AND TERMS OF REFERENCE

- Compile a list of faunal occurrences at development footprints, especially turbine base and hard standing areas.
- Determine sensitivity of such fauna and prioritise groups/species that may be impacted most by the specific actions of the construction phase of the development.
- Classify habitats/terrain on site on a basic level, according to probable occurrences/utilisation of priority groups of fauna.
- Identify the probable impacts of the construction phase on priority fauna.
- Recommend mitigation measures and a short practical action plan to be followed during specific construction activities, in order to minimise impacts on priority fauna. The habitat/terrain classification will be incorporated into a protocol for developmental footprints that may need amendments beyond the dates of this survey (e.g. roads).

2 INTRODUCTION

2.1 Principles of Ecology

Ecology is the study of interactions among organisms and their environment, which includes the interactions organisms have with one other and with their abiotic environment. Essentially, ecosystems consist of dynamically interacting components of organisms and their abiotic environment (Coleman *et al*., 2004). Thus, if a single component of an ecosystem is negatively impacted a multitude of other linked components will also be impacted to some degree.

Biodiversity plays an important role in ecosystem services which, by definition, maintain and improve human quality of life. Preventing extinction of species is one way to preserve biodiversity. Habitat preservation and allowing for species to migrate are important considerations to maintain biodiversity with regards to developments. For example, in the case of a wind energy development, all efforts must be made to conserve and protect keystone species. A keystone species is a species whose presence and role within an ecosystem has a disproportionate effect on other organisms within the system. The many connections that a keystone species holds means that it maintains the organization and structure of entire communities. The loss of a keystone species results in a range of dramatic cascading effects that alters trophic dynamics, food web connections, and can cause the extinction of other species (Odum and Barret, 2005).

The natural environment is made up of systems that are nested within ecosystems. Changes within a single system can affect the sustainability of the ecosystems that are nested within

it as well as the larger ecosystems in which it exists. Human-induced changes may have several (negative and positive) effects on an ecosystem (Odum and Barret, 2005). By studying and understanding the ecological systems, we may strive to lessen and mitigate any negative impacts and thus preserve the balance and sustainability of the natural system.

2.2 Fauna most likely to be impacted during the construction phase

Construction of the proposed development may have several impacts on local fauna. Impacts consist of habitat destruction, vegetation removal, rock blasting, light and noise pollution and direct mortalities of fauna. Being a faunal ground truthing survey, this document only deals with impacts that may results from the construction phase. The faunal groups primarily impacted during the operational phase, such as bats and birds, are assessed in separate dedicated studies.

The Nama-Karoo supports small herbivorous mammals such as springbok, hares, rabbits, rock hyrax, and Otomyid rodents (Arid Zone Ecology Forum, 2010). These mammals will be negatively impacted due to vegetation clearing for turbine bases and associated transmission lines and roads.

Specialized insectivorous mammals such as aardwolf, aardvark, bat-eared fox, and a variety of shrews may be affected by earth works during construction. These insectivores and any other groups of burrowing animals (including priority invertebrates) may be directly impacted or killed by digging.

Reptile fauna inhabiting the study area such as snakes, geckos, lizards and tortoises may be negatively impacted during construction of the development due to rock blasting. Reptiles often use rocky areas for sun basking, and they utilize rock crevices for shelter and retreat sites while hunting. Destruction of rocky areas may result in habitat destruction for these animals as well as direct mortalities.

The noise and light pollution of the construction phase will have a distressing effect on all local fauna. The animals will most probably be driven out of the affected areas. However, the probability of return by the animals after the disturbance is high. Additionally the proportion of habitat impacted upon is relatively low, and therefore the impact of possible direct faunal mortalities during the construction phase are prioritised in this document.

3 METHODOLOGY

The site was visited from 31 August 2014 to 13 September 2014 and the primary methodologies consisted of the following:

3.1 General habitat assessment and classification

During the site survey habitat and terrain types were observed and classified up to the required level applicable to probable occurrences or utilisation of priority groups of fauna. These classifications were supplemented by literature based habitat requirements of the priority fauna as well as satellite imagery from Google Earth.

3.2 Walked survey transects

Walked transect surveys were undertaken to ground truth each turbine development footprint and laydown areas with regards to the type of fauna present and habitat/terrain capable of supporting different faunal groups (**Figure 2**). All sightings as well as signs of fauna (spoor, dung, etc.) were noted. The proposed road path were not strictly followed, since these may still be amended, the habitat assessment map will assist in determining impacts for a variety of activities on different parts of the site.

There was an error with the GPS unit for 2 days, resulting in only intermittent track logs saved for those two days.

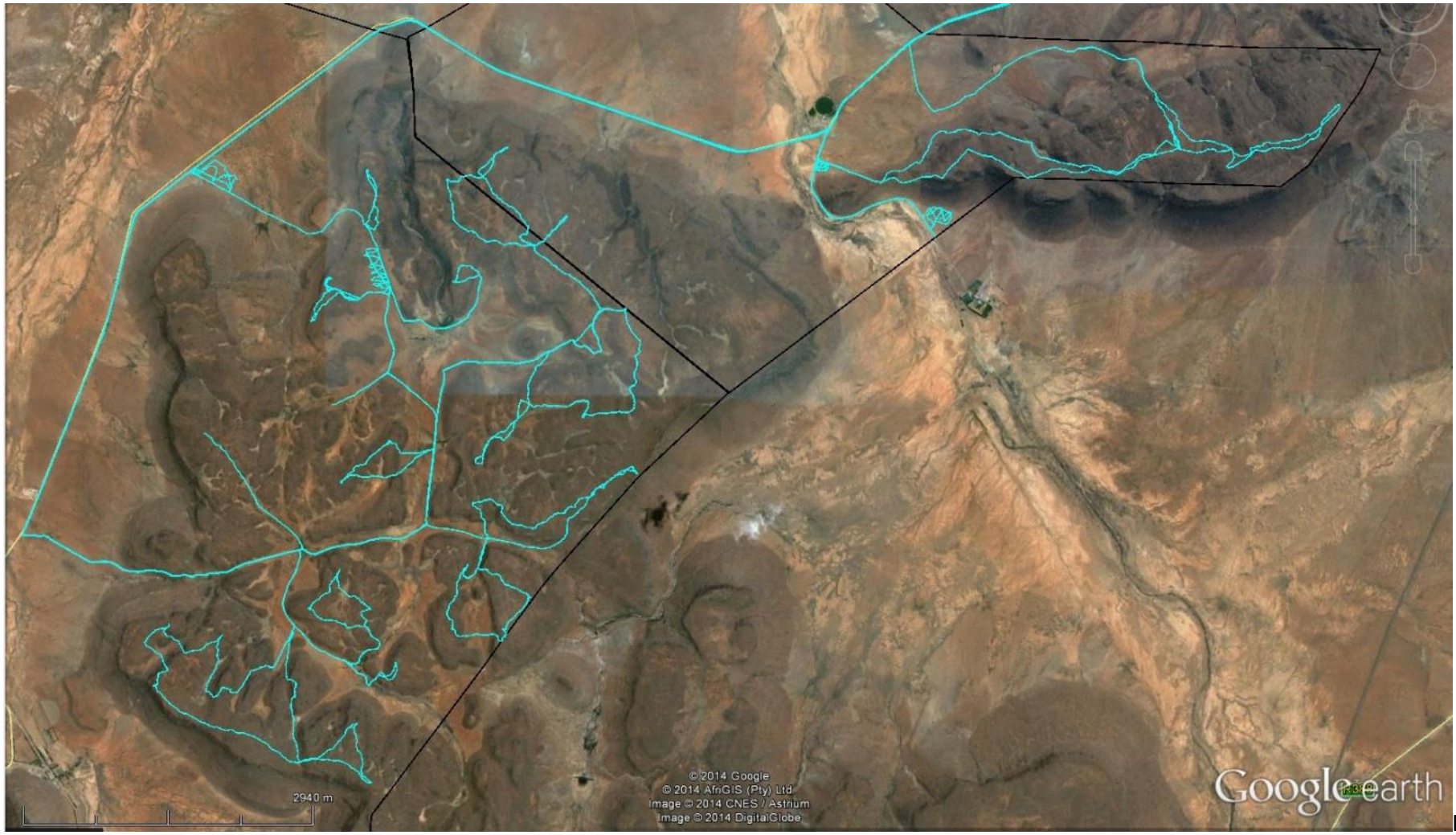

Figure 2: Tracks walked and driven (blue lines) on the proposed Maanhaarberg WEF site, the non-straight tracks are all walked transects.

4 RESULTS AND DISCUSSION

4.1 Vegetation, climate and topography

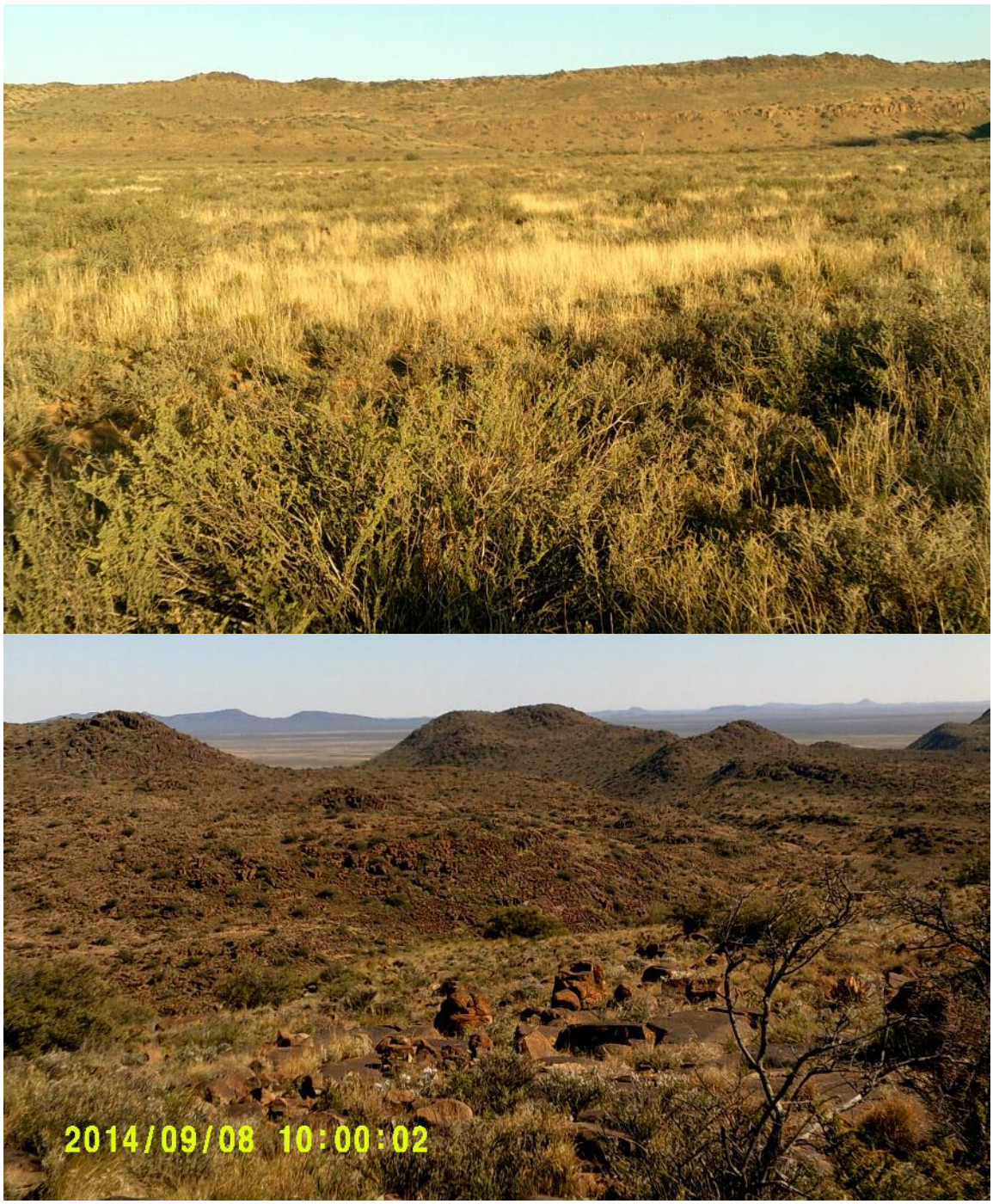

Figure 3 and 4: Photographs of the difference in terrain within the Upper Karoo Hardeveld. Top photograph indicates lower lying areas more suitable for the majority of burrowing animals, bottom photograph indicates typical rocky terrain in higher lying areas with scattered Inselberg outcrops.

The Maanhaarberg site occupies three vegetation units, namely the Northern Upper Karoo, Eastern Upper Karoo and Upper Karoo Hardeveld. The Besemkaree Koppies Shrubland vegetation unit falls within the larger area surrounding the site.

The Northern Upper Karoo unit is found between the Nama-Karoo, arid Kalahari savanna and the arid Highveld grasslands at altitudes between 1000m - 1500m (Mucina and Rutherford 2006). The vegetation is dominated by dwarf shrubs, grasses and *Acacia melifera* subspecies *detinens* and, some low tree species are present particularly in sandy soils (Mucina and Rutherford 2006). There are several endemic floral taxa in the area, namely; *Lithops hookeri, Stomatium pluridens, Atriplex spongiosa, Galenia exigua* and *Manulea deserticola.* The topography is generally flat with isolated hills which may provide roosting sites for crevice dwelling bats. The geology of the area comprises mainly of Volksrust Formation shales with Jurassic Karoo Dolerite sills and sheets supporting the vegetation complex in certain areas. Superficial deposits of Kalahari calcretes cover vast stretches of land that range from shallow to deep soils (Mucina and Rutherford 2006). An annual rainfall between 190mm and 400mm peaks in autumn, and mean monthly maximum and minimum temperatures for De Aar are 37.1^{o}C and -4.8^{o}C (Mucina and Rutherford 2006).

The Eastern Upper Karoo vegetation unit forms part of the Nama-Karoo biome. This unit is found at an altitude of 1000 m – 1700 m. The unit is characterised by flat and gently sloping plains dominated by dwarf microphyllous shrubs and 'white' grasses of the genera *Aristida* and *Eragrostis* (Mucina and Rutherford 2006). Geology consists mostly of sandstones and mudstones, which support duplex soils and some shallow Glenrosa and Mispah soils. Rainfall occurs mainly in autumn and summer with MAP ranging from 180 mm to 430 mm. Mean maximum and minimum temperatures are 36.1°C and -7.2°C for January and July, respectively. Frost incidence is relatively high and ranges from <30 to >80 days. The Eastern Upper Karoo is Least Threatened but veld managers perceive the unit to be experiencing species composition changes hence high-priority action is required (Mucina and Rutherford 2006).

The Upper Karoo Hardeveld vegetation unit is also of the Nama-Karoo biome. The landscape consists of steep slopes of koppies, butts and mesas. Parts of the Great Escarpment possess large boulders that support sparse dwarf Karoo scrub and drought-tolerant grasses. This vegetation unit is one of the richer flora units of the Nama-Karoo with a substantial number of diagnostic species (relative to the surrounding extensive flats) (Mucina and Rutherford 2006). The geology consists of mudstone and arenite. The mean annual precipitation ranges between 150mm and 350mm. Frost incidence is relatively, ranging between <30 days and >80 days (Mucina and Rutherford 2006). Erosion is moderate to high (2 – 64%). The Upper Karoo Hardeveld vegetation unit has a conservation category of Least Threatened with only about 3% statutorily conserved (Mucina and Rutherford 2006).

The Besemkaree Koppies Shrubland unit forms part of the Grassland biome (Mucina and Rutherford 2006). It is distributed through the Northern Cape, Free State and Eastern Cape Provinces at altitudes between 1120-1680m. The landscape includes dolerite koppies, butts and tafelbergs that are covered by a two-layered karroid shrubland with the lower layer dominated by dwarf small-leaved shrubs and grasses while the upper layer is dominated by tall shrubs of *Rhus spp., Euclea crispa* subsp. *ovata, Diospyros austro-africana* and *Olea europaea* subsp. *Africana* (Mucina and Rutherford 2006). The geology and soils on which the Besemkaree Koppies Shrubland unit occurs comprises of dolerite dykes and sills and a mixed geology where dolerites, sandstones and mudstones occur together (Mucina and Rutherford 2006). Rainfall varies over the vast area from approximately 280mm to 580mm, but overall the mean annual precipitation is approximately 400mm with a mean annual temperature of 15^{o}C (Mucina and Rutherford 2006). There are several endemic floral species that occur in the vegetation unit namely; *Cussonia* sp. Nov., *Euphorbia crassipes, Neohenricia sibbettii* and *N. spiculata* (Mucina and Rutherford 2006).

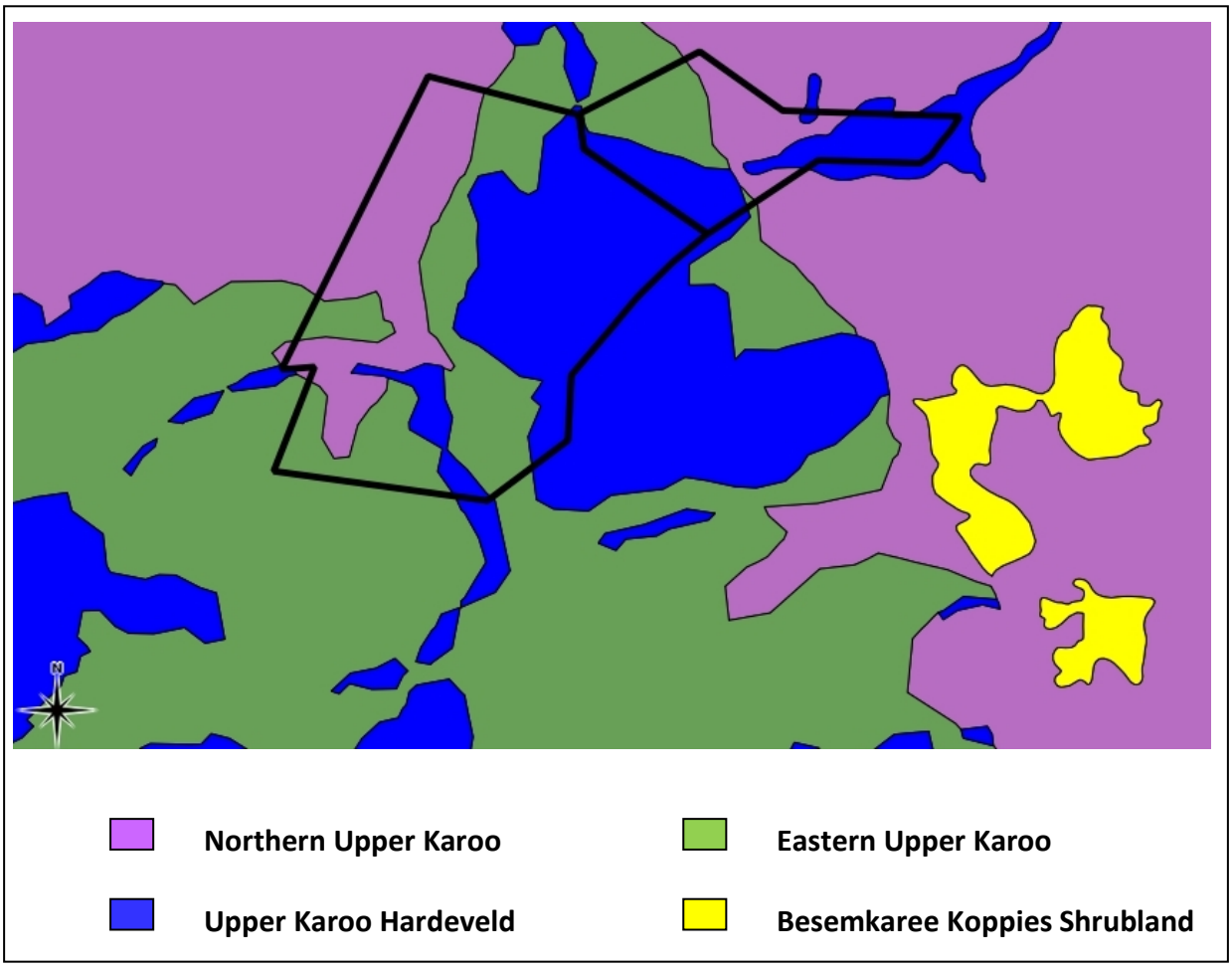

Figure 5: Vegetation units the Maanhaarberg site occupies (Mucina & Rutherford, 2006)

4.2 Relevant habitat classification

The site can on broad level be classified into three different habitat types, relevant to the predicted impacts and priority groups of fauna.

Ridge tops

The proposed turbine locations are all located on top of the low ridges scattered across the Upper Karoo Hardeveld area of the site. The proposed turbine locations all have a high to very high surface rock coverage, varying from scattered small rocks approximately the size of soccer balls to large boulder fields and extensive rock slabs. Surface soil depth is limited in these areas.

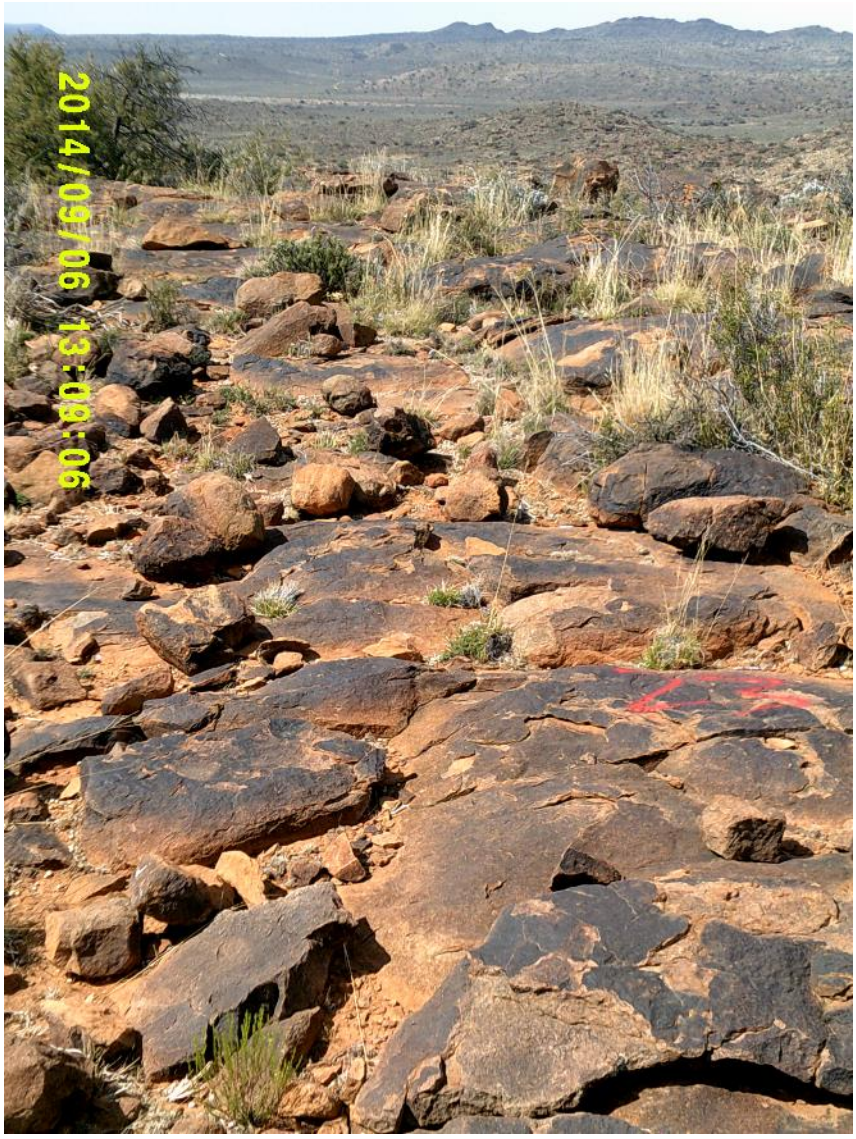

Figure 6: Rocky ridge top with rock slabs, most turbines are proposed in such terrain.

Ridge slopes

These slopes vary in size and inclination from the small gradual slopes on the sides of the small ridges on top of the plateau, to steeper longer slopes on the edges of the Upper Karoo Hardeveld plateau. Surface rock coverage is moderate to high with mostly loose boulders of varying sizes and some scattered rock slabs. Vegetation coverage are relatively high on some of the slopes and surface soil depth varies considerably.

Figure 7: Rocky slope with boulders and vegetation cover.

Low lying flats and valleys

The valleys and low lying areas between ridges and below the plateau is mostly flat with low surface rock coverage, and vegetation cover varies from fields of grass and shrubs to patches of sparse vegetation in the sandy areas. Surface soil depth is deep and can therefore sufficiently support burrowing animals.

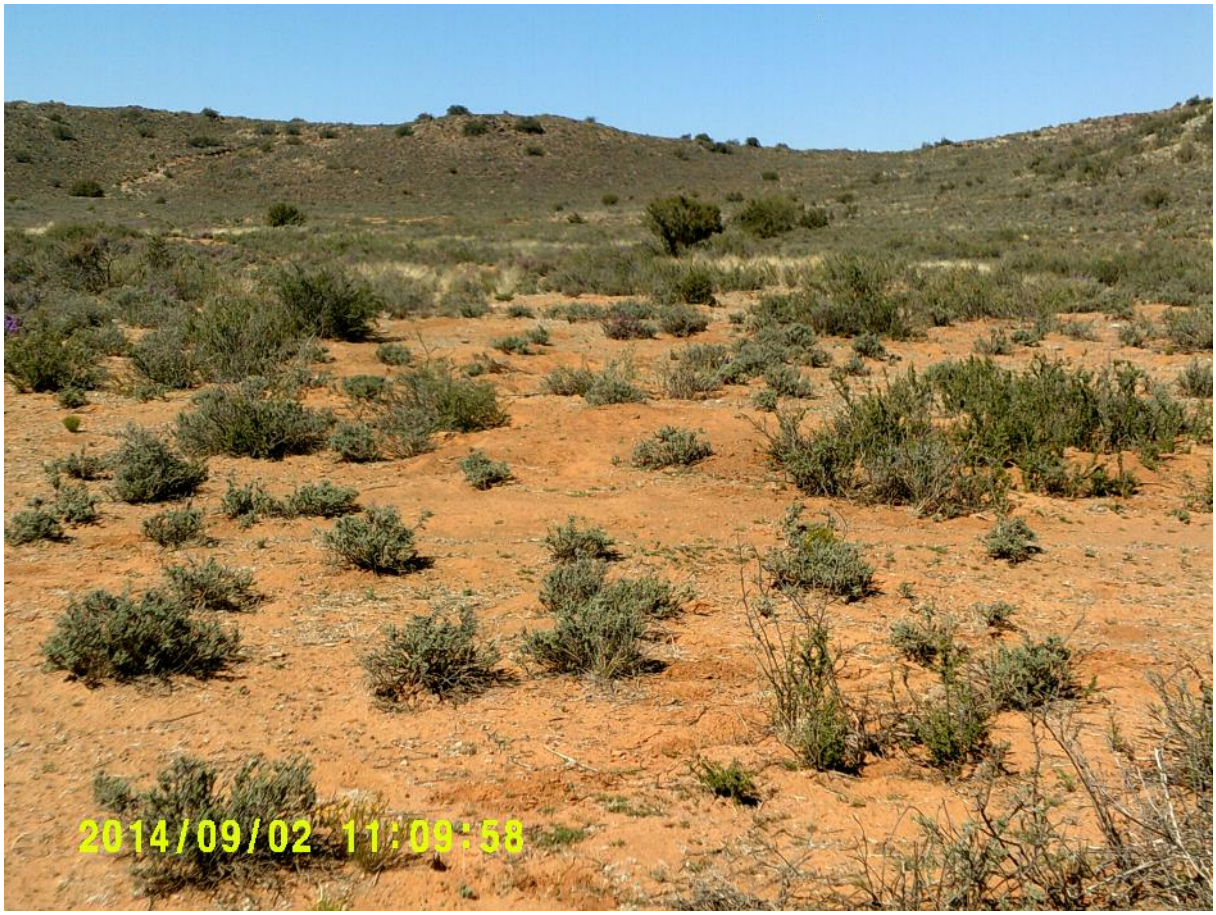

Figure 8: Low lying flats area with little vegetation cover and more sandy soils.

Figure 9: Low lying area with high vegetation cover.

4.3 Literature based fauna that may occur on site, as well as confirmed records

Table 1: Table of species that may be found in and utilising the study area, based on large scale literature distribution maps and habitats on site. LC = Least Concern; NT = Near Threatened; V = Vulnerable; www.iucnredlist.org; www.speciesstatus.sanbi.org). Of these two databases the conservation status of highest protection has been selected.
S1 and S2 refers respectively to Schedule 1 – Specially Protected Species and Schedule 2 – Protected Species from the Northern Cape Nature Conservation Act (Act no. 9 of 2009).

Common name	*Species*	Faunal class	S1	S2	Conservation status	Confirmation of occurrence	Associated habitat type on site, and notes
Brant's whistling rat	*Parotomys brantsii*	Mammal		✓	LC		Low lying sandy flats with sparse plant coverage. Diurnal and burrowing.
Grant's rock mouse	*Micaelamys granti*	Mammal		✓	LC		Rocky slopes and ridge ops with rock boulders. Little is known of habits
Vlei rat	*Otomys irroratus*	Mammal		✓	LC		Grassy vlei and damps areas in valleys.
Aardvark	*Orycteropus afer*	Mammal	✓		LC	Confirmed by locals. Signs observed.	Low lying flats with deep soils and less rocks. Especially areas with termite mounds. Nocturnal.
Aardwolf	*Proteles cristata*	Mammal	✓		LC	Sighted	Open low lying areas with grass and vegetation coverage, but not forested areas. Restricted to termite mound areas. Nocturnal,

Common name	*Species*	Faunal class	S1	S2	Conservation status	Confirmation of occurrence	Associated habitat type on site, and notes
							use old burrows of other species.
African striped weasel	*Poecilogale albinucha*	Mammal	✓		LC		Low lying areas with deep soils. Dig own burrows and use old burrows. Nocturnal.
African wild cat	*Felis silvestris*	Mammal	✓		LC		Rocky and vegetated ridge slopes, valleys with dense vegetation. Do not use burrows when vegetation coverage is sufficient. Nocturnal.
Bat-eared fox	*Otocyon megalotis*	Mammal	✓		LC		Low lying areas with sandy soils and sparse vegetation or grass, especially termite mound areas. Dig burrows and utilise old burrows. Nocturnal and diurnal.
Black-footed cat	*Felis nigripes*	Mammal	✓		V		Low lying areas with open terrain and vegetation cover. Use old burrows from other animals. Nocturnal.
Cape fox	*Vulpes chama*	Mammal	✓		LC		Low lying flatter areas. Dig own

Common name	*Species*	Faunal class	S1	S2	Conservation status	Confirmation of occurrence	Associated habitat type on site, and notes
							burrows. Nocturnal.
South African ground squirrel	*Xerus inauris*	Mammal		✓	LC		Low lying open areas with sparse vegetation cover and harder soils (non-sandy). Dig own burrows. Diurnal.
Cape rock elephant shrew	*Elephantulus edwardii*	Mammal		✓	LC		Rocky slopes as well as low lying areas. Shelter in cracks and crannies. Nocturnal.
Cape/Desert hare	*Lepus capensis*	Mammal		✓	LC		Low lying areas with grass or vegetation cover. Open grasslands.
Eastern Rock Elephant shrew	*Elephantulus myurus*	Mammal		✓	LC		Rocky slopes and ridge tops with rock boulders, mostly absent from rock slab areas with little shelter. Prefers overhangs and vegetation cover with rock boulders. Diurnal.
Hairy-footed gerbil	*Gerbillurus paeba*	Mammal		✓	LC		Low lying sandy areas. Dig own burrows, nocturnal.
Hewitt's red rock rabbit	*Pronolagus saundersiae*	Mammal		✓	LC		Probably rocky slopes and rocky valley bottom areas. Very little

Common name	*Species*	Faunal class	S1	S2	Conservation status	Confirmation of occurrence	Associated habitat type on site, and notes
							information available.
Highveld gerbil	*Tatera brantsii*	Mammal		✓	LC		Low lying sandy areas, dig own burrows.
Honey Badger	*Mellivora capensis*	Mammal	✓		LC		Rocky slopes and low lying areas, may also use rocky boulder ridge top areas. Shelter in cracks and spaces between rocks mostly.
Leopard	*Panthera pardus*	Mammal	✓		V	Possibly signs observed	Rocky slopes and low lying areas, particularly well vegetated kloof areas. Shelter in caves and rock overhangs.
Multimammate mouse	*Mastomys coucha*	Mammal		✓	LC		Wide habitat tolerance. Mostly low lying areas and hill slopes.
Namaqua rock mouse	*Micaelamys namaquensis*	Mammal		✓	LC		Rocky hill slopes and boulder fields. Build communal nests between boulders.
Porcupine	*Hystrix africaeaustralis*	Mammal		✓	LC	Signs observed	Rocky slopes and low lying areas. Occupy hollows, caves, burrows of other species. Nocturnal.

Common name	*Species*	Faunal class	S1	S2	Conservation status	Confirmation of occurrence	Associated habitat type on site, and notes
Pangolin	*Manis temminckii*	Mammal	✓		V		Low lying areas and rocky slopes with deep soils where old burrows of other species can be used. Nocturnal.
Reddish-grey musk shrew	*Crocidura cyanea*	Mammal		✓	LC		Rocky slopes and low lying areas with vegetation cover.
Rock hyrax	*Procavia capensis*	Mammal		✓	LC	Sighted	Rocky slopes with hollows and shelters. Absent from flat rock slabs on ridge tops with minimum shelter.
Round-eared elephant shrew	*Macroscelides proboscideus*	Mammal		✓	LC		Low lying flat areas or hill slopes with boulders and vegetation for cover.
Scrub/Savannah hare	*Lepus saxatilis*	Mammal		✓	LC		Slopes or low lying areas with vegetation cover, absent from open grassland.
Cape short-tailed gerbil	*Desmodillus auricularis*	Mammal		✓	LC		Low lying areas with grass and bush coverage, dig own burrows. Nocturnal.
Cape grey mongoose	*Galerella pulverulenta*	Mammal		✓	LC		Wide habitat tolerance, ridge slopes as well as

Common name	*Species*	Faunal class	S1	S2	Conservation status	Confirmation of occurrence	Associated habitat type on site, and notes
							low lying areas. Diurnal. Solitary.
Small-spotted genet	*Genetta genetta*	Mammal		✓	LC		Open low lying areas, as well as open rocky slope areas. Need scrub or underbrush to shelter during the day. Nocturnal.
South African Hedgehog	*Atelerix frontalis*	Mammal	✓		LC		Low lying and hill slope areas with dry vegetation cover, plentiful insects and moist (not wet) ground. On fringes of waterways.
Spectacled dormouse	*Graphiurus ocularis*	Mammal		✓	LC		Rocky slopes. Nocturnal.
Springhare	*Pedetes capensis*	Mammal		✓	LC		Low lying flatter areas.
Striped polecat	*Ictonyx striatus*	Mammal	✓		LC		Ide habitat tolerance. Low lying areas as well as rocky slopes with vegetation cover. Nocturnal. Dig own burrows in soft sand, but more commonly use old burrows from other species.
Meerkat	*Suricata suricatta*	Mammal		✓	LC	Sighted	Low lying areas with stony and hard substrate. Communal,

Common name	*Species*	Faunal class	S1	S2	Conservation status	Confirmation of occurrence	Associated habitat type on site, and notes
							diurnal and dig extensive burrows.
Tiny musk shrew	*Crocidura fuscomurina*	Mammal		✓	LC		Low lying areas near water with good grass and vegetation cover.
Yellow mongoose	*Cynictis penicillata*	Mammal		✓	LC		Low lying areas with sandy substrate and open areas. Diurnal. Dig own burrows.
Brown house snake	*Lamprophis capensis*	Reptiles		✓	NOT ASSESSED		Wide habitat tolerance. Rocky slopes and especially areas with cover in the form of rock boulders.
Burchell's sand lizard	*Pedioplanis burchelli*	Reptiles		✓	NOT ASSESSED		Low lying areas and rocky slopes with sandy soil and rocks for coverage.
Cape sand lizard	*Pedioplanis laticeps*	Reptiles		✓	LC		Low lying areas and rocky slopes with sandy soil and rocks for coverage.
Common brown water snake	*Lycodonomorphus rufulus*	Reptiles		✓	NOT ASSESSED		Low lying moist and well watered areas.
Common egg-eater	*Dasypeltis scabra*	Reptiles		✓	LC		Low lying areas as well as rocky ridge slopes. Use old termite

Common name	*Species*	Faunal class	S1	S2	Conservation status	Confirmation of occurrence	Associated habitat type on site, and notes
							mounds and other forms of cover.
Common slug-eater	*Duberria lutrix*	Reptiles		✓	LC		Low lying grassland areas.
Common tiger snake	*Telescopus semiannulatus*	Reptiles		✓	NOT ASSESSED		Rocky slopes and other rocky areas.
Common wolf snake	*Lycophidion capense*	Reptiles		✓	LC		Low lying grassland
Greater Padloper	*Homopus femoralis*	Reptiles		✓	NOT ASSESSED		Rocky ridge tops and rocky slopes, especially where horizontal crevices are available due to rock slabs.
Dwarf Karoo girdled lizard	*Cordylus aridus*	Reptiles	✓		EN	Possible sighting	Restricted to rocks and rock outcrops. Ridge tops as well as rocky slopes. Inhabits cracks.
Karoo Padloper	*Homopus boulengeri*	Reptiles		✓	NOT ASSESSED		Rocky ridge tops and rocky slopes, especially where horizontal crevices are available due to rock slabs.
Karoo sandveld lizard	*Nucras livida*	Reptiles		✓	NOT ASSESSED		Low lying areas and rocky slopes with sandy soil and rocks for coverage.
Karoo Tent	*Psammobates*	Reptiles		✓	NOT	Confirmed by	Low lying areas

Common name	*Species*	Faunal class	S1	S2	Conservation status	Confirmation of occurrence	Associated habitat type on site, and notes
Tortoise	*tentorius*				ASSESSED	locals	as well as any other rocky terrain on site.
Leopard Tortoise	*Stigmochelys pardalis*	Reptiles		✓	NOT ASSESSED	Confirmed by locals	Rocky areas with vegetation cover as well as low lying areas.
Mole snake	*Pseudaspis cana*	Reptiles		✓	NOT ASSESSED		Wide habitat. Common in sandy scrub and grassland areas.
Namaqua sand lizard	*Pedioplanis namaquensis*	Reptiles		✓	NOT ASSESSED		Low lying areas and rocky slopes with sandy soil and rocks for coverage.
Rock monitor	*Varanus albigularis*	Reptiles		✓	NOT ASSESSED		Rocky slope areas as well as ridge topes with crevices and horizontal overhang coverage.
Spotted sand lizard	*Pedioplanis lineoocellata*	Reptiles		✓	NOT ASSESSED		Low lying areas and rocky slopes with sandy soil and rocks for coverage.
Spotted sandveld lizard	*Nucras intertexta*	Reptiles		✓	NOT ASSESSED		Low lying areas and rocky slopes with sandy soil and rocks for coverage.
Sundevall's shovel-snout	*Prosymna sundevalli*	Reptiles		✓	NOT ASSESSED		Rocky areas as well as low lying flat areas amongst termite

Common name	*Species*	Faunal class	S1	S2	Conservation status	Confirmation of occurrence	Associated habitat type on site, and notes
							mounds.
Giant Bullfrog	*Pyxicephalus adspersus*	Amphibians	✓		Protected		Low lying flat areas where depressions or pans may be present. Remains burrowed on sandy banks of water bodies for most of the year.
Horned baboon spiders	*Ceratogyrus spp.*	Arachnids	✓			Possibly signs observed	Particularly low lying flat areas with gradual slopes.
Common baboon spiders	*Harpactira spp.*	Arachnids	✓			Signs observed	Particularly low lying flat areas with gradual slopes.
Golden- brown babboon spiders	*Pterinochilus spp*	Arachnids	✓			Possibly signs observed	Particularly low lying flat areas with gradual slopes.
Rock scorpions	*Hadogenes spp.*	Arachnids		✓			In rock crevices on rocky slopes as well as ridge tops
Creeping scorpions	*Opistacanthus spp.*	Arachnids		✓			In rock crevices on rocky slopes as well as ridge tops
Burrowing scorpions	*Opistophthalmus spp.*	Arachnids		✓		Signs observed	Ridge slopes and low lying areas where burrows are constructed facing downhill.

5 PROBABLE IMPACTS AND PROPOSED MITIGATIONS, AND CONCLUSION

Rocky areas and actual turbine positions

When considering **Table 1**, the majority of faunal diversity is concentrated in the low lying and hill slope areas. Only specialist species such as rock scorpions, certain lizards and some tortoises may be present at the proposed turbine positions. However carnivores and other animals that utilise overhangs and hollows/caves may occur in close vicinity to turbine positions.

It is assumed that blasting will be required to excavate the foundations of the proposed turbines, in such cases a radius equivalent to that required for human safety must be scanned for large hollows and caves that can host carnivores. If any carnivores are found or suspected to occupy any such hollows/overhangs, they need to be evicted in an ethical manner by a suitably experienced and qualified person before blasting takes place.

The impacted footprint of the turbine foundations and hard standings on lizards, scorpions and other more abundant fauna (relative to the carnivores) is low in comparison to the available habitat on site. The proposed turbine layout are therefore acceptable.

Low lying areas and ridge slopes

The ridge slopes and especially the low lying areas are of concern as these can host a variety of animals (**Table 1**). The main impact proposed on the low lying areas is the laydown areas to be leveled out and gravel added where needed. These laydown areas, especially the one close to turbines A38 and A37, have multiple Aardvark and other animal burrows as well as numerous Baboon spider burrows. Table 1 clearly illustrates the dependence of various animals on such larger mammal burrows and it suggests that these burrows may be occupied by a variety of fauna, including the Vulnerable Black Footed cat. Leveling these areas can have negative impacts such as direct mortality on animals inhabiting underground burrows.

Table 2: The main species of fauna that are of concern, and that may utilise Aardvark burrows, as well as the months of birth and protection period for young. Protection period refers to the time needed before young may possibly move out of a burrow by itself during disturbance. Risk period indicates the period when helpless young may be in a burrow, unable to move away from disturbances caused by construction. (Skinner & Chimimba, 2005) Data for Aardvark and Pangolins are very limited.

Species	**Birth months**	**Protection period for young**	**Risk period**
Aardvark	June - July	Unknown	June - Unknown
Black-footed cat	Mid Sept – mid Nov	8 weeks	Mid Sept – mid Jan
Pangolin	Mar – mid Sept	5 weeks	Mar - late Oct
Aardwolf	Oct - Dec	8 – 10 weeks	Oct – mid Mar

According to **Table 2**, the preferred period for construction in the low lying areas are start of January to end of May. This is limited to actions that will close up, compact, excavate, seal off or damage burrows in any way, and thereby harm the burrow inhabitants, in the low lying areas. However, construction actions that can harm burrow dwelling animals may still continue in these areas during other times of the year on condition that each Aardvark burrow is confirmed to be vacant. And if inhabited that it be dealt with in an ethical manner considering the possibility of immobile young that may remain in the burrow (e.g. methods of closing off a burrow after the animal left should be approached with caution). Table 2 should be used in addition to the other mitigatory approaches mentioned in this document, since there is a lack of data on the reproduction of these animals.

It is suggested that the laydown area mentioned above be micro-sited to terrain where burrows (including that of baboon spiders) are limited. If an area with burrows are to be used, it is recommended that they are investigated first to determine the presence and identity of inhabitants. And if inhabited they need to be carefully dug up and the inhabitants evicted and relocated (less than 2km away) in an ethical manner by a suitably qualified and experienced person. Such an exercise is not recommended unless completely necessary.

Individual burrows or areas with burrows can be marked and impact must be avoided on the burrows for a period of minimum 2 weeks, allowing the inhabitants to move out. However if disturbances and activities resume nearby to the burrows it may facilitate in driving the inhabitants out of their burrows.

In the case of baboon spiders, unless a new artificial burrow is created, relocation may be unsuccessful due to the inability of these spiders to dig new burrows once they shed their juvenile skins.

A provisional road layout has been provided, therefore in the case where the road layout may change the principles described for each habitat should be followed. The same principles mentioned above should also be followed for areas where burrows are present during road construction.

Tortoises have a very high likelihood to be impacted upon by heavy machinery and vehicles (bakkies and 4x4's) especially when new terrain is driven/cleared where no roads are present. It is recommended that the new path of a vehicle be walked out by a person in front of the vehicle, observing for tortoises. Once roads are established drivers should be made aware of and cautious of tortoises crossing roads and must refrain from driving off road. The area between turbines A56, A64 and AB12 are of particular concern for tortoises, but not excluding all other areas important to tortoises mentioned in Table 1.

Most other groups of fauna not mentioned in Table 1 are expected to temporarily move away from the path and activity of construction.

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Appendix 13
EMP Addendum for additional activities

BASIC ASSESSMENT PROCESS FOR ADDITIONAL ACTIVITIES AT THE PREVIOUSLY AUTHORISED LONGYUAN MULILO DE AAR MAANHAARBERG WIND ENERGY FACILITY (100 MW) NEAR DE AAR, NORTHERN CAPE

DENC REF NO.: NC/BA/05/PIX/EMT/DEA2/014

ENVIRONMENTAL MANAGEMENT PROGRAMME ADDENDUM TO THE PREVISOULY AUTHORISED EMP

25 FEBRUARY 2014

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Document Control Record

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Report Title	Basic Assessment Process for Additional Activities at Authorised Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility (100 MW) near De Aar, Northern Cape.					
Document ID	**8846**	**Project Number**	110355			
File Path	P:\Projects\110355 De Aar 1 BAR\03 PRJ Del\3 DELIVERY\1 REPORTS\2 DRAFT BASIC ASSESSMENT REPORT					
Client	Longyuan Mulilo De Aar Wind Power (Pty) Ltd	**Client Contact**	Karen Versfeld			
Rev	**Date**	**Revision Details/Status**	**Prepared by**	**Author**	**Verifier**	**Approver**
A	25 February 2014		Karen de Bruyn; Franci Gresse	Karen de Bruyn; Franci Gresse	Charles Norman	Louise Corbett
Current Revision	1					

Approval

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ABBREVIATIONS

BA	Basic Assessment
DEA	Department of Environmental Affairs
DENC	Department of Environment and Nature Conservation, Northern Cape
DJEC	DJ Environmental Consultants
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
NEMA	National Environmental Management Act (No. 107 of 1998)
WEF	Wind Energy Facility

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1 BACKGROUND INFORMATION

This document represents an addendum to the Environmental Management Programme (EMP) compiled during 2010 by DJ Environmental Consultants (DJEC) as part of the Environmental Impact Assessment process (EIA) for the 100 megawatt (MW) Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility (WEF) near De Aar, Northern Cape.

This EMP was authorised during October 2011 as part of the Environmental Authorisation (EA) (DEA: 12/12/20/1651; NEAS: DEAT/EIA/6159/2009) for the WEF. Therefore, this addendum should be read in conjunction with the previously approved EMP[1].

1.1 Project description of additional activities proposed

The authorised De Aar 1 WEF consists of 67 turbines, each with a generation capacity of 1.5 MW. The total wind farm footprint (67 ha) is spread over an area of 11 766 hectares (ha) accounting for 0.005% of the total area, with the required spacing between turbines of 200 m to 600 m, depending on terrain topography and main wind direction. The turbines are mounted on cylindrical steel towers 80 m high and 4 m in diameter at the base. Each turbine rotor has three 40 m long blades that are manufactured from a composite material. Foundations to support turbine towers will consist of circular concrete foundations with a diameter of 16 m (201 m^2) per turbine. Hard standing areas to support cranes will be 50 m x 50 m per turbine.

Internal 33 kV overhead electrical reticulation lines were assessed as part of the previous EIA and will connect the turbines to the onsite substation. Internal electrical reticulation lines would follow the route of the access roads as far as possible. The onsite substation / control building area will be 100 m x 200 m in extent. This area includes a temporary construction yard that will be used to house equipment and materials related only to the construction of the on-site substation and construction building. The wind turbines will generate electricity at a voltage of 33 kV which will be stepped up via a transformer to 132 kV which will lead over a 22 km distance to the Hydra substation, where the electricity will be fed into the national grid

The previous assessment did not take into consideration the surface water features onsite. In order to mitigate any negative impacts, this EMP addendum focuses on mitigating impacts associated with the construction of internal access roads, 33 kV electrical reticulation lines, three construction yards and a substation/ control building located in close proximity to surface water features. The wind turbine generators are located 100 m from surface water features and were therefore not included in this assessment.

[1] DJ Environmental Consultants, 2010. Environmental Management Programme for the proposed establishment of a Wind Farm, De Aar.

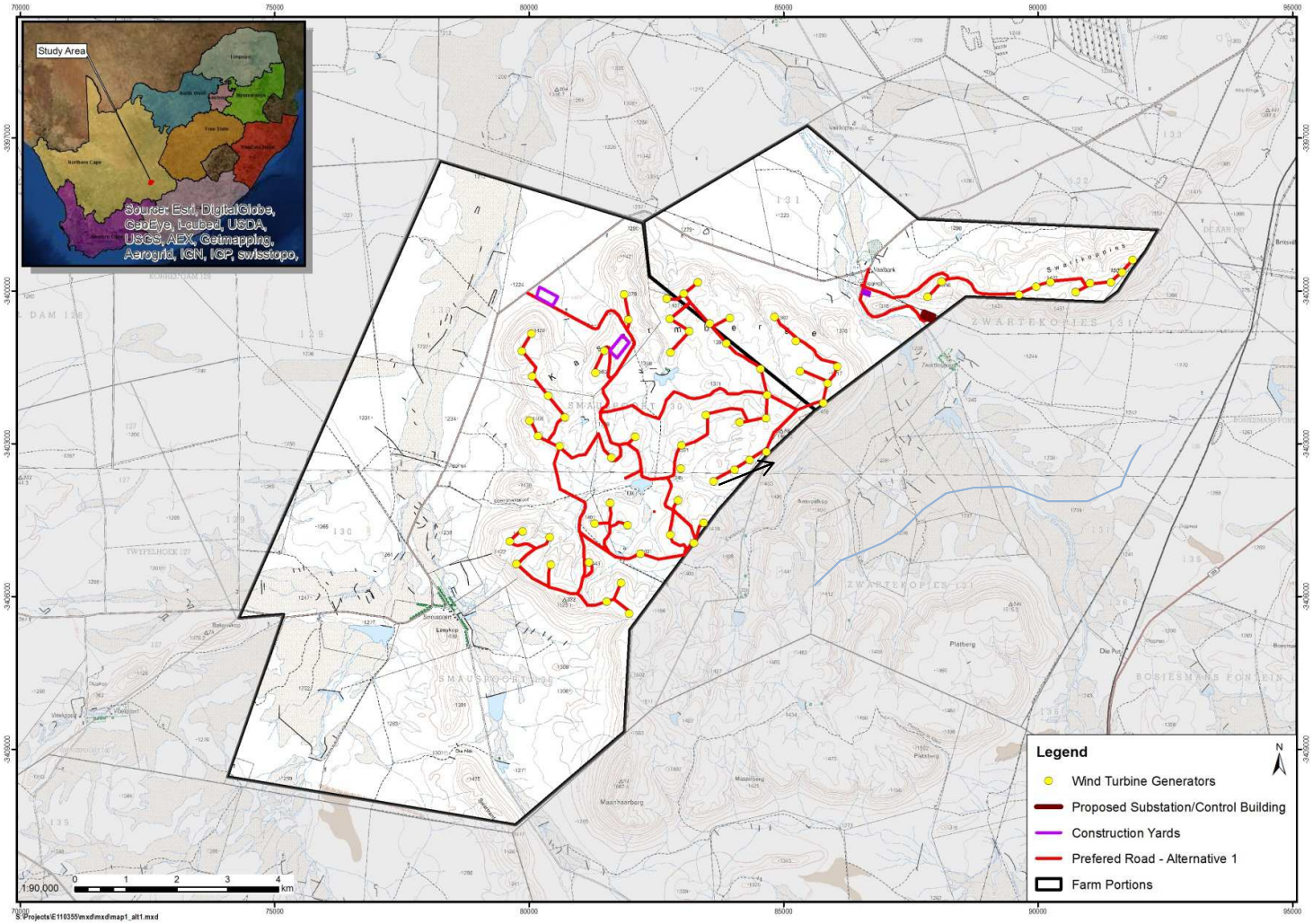

Figure 1 | Access roads, substation/ control building and construction laydown areas currently proposed (preferred layout)

2 MITIGATION MEASURES

The design, construction and operational phases for the WEF should respond to the identified environmental mitigation measures as recommended by the aquatic specialist to reduce the environmental impacts:

Planning phase

- With regards to the proposed substation, Longyuan Mulilo shall consider either to divert the drainage channel(s) that currently pass through the site around the proposed substation and/or to do some minor adjustment to the location of the facility. This will be confirmed after the storm water design has been finalised.

Construction phase

- Construction activities shall be limited to the identified sites for the WEF and the identified access roads.

i. <u>WEF</u>

- Turbines (including its area of disturbance) shall not be located within 100 m of drainage lines of the Elandsfontein River (measured from the centre of the channel).
- The small wetland area in the centre of the site as well as the larger stream channels shall be considered as 'no-go' portions of the site. Please see Section 5 for a description on the No-Go areas and Figure 2.
- Cleared areas shall be rehabilitated after construction is completed.

ii. <u>33 kV electrical reticulation lines and substation/ control building</u>

- Monopoles for the electrical reticulation lines shall be placed outside of the recommended buffer for the streams/drainage lines (20 m).
- Where new access roads and electrical reticulation lines need to be constructed across drainage channels, disturbance of the channels shall be limited and the crossing shall be perpendicular to the channel.
- Electrical reticulation lines and roads created parallel to the channels shall be located at least 20 m away from the stream channel.
- These disturbed areas shall be rehabilitated after construction is completed and the areas shall be monitored for growth of invasive alien plants.
- Ensure that on-site storm water management is such that erosion within the drainage lines is minimised and that the channels are rehabilitated once construction activities are complete.

iii. <u>Access roads</u>

- Existing road infrastructure shall be utilized as far as possible to minimise the overall disturbance created by the proposed project.
- In terms of the new access roads, where the access roads cross streams these shall, where possible, cross perpendicular to the stream to minimise disturbances within the stream/drainage channel.
- Where access roads need to be constructed through ephemeral streams, disturbances to the channel shall be kept to a minimum.

- All crossings over drainage channels or stream beds shall be such that the flow within the drainage channel is not impeded or diverted.
- Roads created parallel to the channels shall be located at least 20 m away from the stream channel measured from the centre of the stream channel.
- Temporary roads created during the construction phase shall also comply with the requisite 20 m buffer and be rehabilitated once construction activities have been completed.
- Road infrastructure and electrical reticulation lines shall coincide as much as possible to minimise impacts from the road network and associated activities.
- Any disturbed area shall be rehabilitated to ensure that these areas do not become subject to erosion or invasive alien plant growth.

iv. Proposed construction yards

- Construction activities shall be restricted to the identified construction yard sites.
- Rehabilitation of cleared areas shall be initiated immediately after construction is completed.
- Ensure that on-site storm water management is such that erosion within the drainage lines is minimised and that the channels are rehabilitated once construction activities are complete.
- Monitoring of these sites post-construction shall take place to ensure that rehabilitation have been done adequately and do not provide opportunity of growth of invasive alien plants.
- Water for the construction phase of the project shall be obtained from sources outside of the plateau areas.
- All materials on the construction sites shall be properly stored and contained.
- Disposal of waste from the sites shall be properly managed.
- Ablution facilities shall be provided at the construction sites at least 100 m away from the drainage lines/ephemeral streams. These shall be provided at a ratio of one portable toilet per 15 construction workers and shall be serviced at least once per week.

Operation activities

- Operational activities shall be limited to the development footprint for the proposed development and the identified access roads.

i. Maintenance of wind energy facilities

- Invasive alien plant growth shall be monitored on an ongoing basis to ensure that these disturbed areas do not become infested with invasive alien plants.
- All storm water run-off infrastructure shall be maintained to mitigate both flow and water quality impacts related to storm water leaving the wind energy facilities site.
- All erosion features developing as a result of the WEF infrastructure shall be stabilised as soon as possible.
- Water sources shall be obtained from outside of the plateau areas for the operation phase.
- Sewage and solid waste shall be disposed of outside of the plateau areas for the operation phase.

ii. Proposed electricity distribution network and onsite substation / control building

- Maintenance of electrical reticulation lines shall only take place via the designated access roads.
- The Storm Water Management Plan for the proposed associated infrastructure, including the onsite substation/ control building, shall ensure that erosion within the drainage channels at the facility does not take place.
- Any erosion within the channel at, or downstream of the facility, shall be monitored and mitigated after larger rainfall events.

iii. Proposed access roads

- Maintenance of infrastructure related to the project shall only take place via the designated access roads.
- Disturbed areas along the access roads shall be monitored every three months to ensure that these areas do not become subject to erosion or invasive alien plant growth.
- Storm water control measures along the access roads shall be monitored and managed to ensure that erosion does not take place within the drainage channels and streams at the road crossings.

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3 DESIGN/ CONSTRUCTION PHASE EMP

Table 1: Design and Construction Phase EMP

No	ASPECT	IMPACT	MITIGATION MEASURE: (objective and mechanism)	PERFORMANCE INDICATOR	RESPONSIBILITY	SCHEDULE	VERIFICATION
1.	Authorised WEF	Limited disturbance of freshwater related habitats as a result of construction work.	Objective: To ensure that the construction activities do not result in avoidable impacts on the surface water features. Mechanism: 1) Construction activities shall as far as possible be limited to the identified sites for the WEF and the identified access roads. 2) No turbine (including its area of disturbance) may be located within 100 m of drainage lines of the Elandsfontein River (measured from the centre of the channel). 3) The small wetland area in the centre of the site as well as the larger stream channels shall be considered as 'no-go' portions of the site. 4) Cleared areas shall be rehabilitated after construction is completed. 5) A rehabilitation plan shall be compiled prior to the commencement of the construction phase.	"No avoidable impacts to surface water features". "Rehabilitation plan compiled and implemented".	ECO, Engineer and EPC.	*Mechanism 1-3* During the design and construction phases (from site establishment to contract completion). *Mechanism 4-5* During the construction phase (from site establishment to contract completion).	ECO and developer
2.	Approved electricity distribution network (33 kV electrical reticulation line) and substation/ control building	Limited disturbance of freshwater related habitats as a result of construction work	Objective: To ensure that the construction activities do not result in avoidable impacts on the surface water features. Mechanism: 1) Monopoles for electrical reticulation lines shall be placed outside of the recommended buffer for the streams/drainage lines (20 m). 2) Where new access roads and electrical	"No avoidable impacts to surface water features".	ECO, Engineer and EPC.	*Mechanism 1-3* During the design and construction phases (from site establishment to contract completion).	ECO and developer

No	ASPECT	IMPACT	MITIGATION MEASURE: (objective and mechanism)	PERFORMANCE INDICATOR	RESPONSIBILITY	SCHEDULE	VERIFICATION
			reticulation lines need to be constructed through the drainage channels, disturbance of the channels shall be limited and the crossing should preferably be perpendicular to the channel. 3) Electrical Reticulation lines and roads created parallel to the channels shall be located at least 20 m away from the stream channel. 4) These areas shall be rehabilitated after construction is complete and the areas monitored for growth of invasive alien plants. 5) Ensure that on-site storm water management is such that erosion within the drainage lines is minimised and that the channels are rehabilitated once construction activities are complete.			*Mechanism 4-5* During the construction phase (from site establishment to contract completion).	
3.	Access roads, both temporary and permanent roads	Limited disturbance of freshwater related habitats as a result of construction work	Objective: To ensure that the construction activities do not result in avoidable impacts on the surface water features. Mechanism: 1) Existing road infrastructure shall be utilised, as far as possible, to minimise the overall disturbance created by the proposed project. 2) In terms of the new access roads, where the access roads cross streams they shall as far as possible cross perpendicularly to the stream to minimise the disturbance within the stream/drainage channel. 3) Where access roads need to be constructed through ephemeral streams, disturbance of the channel shall be limited. 4) All crossings over drainage channels or	"No avoidable impacts to surface water features".	ECO, Engineer and EPC.	*Mechanism 1-2, 5 and 7* During the design and construction phases (from site establishment to contract completion). *Mechanism 3, 4 and 6* During the construction phase (from site establishment to	ECO and developer

No	ASPECT	IMPACT	MITIGATION MEASURE: (objective and mechanism)	PERFORMANCE INDICATOR	RESPONSIBILITY	SCHEDULE	VERIFICATION
			stream beds shall be such that the flow within the drainage channel is not impeded. 5) Roads created parallel to the channels shall be located at least 20 m away from the stream channel. 6) Temporary roads created during the construction phase shall also comply with the requisite 20 m buffer and be rehabilitated once construction activities are complete. 7) Road infrastructure and electrical reticulation lines shall coincide as much as possible to minimise the road network and impact of these activities. 8) Any disturbed areas shall be rehabilitated to ensure that these areas do not become subject to erosion or invasive alien plant growth.			contract completion).	
4.	Construction yards	Limited disturbance of freshwater related habitats as a result of construction work	Objective: To ensure that the construction activities do not result in avoidable impacts on the surface water features. Mechanism: 1) Construction activities shall be limited to the identified construction yard sites. It is important that any of the cleared areas are rehabilitated after construction is completed. 2) Ensure that on-site storm water management is such that erosion within the drainage lines is minimised and that the channels are rehabilitated once construction activities are complete. 3) Monitoring of these sites post-construction will need to take place to ensure that have been adequately rehabilitated and do not	"No avoidable impacts to surface water features".	ECO, Engineer and EPC.	During the construction phase (from site establishment to contract completion).	ECO and developer

No	ASPECT	IMPACT	MITIGATION MEASURE: (objective and mechanism)	PERFORMANCE INDICATOR	RESPONSIBILITY	SCHEDULE	VERIFICATION
			provide opportunity of growth of invasive alien plants. 4) Water for the construction phase of the project shall be obtained for sources outside of the plateau areas. 5) All materials shall be properly stored and contained. 6) Disposal of waste from the sites shall also be properly managed. 7) Construction workers shall be given ablution facilities at the construction sites that are located at least 100m away from the drainage lines/ephemeral streams and regularly serviced.				

4 OPERATIONAL PHASE EMP

Table 2: Operation Phase EMP

No	ASPECT	IMPACT	MITIGATION MEASURE: (objective and mechanism)	PERFORMANCE INDICATOR	RESPONSIBILITY	SCHEDULE	VERIFICATION
1.	General management	Limited disturbance of freshwater related habitats as a result of operational work	Objective: Prevent operational activities from impacting on surrounding surface water features. Mechanism: 1) Operational activities shall be limited to the delineated site for the proposed development and the identified access roads. 2) Water sources shall be obtained from, and sewage and solid waste or disposed of, outside of the plateau areas for the operation phase.	"No avoidable impacts to surface water features".	Engineer	During the operational phase.	Engineer
2.	Erosion management	Limited disturbance of freshwater related habitats as a result of operational work	Objective: Prevent operational activities from resulting in erosion. Mechanism: 1) Any storm water run-off infrastructure shall be maintained to mitigate both the flow and water quality impacts of any storm water leaving the wind energy facilities site. 2) Should any erosion features develop, they shall be stabilised as soon as possible. 3) Storm water management at the proposed substation shall ensure that erosion within the drainage channels at the facility does not take place.	"No avoidable impacts to surface water features".	Engineer	During the operational phase.	Engineer

No	ASPECT	IMPACT	MITIGATION MEASURE: (objective and mechanism)	PERFORMANCE INDICATOR	RESPONSIBILITY	SCHEDULE	VERIFICATION
3.	Alien vegetation management	Limited disturbance of freshwater related habitats as a result of operational work	Objective: Prevent operational activities from impacting on vegetation. Mechanism: 1) Invasive alien plant growth shall be monitored on an ongoing basis to ensure that these disturbed areas do not become infested with invasive alien plants. 2) Disturbed areas along the access roads shall be monitored to ensure that these areas do not become subject to erosion or invasive alien plant growth.	"No avoidable impacts to surface water features".	Engineer	During the operational phase.	Engineer
4.	Infrastructure maintenance	Limited disturbance of freshwater related habitats as a result of operational work	Objective: Prevent operational activities from impacting on surrounding surface water features. Mechanism: 1) Maintenance of electrical reticulation lines and other infrastructure shall only take place via the designated access roads.	"No avoidable impacts to surface water features".	Engineer	During the operational phase.	Engineer

5 NO-GO AREAS

In terms of the sensitivity of the site, the larger streams and the wetland area, as indicated in Figure 2, are deemed to be the most sensitive and shall be treated as 'no-go' areas. The remainder of the site tends to consist of small drainage features that are considered to be ecologically less significant. Due to the sensitivity of the plateau area as a whole as a recharge area for the wider Elandsfontein Catchment, it would be essential that water sources for the project be obtained from outside of the plateau areas. Sewage and solid waste shall be disposed of outside of the plateau areas

In order to protect these no-go areas, the following buffers shall be implemented:

- No turbine (including its area of disturbance) shall be located within 100 m of drainage lines of the Elandsfontein River (measured from the centre of the channel).
- The small wetland area in the centre of the site as well as the larger stream channels shall be considered as 'no-go' portions of the site.
- Electrical reticulation lines and roads created parallel to the channels shall be located at least 20 m away from the stream channel.
- Temporary roads created during the construction phase shall also comply with the requisite 20 m buffer and be rehabilitated once construction activities are complete.
- Monopoles for electrical reticulation lines should be placed outside of the recommended buffer for the streams/drainage lines (20 m).
- Construction workers should be given ablution facilities at the construction sites that are located at least 100 m away from the drainage lines/ephemeral streams and regularly serviced.

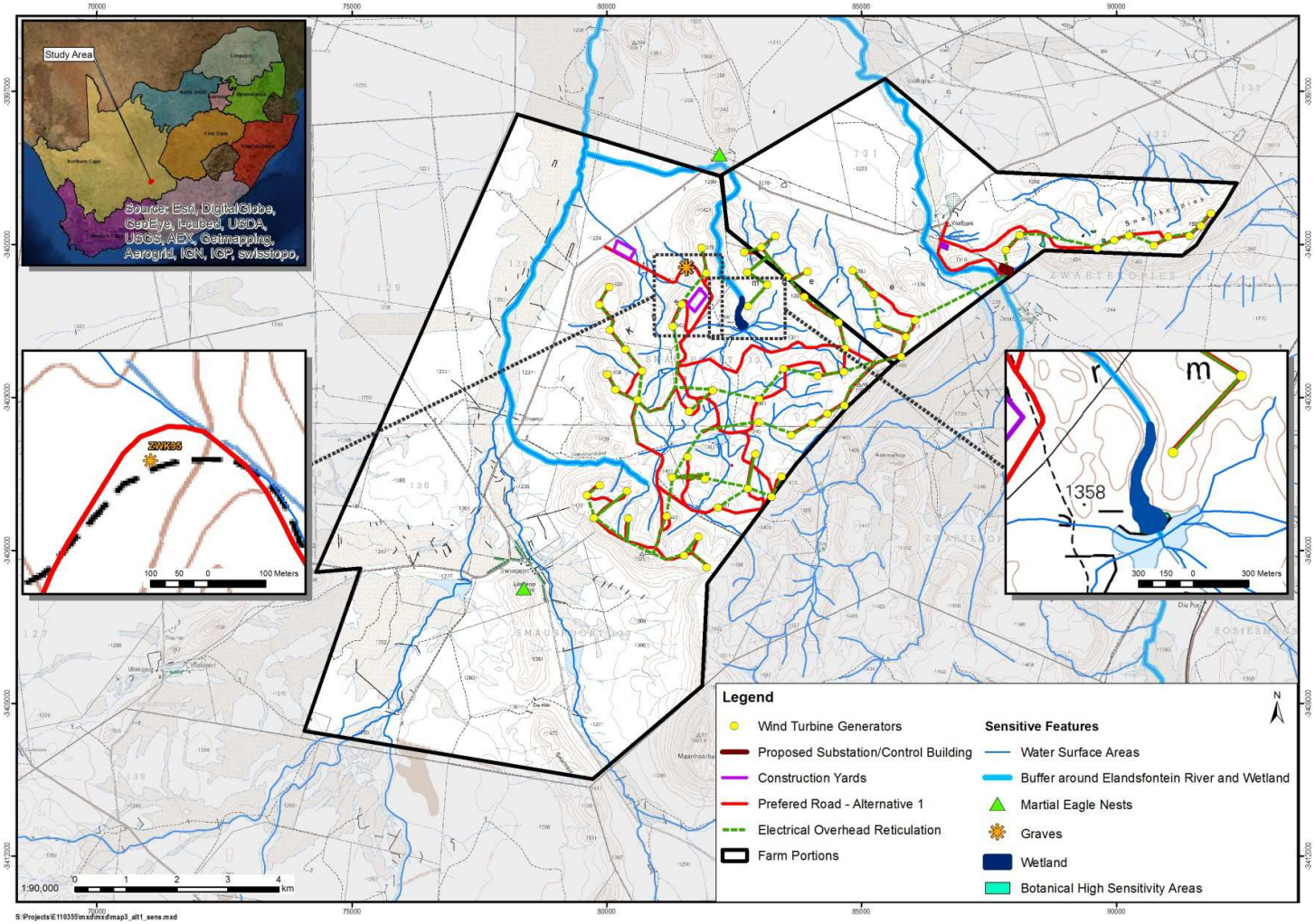

Figure 2 | Sensitivity map indicating the buffers and no-go areas

6 PENALTIES

Penalties shall be issued for transgressions and may be issued per incident at the discretion of the Engineer and/or the ECO. Such penalties shall be issued in addition to any remedial costs incurred as a result of non-compliance with the environmental specifications. The Engineer shall inform the Contractor of the contravention and the amount of the penalty, and shall deduct the amount from monies due under the Contract. A penalty register shall be kept and shall be made available on request.

Penalties would be handled as described in the 2010 approved EMP Section 12.

7 AMENDMENTS TO EMP

Amendments to the EMP shall be submitted to and approved by the competent authority before the changes are commenced with.

8 REGISTERS

Copies of the attendance registers for all environmental awareness training, complaints registers, penalty registers and method statements shall be kept and made available to the competent authority on request.

9 CONCLUSION

In conclusion, the EMP addendum shall be regarded as a living document to allow for changes to the EMP addendum in response to environmental conditions and legal requirements, while retaining the underlying principles and objectives on which this document is based.

The compilation of the EMP addendum has incorporated impacts and mitigation measures from the BA as well as incorporating principles of best practice in terms of environmental management. By identifying the potential impacts, mitigation measures, performance indicators, responsibilities, available resources, potential schedule and verification responsibility, the EMP addendum has provided a platform on which both the construction phase and the operational phase can be founded. The EMP addendum has ensured that the previously authorised EMPs will be able to incorporate mitigation measures based on the additional infrastructure proposed in its entirety.

Curriculum vitae: Mrs K de BRUYN

Name	:	**DE BRUYN, KAREN**
Date of Birth	:	12 December 1987
Profession/Specialisation	:	Environmental studies and management
Years with Firm	:	3
Nationality	:	South African
Years experience	:	4

Key qualifications

Karen is an environmental scientist with three years' of experience in the environmental management field. She has a wide range of experience in undertaking environmental processes for small and medium to large-scale developments ranging from renewable energy projects, civil projects and general waste related projects to mining projects.

As technical staff, Karen is responsible for compiling reports for both the basic assessment and environmental impact assessment (EIA) processes in accordance with applicable legislation.

Karen is a certified natural scientist with the South African Council for Natural Scientific Professions (SACNSP), a member of the International Association for Impact Assessments South Africa (IAIASA) and also an associate member of the Institute of Waste Management of Southern Africa (IWMSA). She holds a Master of Philosophy degree in Environmental Management and a Bachelor of Science degree in Conservation Ecology, both obtained from the University of Stellenbosch in South Africa.

Employment record

03/2011 - Date	Aurecon, Environmental Assessment Practitioner (EAP)
02/2010 - 02/2011	Anèl Blignaut Environmental Consultants, Junior Environmental Assessment Practitioner (EAP)

Experience record

Mulilo photovoltaic (PV) expansion **(Northern Cape Province, South Africa) 03/2013 - Date.** *Technical Staff Member.* This project entailed two EIA processes for the proposed photovoltaic energy facilities at Badenhorst Dam Farm and Du Plessis Dam Farm. At Badenhorst Dam Farm, the solar energy project would comprise of four 75MW solar energy facilities. At Du Plessis Dam Farm, the solar energy project would comprise of three 75MW solar energy facilities. Responsible for report compilation, review of specialist reports and public participation process. Involved for 1.27 person-months. (Mulilo Renewable Energy (Pty) Ltd).

Social and environmental impact assessment (SEIA) for the proposed mining of the Z20 uranium deposit. **(Erongo Region, Namibia) 10/2012 - 10/2013.** *Technical Staff Member.* Aurecon was appointed to manage a social and environmental impact assessment (SEIA) for the proposed mining of the Z20 uranium deposit and the infrastructure corridor linking the mine to the Rössing plant. Responsible for compilation of the scoping, the SEIA and environmental management plan (EMP) reports. Involved for 2.18 person-months. (Rössing Uranium Limited).

Update to environmental and social impact assessment (ESIA) for the construction of the Ministry of Staff houses at Ombika Gate of the Etosha National Park **(Etosha National Park, Namibia) 06/2012 - 08/2012.** *Technical Staff Member.* The Millennium Challenge Account Namibia (MCA-N) is supporting the Ministry of Environment and Tourism (MET) with regard to infrastructure improvements in Etosha National Park (ENP). An environmental and social impact assessment (ESIA) study in 2010 by Aurecon identified and assessed all environmental and social impacts and developed required mitigation measures for all identified environmental issues for the site on the eastern side of the Ombika Gate (Ombika East). Both the site selection report and the follow-up site specific ESIA study were formally approved and environmental clearance granted by MET in accordance with the Environmental Management Act (EMA) of 2007. However, MET has formally requested that an alternate site on the west side of the road (Ombika West) be included in the assessment for the new staff village at Ombika (Okaukuejo Gate). Responsible for updating the ESIA report, assisting with report writing, presenting results to Interested and Affected Parties (I&APs), site visits and informing adjacent landowners of the additional study. Involved for 1 person-month. (Ministry of

Environment and Tourism).

Construction phase environmental management programme (EMP) for the proposed office building for SANRAL on Erf 39688, Upper Oakdale **(Western Cape Province, South Africa) 04/2012 - 05/2012.** *Technical Staff Member.* SANRAL required additional office space and proposed to develop a business park that would involve the construction of an office building of approximately 3000 m²; widening of the existing Mispel road, additional access roads, landscaping, lighting, parking bays, security and signage. The environmental management programme (EMP) provided a link between the identified impacts and the environmental management required during project implementation. Responsible for compiling the EMP, liaising with client and site visits. Involved for 1 person-month. (SANRAL).

Integrated waste management plan and Section 24 G process to address the illegal waste disposal activities at Strandfontein High School, Mitchell's Plain **(Western Cape Province, South Africa) 02/2012 - Date.** *Technical Staff Member.* The Department of Environmental Affairs and Development Planning (DEA&DP) Directorate: Environmental Compliance and Enforcement, issued Strandfontein Secondary School with a warning letter based on the illegal waste disposal activities on Erf 14927. In response to these illegal activities, the DEA&DP intervened and all disposal activities were ceased. An integrated waste management Plan (IWMP) was compiled and a Section 24 G process in terms of NEMA is being undertaken. Responsible for report compilation, liaising with authorities and site visits. Involved for 4 person-months. (Western Cape Education Department).

Proposed photovoltaic solar energy facilities near De Aar **(Northern Cape Province, South Africa) 09/2011 - Date.** *Technical Staff Member.* Mulilo Renewable Energy proposed to construct three photovoltaic solar energy facilities near De Aar, which would enable them to be taken into consideration as an independent power producer (IPP). The integrated resource plan (IRP) 2010 allows for an additional 14 749MW of renewable energy in the electricity mix in South Africa by 2030, and Mulilo wanted to participate in this programme. The proposed facilities would be able to generate 169MW collectively. Responsible for compiling the scoping reports, the basic assessment report (BAR), conducting the public participation process (PPP) and liaising with all stakeholders. Involved for 4 person-months. (Mulilo Renewable Energy (Pty) Ltd).

Determination of future rehabilitation costs associated with existing landfill sites **(Regional, South Africa) 05/2011 - Date.** *Technical Staff Member.* The project entailed the determination of associated future rehabilitation costs of existing landfill and solid waste disposal sites in line with GRAP 17 requirements. Where licences and permits were lacking, the minimum requirements for rehabilitation as developed by Department of Water Affairs during 1998 were used to ensure compliance. The costing included provision for the relevant environmental processes, civil works and post decommissioning monitoring. Responsible for report writing, finances and management of specialists. Involved for 1 person-month. (Mubesko Africa).

Operational phase management plan of the Sandown Shoprite Checkers in Parklands **(Western Cape Province, South Africa) 04/2011 - 05/2011.** *Technical Staff Member.* As a prerequisite to get the building plans for the Sandown Shoprite Checkers approved, an operational environmental monitoring programme (OEMP) had to be submitted to the City of Cape Town. The OEMP addressed key issues of on-site stormwater management, landscaping and management of a portion of public open space and a retention pond containing floating islands. Responsible for compiling an operation phase management plan. Involved for 1 person-month. (Shoprite Checkers).

Basic assessment process for the upgrade of Distillery Road in Wellington **(Western Cape Province, South Africa) 04/2011 - Date.** *Technical Staff Member.* Drakenstein Municipality was aiming to upgrade a 1.4km section of Stokery Road, starting 200m from the intersection with Main Road 27, Champagne Street, up to the intersection with Main Road 219, Main Street. The geometric layout was upgraded from a 9.2m surfaced road to a 14.8m surfaced road, with 1.8m surfaced sidewalks. This allows for two 3.4m lanes per direction to accommodate the left and right turning of heavy vehicles, and for safer pedestrian usage. The stormwater system upgrade included a concrete culvert to replace the current unlined channel on the western side. Responsible for completing the application form, the basic assessment report (BAR) and the environmental management plan (EMP). Involved for 3 person-months. (Drakenstein Local Municipality).

Borrow pit inspection in Oudtshoorn **(Western Cape Province, South Africa) 03/2011 - 03/2011.** *Technical Staff Member.* The project entailed assisting with the screening evaluation of potential borrow pit sites in the Oudtshoorn Municipal District. The three potential borrow pit sites were assessed in a high level screening process according to suitability from an environmental perspective to take it to the next level of geological investigation. Responsible for assisting the team leader with the compilation of the feedback/screening report of the potential sites that were investigated, and assisting with field work.

Involved for 0.5 person-months.

Education

2011 : MPhil Environmental Management, University of Stellenbosch, South Africa
2009 : BSc Conservation Ecology, University of Stellenbosch, South Africa

Career enhancing courses

2013 : Project Management, University of Cape Town (UCT), South Africa
2012 : Certificate in Business Writing for Professionals, University of Cape Town (UCT), South Africa

Professional affiliations

Associate Member, Institute of Waste Management of Southern Africa (IWMSA)
Member, International Association for Impact Assessments South Africa (IAIASA)
Certified Natural Scientist, South African Council for Natural Scientific Professions (SACNSP)

Languages

	Reading	**Writing**	**Speaking**
English	Excellent	Excellent	Excellent
Afrikaans	Excellent	Excellent	Excellent

Publications

De Bruyn K, and Pretorius D, 2013. "Addressing contemporary recycling problems inherited by poor planning". International Association of Impact Assessments Conference.

Referees

Company	**Contact Person**	**Telephone nr.**
Anèl Blignaut Environmental Consultants	Anèl Blignaut	+27 82 751 9596 anel@dpeng.co.za

Curriculum vitae: Ms L CORBETT

Name	:	**CORBETT, LOUISE**
Date of Birth	:	31 July 1981
Profession/Specialisation	:	Environmental Practitioner
Years with Firm	:	7
Nationality	:	South African
Years experience	:	8

Key qualifications

Louise is currently employed as an Associate and Senior Environmental Practitioner in Aurecon's Cape Town office. She has a BSc (Hons) in Environmental and Geographical Science, specialising in Environmental Management, which she obtained from the University of Cape Town (UCT) in 2004. She has seven years' experience in the environmental field and has compiled and managed numerous environmental investigations, including Environmental Impact Assessments (EIAs), Environmental Management Plans (EMPs) and Environmental Management Programmes (EMPs).

Louise has a particular interest in the energy sector, and has undertaken numerous environmental projects in this field. She was the Treasurer of the South African affiliate of the International Association for Impact Assessment (IAIA) for the Western Cape Branch from 2009 to 2011, and remains a Member. She is also a Registered Professional Natural Scientist with the South African Council for Natural Scientific Professions (SACNSP).

Employment record

02/2012 - Date	Aurecon, Associate/Senior Environmental Practitioner
2009 - 01/2012	Aurecon, Senior Environmental Practitioner
2006 - 2009	Aurecon, Environmental Practitioner
2006 - 2007	CCA Environmental (Pty) Ltd, Cape Town, South Africa, Environmental Consultant
2005	Morrison's Plc, London, United Kingdom, Systems Administrator
2004 - 2005	Barclays Bank Plc, London, United Kingdom, Customer Services Advisor

Experience record

Richtersveld Wind Energy Facility (WEF) **(Northern Cape Province, South Africa) 07/2012 - 08/2012.** *Project Leader.* The project entailed a due diligence of the proposed Wind Energy Facility (WEF) to review compliance with the requirements of the Department of Energy's Independent Power Producer (IPP) process. Responsible for the management and review of the environmental input to the due diligence report. (TRE Tozzi Renewable Energy S.p.A and Guma Group).

Ramp-up of manganese for the Port of Port Elizabeth **(Eastern Cape Province, South Africa) 07/2012 - Date.** *Environmental Practitioner.* The project entailed FEL2 study consulting services for providing a second berth for manganese bulk vessels in the Port of Port Elizabeth to ramp up export volumes, by extending the existing berth 14. Three main options (with sub-options) were developed as solutions to accommodate the preferred mooring arrangement layout, namely the provision of a mooring buoy; the provision of a mooring dolphin; and mooring to the existing quay. Responsible for review of environmental input required to determine if the project required authorisation in terms of the National Environmental Management Act (NEMA). (Transnet National Ports Authority (TNPA)).

Wind and solar energy facility on Kangnas Farm near Springbok **(Northern Cape Province, South Africa) 03/2012 - Date.** *Project Leader.* The project entailed an Environmental Impact Assessment (EIA) for a wind and solar energy facility comprising 750MW and 250MW respectively, located approximately 40km from Springbok. Responsible for the management and review of the EIA process and finances. (Mainstream Renewable Power South Africa).

Hydropower station on the Orange River near Kakamas **(Northern Cape Province, South Africa) 2011 - 2012.** *Project Leader.* The project entailed a Basic Assessment (BA) for a hydropower station comprising 12MW, located on the Orange River near Kakamas. Responsible for the management, finances, undertaking the BA process, specialist coordination and Public Participation Process (PPP). (ArcellorMittal).

Fatal flaw study for four potential Wind Energy Facility (WEF) sites **(Northern and Western Cape Provinces, South Africa) 11/2011 - 05/2012.** *Project Leader.* The study entailed a fatal flaw analysis of four potential Wind Energy Facility (WEF) sites across the Northern and Western Cape. Responsible for the management and review of the fatal flaw analysis. (Mainstream Renewable Power South Africa).

Three Photovoltaic (PV) energy facilities near De Aar **(Northern Cape Province, South Africa) 09/2011 - Date.** *Project Leader.* The project entailed two Environmental Impact Assessments (EIAs) and a Basic Assessment (BA) for three Photovoltaic (PV) energy facilities, comprising between 20MW and 150MW, located near De Aar. (Mulilo Renewable Energy (MRE)).

Three Photovoltaic (PV) energy facilities near Copperton **(Northern Cape Province, South Africa) 09/2011 - Date.** *Project Leader.* The project entailed three Environmental Impact Assessments (EIAs) for three Photovoltaic (PV) energy facilities comprising 75MW to 150MW, located near Copperton. Responsible for the management and review of the EIA process and finances. (Mulilo Renewable Energy (MRE)).

Wind Energy Facility (WEF) on the eastern plateau near De Aar **(Northern Cape Province, South Africa) 09/2011 - Date.** *Project Leader.* The project entailed an Environmental Impact Assessment (EIA), in terms of the National Environmental Management Act (NEMA), for a new Wind Energy Facility (WEF) comprising 300MW to 520MW. The site is located on the eastern plateau, approximately 20km east of De Aar. Responsible for the management and review of the EIA process and finances. (Mulilo Renewable Energy (MRE)).

Wind Energy Facility (WEF) near Koekenaap **(Western Cape Province, South Africa) 07/2011 - Date.** *Project Leader.* The project entailed undertaking the Basic Assessment (BA) for the construction of eight proposed wind turbines to generate approximately 19.2MW on the Olifant's River settlement near Koekenaap. Responsible for the management and review of the BA process and finances. (Plan 8).

Reverse Osmosis (RO) plant at Hendrina Power Station near Pullenshope **(Mpumalanga Province, South Africa) 02/2011 - 08/2012.** *Project Leader/Senior Environmental Practitioner.* The Water Management System (WMS) at Hendrina Power Station was at risk of non-compliance with Eskom's Zero Liquid Effluent Discharge (ZLED) policy due to excess wastewater. In order to reduce the risk of non-compliance, Eskom proposed to construct a Reverse Osmosis (RO) plant to treat concentrated cooling water, which was being disposed of at the Ash Dam as wastewater. The treated water from this plant would be re-used in the power station's processes. The project entailed a Basic Assessment (BA) and Waste Management Licence (WLM) for the RO plant. Responsible for the undertaking, management and review of the BA process and finances. (Eskom Holdings).

Rehabilitation of the stormwater system at Zevenwacht Residential Estate **(Western Cape Province, South Africa) 2011 - Date.** *Project Leader.* The project entailed a Basic Assessment (BA) for the rehabilitation of the stormwater management system on Zevenwacht Residential Estate in order to avoid seasonal flooding of an adjacent residential estate. Responsible for the management and review of the BA process. (City of Cape Town).

Anaerobic biodigester in Elgin **(Western Cape Province, South Africa) 12/2010 - Date.** *Project Leader.* The project entailed a Basic Assessment (BA) for an anaerobic digester and associated infrastructure for the processing of organic waste to generate heat and electricity on erven 291 and 292 in Grabouw. Responsible for the management and review of the BA process and finances. (Elgin Fruit Juices).

Wind Energy Facility (WEF) near Gouda **(Western Cape Province, South Africa) 12/2010 - Date.** *Project Leader.* The project entailed an Environmental Impact Assessment (EIA) for a Wind Energy Facility (WEF) comprising 30MW, located near Gouda. Responsible for the undertaking, and the management and review of the EIA process and finances. (iNca Energy).

Upgrading of the Pretoria Portland Cement (PPC) Riebeeck Plant near Riebeeck West **(Western Cape Province, South Africa) 11/2010 - 2012.** *Technical Advisor.* This project entailed the undertaking of an Environmental Impact Assessment (EIA) for the upgrading of the existing Pretoria Portland Cement (PPC) Riebeeck Plant. Aurecon undertook the environmental authorisation processes required for the proposed upgrade to the existing cement manufacturing plant in Riebeeck West. The upgrade of PPC Riebeeck would align the plant's functioning and operations with the emission requirements now and in the foreseeable future. Responsible for ad hoc review and technical input. (Pretoria Portland Cement (PPC)).

Wind Energy Facility (WEF) in Saldanha **(Western Cape Province, South Africa) 10/2010 - 12/2012.** *Project Leader.* The project entailed a Basic Assessment (BA) for a Wind Energy Facility, comprising six

turbines, located within the industrial area of Saldanha. Responsible for the management and review of the BA process and finances. (ArcellorMittal).

Wind Energy Facility (WEF) on Struisbult Farm near Copperton **(Northern Cape Province, South Africa) 10/2010 - 12/2012.** *Project Leader.* The project entailed an Environmental Impact Assessment (EIA) for a Wind Energy Facility comprising 140MW, located near Copperton. Responsible for the undertaking, management and review of the EIA process and finances. (Plan 8).

Solar energy facility on Onder Rietvlei Farm near Aurora **(Western Cape Province, South Africa) 07/2010 - 02/2012.** *Project Member.* The project entailed a Basic Assessment (BA) for the proposed construction of a 10MW solar energy facility on Portion 3 of Farm 18 near Aurora. Responsible for review of documentation. (Solairedirect Southern Africa).

Environmental Impact Assessment (EIA) for Moatize Coal Mine expansion **(Tete Province, South Africa) 03/2010 - 01/2011.** *Environmental Impact Assessment (EIA) Technical Team Member.* The Moatize Mine mainly produced coking coal for export (12Mtpa), but it was proposed to expand operations at the mine due to the favourable global market for coal. It was planned that Moatize Mine would increase its production of Run of Mine (ROM) coal from 26 to 52Mtpa, which would result in an additional 12Mtpa of coal production for export. The project entailed an Environmental Impact Assessment (EIA) for the expansion of the existing Moatize Coal Mine in the Tête Province in Mozambique. Responsible for report writing. (Vale Moçambique).

Extension of the ash dam facility at Kriel Power Station **(Mpumalanga Province, South Africa) 11/2009 - Date.** *Advisory Role.* The project entailed an Environmental Impact Assessment (EIA) and a Waste Management Licence (WML) for the proposed construction of a fourth ash dam facility at the Kriel Power Station. This ash dam would fulfil ash disposal requirements for the remainder of the power station's operational life, during which approximately 111.18 million cubic metres of ash will be produced. Responsible for ad hoc review of various documents and providing technical input as required. (Eskom Holdings).

Reverse Osmosis (RO) plant at Tutuka Power Station **(Mpumalanga Province, South Africa) 11/2009 - 07/2012.** *Senior Environmental Practitioner.* The brine from the existing Reverse Osmosis (RO) plant was being disposed of on the ash dump through irrigation, which was resulting in leachate from the ash dump. Eskom proposed the construction of an additional RO plant to concentrate the brine from the existing plant in order to limit brine being sent to the ash dump, and to recover water that would be used within the power station. The project entailed a Basic Assessment (BA) and Waste Management Licence (WML) for the RO plant. Responsible for the undertaking, management and review of the BA process and finances. (Eskom Holdings).

Wind monitoring masts in Middelburg **(Eastern Cape Province, South Africa) 03/2009 - 07/2010.** *Senior Environmental Practitioner.* The project entailed a Basic Assessment (BA) for two wind monitoring masts for the collection of wind data. Responsible for the compilation of the Basic Assessment Report (BAR) and ran the public participation process. (African Infrastructure Investment Managers (AIIM)).

Wind monitoring masts in Cookhouse **(Eastern Cape Province, South Africa) 2009.** *Senior Environmental Practitioner.* The project entailed a Basic Assessment (BA) for two wind monitoring masts for the collection of wind data. Responsible for the compilation of the Basic Assessment Report (BAR) and running the Public Participation Process (PPP). (African Infrastructure Investment Managers (AIIM)).

Wind monitoring masts in De Aar **(Northern Cape Province, South Africa) 2009.** *Senior Environmental Practitioner.* The project entailed a Basic Assessment (BA) for two proposed wind monitoring masts for the collection of wind data in De Aar. Responsible for the compilation of the Basic Assessment Report (BAR) and running the Public Participation Process (PPP). (African Infrastructure Investment Managers (AIIM)).

Two coal-fired power stations in the Waterberg area **(Limpopo Province, South Africa) 03/2008 - Date.** *Project Leader.* The project involved site selection and an Environmental Impact Assessment (EIA) for two proposed coal-fired power stations in Limpopo. The EIA and the framework compilation of an Environmental Management Plan (EMP) were undertaken with the involvement of 17 specialists. Responsible for the site selection process, undertaken by the EIA team; and identifying sites based on technical, environmental and economic constraints. Later in the project cycle took over the management of the project, including compilation of the Environmental Impact Report (EIR) and project finances. (Eskom).

Garden City New Town Development near Kraaifontein **(Western Cape Province, South Africa) 01/2008 - 2012.** *Senior Environmental Practitioner.* This project included an Environmental Impact Assessment (EIA), in terms of the National Environmental Management Act (NEMA), for a proposed

integrated mixed use housing development covering 782ha, on behalf of Garden Cities and Basil Read. The development comprises various housing types (low income, finance linked and bonded homes), crèches and schools, places of worship, a market area and transport nodes, commercial and light industrial premises, a police station, clinics, sports fields and open spaces/parks, stormwater detention ponds, roads, sewage, water infrastructure and an electrical substation. Responsible for the EIA, all related administrative and management tasks and the compilation of a framework Environmental Management Plan (EMP). (Garden Cities/Basil Read).

Review work **(Eastern Cape Province, South Africa) 2008.** *Environmental Practitioner.* Appointed by the Eastern Cape's Department of Economic Development and Environmental Affairs (DEDEA) to review and process the backlog of Environmental Impact Assessment (EIA) applications under the Environmental Conservation Act (ECA). Responsible for reviewing and processing a number of applications under the ECA according to sound EIA practices and legal requirements; drafting correspondence to applicants, as well as Records of Decision (RoD) on behalf of DEDEA. (Eastern Cape Department of Economic Development and Environmental Affairs (DEDEA).

Siting exercise for a Coal-to-Liquids (CTL) facility **(South Africa) 2008.** *Environmental Practitioner.* The project entailed the identification of sites for an 80-barrel a day Coal-to-Liquids (CTL) facility as well as selection of a preferred site based on a multi-criteria decision analysis tool. Responsible for the compilation of reports. (PetroSA).

Plant extraction facility in the Paarl Industrial Area **(Western Cape Province, South Africa) 11/2007 - 07/2009.** *Environmental Practitioner.* The project comprised a Basic Assessment (BA) for the construction of a plant extraction facility in Paarl. Responsible for compiling the Basic Assessment Report (BAR) and running the Public Participation Process (PPP). (Cognis).

Subdivision of Farm Palmiet River, Number 319, Elgin **(Western Cape Province, South Africa) 02/2007 - 02/2009.** *Environmental Practitioner.* The project included a Basic Assessment (BA) for the proposed subdivision of Farm Palmiet River for residential purposes. Responsible for finalising the Basic Assessment Report (BAR) and compiling the comments and response report. (Molteno Brothers).

Deepwater geophysical survey of the South African continental margin **(South Africa) 2007.** *Environmental Practitioner.* The project comprised a deepwater geophysical survey of the South African continental margin. Responsible for the compilation of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP), undertaking the Public Participation Process (PPP), and specialist coordination. (PetroSA).

Upgrade of fuel pipelines at Cape Town International Airport (CTIA) **(Western Cape Province, South Africa) 2007.** *Environmental Practitioner.* The project comprised an exemption application for the upgrading of fuel pipelines at Cape Town International Airport (CTIA). Responsible for working on compiling the exemption application. (Kantey & Templer for Airports Company of South Africa (ACSA)).

2D seismic survey in the northern block, offshore Namibia **(Namibia) 2007.** *Environmental Practitioner.* The project comprised a 2D seismic survey in the Northern Block, offshore Namibia. Responsible for compiling the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP), undertaking the Public Participation Process (PPP), and specialist coordination. (BHP Billiton).

Rocklands Eco Estate, Cape Town **(Western Cape Province, South Africa) 07/2006 - 2007.** *Environmental Practitioner.* The project involved a Basic Assessment (BA) for the development of a proposed eco estate with approximately 80 houses and public open space. Responsible for being involved in specialist coordination and running the Public Participation Process (PPP). (Rocklands Eco Estate (Pty) Ltd).

Upgrading of facilities at the River Club in Observatory **(Western Cape Province, South Africa) 2006 - 2007.** *Environmental Practitioner.* The project included a Basic Assessment (BA) for the proposed upgrading of facilities at the River Club, including a conference centre and additional buildings. Responsible for being involved in specialist coordination and running the Public Participation Process (PPP).

Subdivision and rezoning of Erf 3410, Simon's Town **(Western Cape Province, South Africa) 2006 - 2007.** *Environmental Practitioner.* The project consisted of a Basic Assessment (BA) for the proposed development of 10 luxury houses in Glencairn. Responsible for compiling the Basic Assessment Report (BAR), specialist coordination, and running the Public Participation Process (PPP). (Cape Town Coastal Properties).

Subdivision and rezoning of Erf 23300 in Maitland, Royal Maitland Phase 3 **(Western Cape Province, South Africa) 2006 - 2007.** *Environmental Practitioner.* The project entailed a Basic Assessment (BA) for the subdivision and rezoning of Erf 23300 in Maitland, for the proposed development of middle-income housing (Royal Maitland Phase 3). Responsible for being involved in compiling the Basic Assessment Report (BAR), specialist coordination and running the Public Participation Process (PPP). (Cape Town Community Housing Company (CTCHC)).

Subdivision and rezoning of Erf 1366, Eerste River **(Western Cape Province, South Africa) 2006 - 2007.** *Environmental Practitioner.* The project comprised a Basic Assessment (BA) for rezoning Erf 1366, Eerste River, for a residential development of 47 houses. Responsible for compiling the Basic Assessment Report (BAR), specialist coordination, running the Public Participation Process (PPP), and compiling a Construction Environmental Management Plan (CEMP). (Tech-Sure Fin).

Development of the Ibhubesi gas field and associated infrastructure **(Western Cape Province, South Africa) 2006 - 2007.** *Environmental Practitioner.* This project included an Environmental Impact Assessment (EIA) for the development of Ibhubesi natural gas field and associated infrastructure near Saldanha Bay. Responsible for writing sections of the scoping report and EIA, as well as compiling comments reports and maintaining the Interested and Affected Parties (I&AP) database. (Forest Oil).

Upgrading of National Route 1 (N1) intersections near De Doorns **(Western Cape Province, South Africa) 07/2006 - 01/2007.** *Environmental Practitioner.* The project consisted of a Basic Assessment (BA) for the proposed upgrading of intersections on National Route 1 (N1) near De Doorns. Responsible for being involved in the compilation of the Basic Assessment Report (BAR) and running the Public Participation Process (PPP). (Argus Gibb for the South African National Roads Agency Limited (SANRAL)).

New regional landfill to service the City of Cape Town **(Western Cape Province, South Africa) 2006 - 2007.** *Environmental Practitioner.* The project involved an Environmental Impact Assessment (EIA) for a landfill near Atlantis. Responsible for being involved in organising the Public Participation Process, compiling a comments report and managing the Interested and Affected Parties (I&AP) database. (City of Cape Town).

Borrow pits for the upgrading of road sections in the Overberg District **(Western Cape Province, South Africa) 2006 - 2007.** *Environmental Practitioner.* The project entailed Environmental Management Programmes (EMPs) in terms of the Minerals and Petroleum Resources Development Act (MPRDA) for nine borrow pits, required for the resurfacing of gravel roads in the Overberg District. Responsible for compiling the EMPs, managing two specialists and running the Public Participation Process (PPP). (PD Naidoo & Associates for the Provincial Administration of the Western Cape (PGWC)).

Borrow pits in the Beaufort West and Murraysburg area, Karoo **(Western Cape Province, South Africa) 2006 - 2007.** *Environmental Practitioner.* The project entailed Environmental Management Programmes (EMPs) in terms of the Minerals and Petroleum Resources Development Act (MPRDA) for 40 strategic borrow pits, required for the resurfacing of gravel roads in and around the Beaufort West and Murraysburg areas (Central Karoo District) in the Karoo. Responsible for compiling the EMPs, managing two specialists and running the Public Participation Process (PPP). (Kwezi V3 for the Provincial Government of the Western Cape (PGWC)).

Rezoning of public open space in Boston, Bellville **(Western Cape Province, South Africa) 2006 - 2007.** *Environmental Practitioner.* The project entailed a Basic Assessment (BA) for the proposed construction of an off-ramp and parking area in on a portion of Erf 10565 in Boston, Bellville. Responsible for helping to compile the Basic Assessment Report (BAR), and running the Public Participation Process (PPP). (Bright's Hardware).

Resealing of a trunk road and main roads, and the upgrading of a divisional road near Uniondale **(Western Cape Province, South Africa) 2006.** *Environmental Practitioner.* The project entailed the resealing of Trunk Road 44, Section 1 (TR44/1); Main Roads 401, 404, and 368 (MR401, MR404 and MR368); and the upgrading of Divisional Road 1834 (DR1834) from gravel to sealed road. An associated borrow pit was also developed. Responsible for the compilation of the Environmental Management Plan (EMP) and checklist in terms of the Environmental Conservation Act (ECA); and undertaking the Public Participation Process (PPP) and specialist coordination. (SNA for the Provincial Government of the Western Cape (PGWC)).

Geotechnical survey in the southern and northern blocks offshore Namibia **(Namibia) 2006.**

Environmental Practitioner. The project comprised a geotechnical survey of the southern and northern blocks offshore Namibia. Responsible for the compilation of an addendum report for the surveys and managing the Public Participation Process (PPP), specialist coordination, and the compilation of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP). (BHP Billiton).

***Exemption application for tow surfing in the Table Mountain National Park Marine Protected Area (MPA)* (Western Cape Province, South Africa) 2006.** *Environmental Practitioner.* The project entailed an exemption application to allow for tow surfing, a prohibited activity, within the Table Mountain National Marine Protected Area (MPA). Responsible for compiling the exemption application, which included research into the environmental impacts of tow surfing, in terms of noise and emissions. (Tow-Surf South Africa).

***Construction Environmental Management Plan (CEMP) for Sitari Fields Golf Estate, Firgrove/Macassar* (Western Cape Province, South Africa) 2006.** *Environmental Practitioner.* The project comprised a golf estate consisting of mixed uses, including a golf course, housing and a clubhouse. Responsible for the compilation of a Construction Environmental Management Plan (CEMP). (Olympian Developing Company).

***Abstraction of groundwater to augment Sedgefield's water supply* (Western Cape, South Africa) 12/2004 - 02/2009.** *Senior Environmental Practitioner.* The project entailed a Basic Assessment (BA) for the abstraction of groundwater in order to augment Sedgefield's water supply. The approach was based on making better use of the available water resources and supplementing the traditional surface water resources with a combination of ground water, desalinated water and the re-use of final effluent. The conjunctive supply approach limits the risk of supply failure from a single source, and ensures sustainable potable water security for Sedgefield. Responsible for the compilation of the Basic Assessment Report (BAR) and for running the Public Participation Process (PPP). (Knysna Local Municipality).

***Sedgefield off-channel storage dam* (Western Cape Province, South Africa) 12/2004 - 06/2010.** *Environmental Practitioner.* The project involved an Environmental Impact Assessment (EIA) for an off-channel dam in Sedgefield. Responsible for compiling the EIA report and for the Public Participation Process (PPP). (Knysna Local Municipality).

Education

2004 : BSc (Hons) Environmental Management, University of Cape Town (UCT), South Africa
2003 : BSc Environmental and Geographical Science, University of Cape Town (UCT), South Africa

Career enhancing courses

2012 : Conflict Management Course, Centre for Conflict Resolution (CCR), Cape Town, South Africa
2010 : Project Management Course, Aurecon in-house training, South Africa
2009 : Certificate in Project Management: Principles and methods for use in business, University of Cape Town (UCT), South Africa
2008 : Using Natural Resources for Community Development, Gesellschaft Technische Zusammenarbeit (GTZ), South Africa

Professional affiliations

Member, International Association for Impact Assessment South Africa (IAIAsa)
Professional Natural Scientist, South African Council for Natural Scientific Professions (SACNASP)

Languages

	Reading	**Writing**	**Speaking**
English	Excellent	Excellent	Excellent
Afrikaans	Good	Good	Good

Publications

Corbett L, and Mangnall M, 2009. "The Value of Pre-EIA Screening Exercises". Presented at the 2009

Internatioal Association for Impact Assessment (IAIA) Conference.