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Terrestrial Biodiversity, Plant and Animal Species Impact Assessment Report

A TERRESTRIAL BIODIVERSITY IMPACT ASSESSMENT (INCLUDING PLANT AND ANIMAL SPECIES ASSESSMENT) FOR THE PROPOSED POWER LINE FOR THE GROOTPOORT PHOTOVOLTAIC SOLAR POWER PLANT NEAR LUCKHOFF, FREE STATE PROVINCE

August 2021

Prepared for: ENVIRONAMICS CC

Compiled by Dr BJ Henning

Document version 1.0 – Draft

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August 2021

Compiled by:

Dr BJ Henning (*Pri Sci Nat – Ecological Science and Soil Science)*
PhD. Plant Ecology
M.Sc. Botany - Soil Science related

Reviewed by:

Mr. J.H.Botha *(Pr. Sci. Nat.- Ecological Science & Environmental Management)*
B.Sc. Botany & Zoology, B.Sc. Hons Zoology,
M.Sc. Geography and Environmental Management

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Name	Institution
Ms C. Van Rooyen	ENVIRONAMICS CC
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Curriculum Vitae

CURRICULUM VITAE

B J Henning

PhD Plant Ecology

PERSONAL DETAILS

Name:	BAREND JOHANNES HENNING
Date of Birth:	1976-09-06
Profession/Specialization:	Senior Ecologist
Years with Firm:	6 years (previously 2006-2012 & since May 2020)
Nationality:	South African
Years' experience:	15 years

QUALIFICATIONS

University attended:	University of Pretoria, Pretoria (1995- 2002) PhD Plant Ecology, MSc (Botany), BSc (Hons.), BSc

COURSES

Advanced Wetland Course (UP CE, 2010)

Wetland Rehabilitation Course (UFS, 2015)

Course on wetland offsets (SANBI)

KEY QUALIFICATIONS AND EXPERIENCE

- Senior Ecologist / Soil Science Specialist for Ages Limpopo since September 2006 to 2012 and again since May 2020 involved in the following aspects:
    - Agricultural potential and land capability studies of soils on farms. (Reference: Mr Johan Botha, AGES Limpopo; 0152911577, Mr Herman Gildenhuys, Exigo; 0127512160;)
    - Spatial Development Frameworks.
    - Strategic Development Area Frameworks for local municipalities
    - Vegetation surveys, sensitivity, and zoning analysis of development sites, including eco-estates, mines, residential developments, shopping centres, roads, water supply and other related infrastructure etc (Reference: Mr Johan Botha, AGES Limpopo; 0152911577, Mr Herman Gildenhuys, Exigo; 0127512160;)
    - Faunal analysis and scoping reports (Reference: Mr Johan Botha, AGES Limpopo; 0152911577, Mr Herman Gildenhuys, Exigo; 0127512160)

  - Avifauna studies related to solar plant and power line connection developments.
  - Wetland delineations and functional capacity assessments (completed advanced wetland course of the Continued Education Department, University of Pretoria 2010 as well as Wetland rehabilitation course of the University of the Free State).
  - Wildlife Management Plans and habitat assessment for rare and endangered game species.
  - GIS related functions.

- Senior Ecologist for Exigo (previously AGES Gauteng) November 2012 to April 2020. Involved in all the abovementioned aspects.
- Environmental Consultant for Envirodel Wildlife & Ecological Services cc and Dubel Integrated Environmental Services, Polokwane 2004 - 2006. Involved in the following aspects:
  - Wildlife management plans for game farms /reserves throughout the Limpopo Province
  - Environmental impact assessments (vegetation surveys and faunal scoping reports), habitat suitability analysis and report compilation.
  - Coordinating and performing grass monitoring surveys for the Limpopo Tourism and Parks Board
  - Soil potential studies.
- Environmental Consultant for Ficus – pro Environmental Services cc., Modimolle 2004 / 5. Involved mostly in fieldwork, report compilation or impact studies. Reference: Mr. R. Venter (0147173378)
- Subconsultant for AGES (Africa Geo-Environmental Services 2005-2006. Vegetation surveys and sensitivity zoning and analyses. Mr Johan Botha (0836449957)
- Eco-Agent environmental services cc, Pretoria 2002 - 2004. Involved in environmental impact studies. Prof G. J. Bredenkamp (0825767046), University of Pretoria.
- Enviroguard environmental services cc, Heidelberg 2002 - 2004. Involved in environmental impact studies. Prof L. R Brown (0825767046).
- GIS related aspects for all the above-mentioned aspects on projects

POSITION AND DUTIES

Employed as Senior Ecological Specialist. Main duties and responsibilities include:

- Compilation of project proposals.
- Conducting specialist assessments
    - Ecological assessments
    - Soils and Land use potential studies.
    - Wetland assessments.
    - Wetland rehabilitation plans.
    - Ecological & wetland monitoring.
    - Biodiversity Action & Management Plans.
    - Agricultural assessments.
    - Avifauna assessments.
    - Wildlife Management Plans and assessments.
    - Rehabilitation Strategy & Implementation Programmes (RSIPs)
- Liaison with clients.
- GIS and map compilation.
- Project admin and management.
- Integration and interaction with the environmental consultants.
- Travelling.
- Any ad hoc duties that may be given by immediate manager.

Declaration

I, DR BJ Henning declare that -

- I act as the independent specialist.
- I will perform the work relating to the project in an objective manner, even if this results in views and findings that are not favourable to the project proponent.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this project, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Gazette No. 43310 Government Notice R. 320, Plant and Animal Species Protocols, regulations and any guidelines that have relevance to the activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I will consider, to the extent possible, the matters listed in Regulation 18 of the NEMA EIA Regulations.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the project proponent and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the project; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority or project proponent.
- All the particulars furnished by me in this document are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 320 and is punishable in terms of section 24F of the Act.

_____

SIGNATURE OF SPECIALIST

AUGUST 2021

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NOTATIONS AND TERMS

Biota: living things; plants, animals, bacteria

Bottomland: the lowlands along streams and rivers, on alluvial (river deposited) soil.

Connectivity: in this context, referring to either the upstream-downstream or lateral (between the channel and the adjacent floodplain) connectivity of a drainage line. Upstream-downstream connectivity is an important consideration for the movement of sediment as well as migratory aquatic biota. Lateral connectivity is important for the floodplain species dependent on the wetting and nutrients associated with overbank flooding.

Endorheic: closed drainage e.g., a pan.

Floristic: of flora (plants).

Floodplain: wetland inundated when a river overtops its banks during flood events resulting in the wetland soils being saturated for extended periods of time.

Gley: soil material that has developed under anaerobic conditions because of prolonged saturation with water. Grey and sometimes blue or green colours predominate but **mottles** (yellow, red, brown, and black) may be present and indicate localised areas of better aeration.

Groundwater: subsurface water in the zone in which permeable rocks, and often the overlying soil, are saturated under pressure equal to or greater than atmospheric.

Horizon: see soil horizons.

Hydrophyte: any plant that grows in water or on a substratum that is at least periodically deficient in oxygen because of soil saturation or flooding; plants typically found in wet habitats.

Hydro-geomorphic: refers to the water source and geology forms.

Hydrology is defined in this context as the distribution and movement of water through a wetland and its soils.

Geomorphology is defined in this context as the distribution and retention patterns of sediment within the wetland.

Infilling: dumping of soil or solid waste onto the wetland surface. Infilling generally has a very high and permanent impact on wetland functioning and is like drainage in that the upper soil layers are rendered less wet, usually so much so that the area no longer functions as a wetland.

Mottles: soils with variegated colour patters are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.

Organic soil material: soil material with a high abundance of un-decomposed plant material and humus.

Palustrine (wetland): all non-tidal wetlands dominated by persistent emergent plants (e.g., reeds) emergent mosses or lichens, or shrubs or trees (see Cowardin *et al.*, 1979).

Perched water table: the upper limit of a zone of saturation in soil, separated by a relatively impermeable unsaturated zone from the main body of groundwater.

Permanently wet soil: soil which is flooded or waterlogged to the soil surface throughout the year, in

most years.

Riparian: the area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as **riparian wetlands**. However, some riparian areas are not wetlands (e.g., an area where alluvium is periodically deposited by a stream during floods, but which is well drained).

Roughness coefficient: an index of the roughness of a surface; a reflection of the frictional resistance offered by the surface to water flow.

Runoff: total water yield from a catchment including surface and subsurface flow.

Seasonally wet soil: soil which is flooded or waterlogged to the soil surface for extended periods (>1 month) during the wet season but is predominantly dry during the dry season.

Sedges: grass-like plants belonging to the family *Cyperaceae*, sometimes referred to as nutgrasses. Papyrus is a member of this family.

Soil drainage classes: describe the soil moisture conditions as determined by the capacity of the soil and the site for removing excess water. The classes range from very well drained, where excess water is removed very quickly, to very poorly drained, where excess water is removed very slowly. Wetlands include all soils in the very poorly drained and poorly drained classes, and some soils in the somewhat poorly drained class. These three classes are roughly equivalent to the permanent, seasonal and temporary classes.

Soil horizons: layers of soil that have uniform characteristics and have developed through pedogenic processes; they are bound by air, hard rock or other horizons (i.e., soil material that has different characteristics).

Soil profile: the vertically sectioned sample through the soil mantle, usually consisting of two or three horizons (Soil Classification Working Group, 1991).

Soil saturation: the soil is considered saturated if the water table or **capillary fringe** reaches the soil surface (Soil Survey Staff, 1992).

Temporarily wet soil: the soil close to the soil surface (i.e., within 50 cm) is wet for periods > 2 weeks during the wet season in most years. However, it is seldom flooded or saturated at the surface for longer than a month.

Terrain unit classes: areas of the land surface with homogenous form and slope. Terrain may be seen as being made up of all or some of the following units: crest (1), scarp (2), midslope (3), footslope (4) and valley bottom (5).

Transpiration: the transfer of water from plants into the atmosphere as water vapour

Unchanneled valley bottom: linear fluvial, net depositional valley bottom surfaces which do not have a channel. The valley floor is a depositional environment composed of fluvial or colluvial deposited sediment. These systems tend to be found in the upper catchment areas.

Vegetation is defined in this context as the vegetation structural and compositional state.

Water regime: when and for how long the soil is flooded or saturated.

Water Quality largely self-explanatory and reflecting the changes in quality because of changes in

land use or as a direct result of activities within the wetland itself that could lead to changes in the quality of the water flowing through and within the wetland.

Waterlogged: soil or land saturated with water long enough for anaerobic conditions to develop.

Wetland: land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

Wetland catchment: the area up-slope of the wetland from which water flows into the wetland and including the wetland itself.

Wetland delineation: The determination and marking of the boundary of a wetland on a map.

LIST OF ABBREVIATIONS

Abbreviation	Description
ARC	Agricultural Research Council
C-Plan	Conservation Plan
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DME	Department of Minerals and Energy Affairs
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPR	Environmental Management Programme Report
ENPAT	Environmental Potential Atlas
GIS	Geographic Information Systems
GPS	Geographical Positioning System
HGM	Hydro-Geomorphic
HFI	Hydrological Function and Importance
IHI	Index of Habitat Integrity
IUCN	World Conservation Union
MAE	Mean Annual Evaporation
MAMSL	Meter Above Mean Sea Level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
NEMA	National Environmental Management Act
PES	Present Ecological State
PESC	Present Ecological Status Class
PQ4	Priority Quaternary Catchment
QDS	Quarter Degree Square
SADC	Southern African Development Community
SANBI	South African National Biodiversity Institute
WMA	Water Management Area
WHO	World Health Organisation

1 ASSIGNMENT

AGES Limpopo (Pty) Ltd was appointed by ENVIRONAMICS CC to conduct a terrestrial biodiversity, plant species and animal species impact assessment for the proposed development of 132kV single-circuit power line to enable the connection of the authorised Grootpoort Photovoltaic Solar Power Plant (DFFE ref.: 14/12/16/3/3/2/835) to the national grid network. This will enable the evacuation of the generated solar electricity. A 200m wide and 8km long grid connection corridor is being assessed for the placement of the power line route and associated infrastructure. The power line is proposed to connect into the existing Canal Substation. A service road and substation associated with the power line are also proposed to be developed.

The Species Environmental Impact Assessments Guideline has been developed in support of the Terrestrial Biodiversity, Plant and Animal Species protocols that were gazetted 30th October 2020 (Government Notice number 1150). This guideline provides details for implementing relevant species protocols and is available for use to plant and animal specialists, environmental assessment practitioners and Competent Authorities.

According to the national web-based environmental screening tool in terms of National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998), the site has the following sensitivities:

- Terrestrial Biodiversity: Very High Sensitivity (Figure 1).
- Animal Species Theme: Medium Sensitivity (Figure 2).
- Plant Species Theme: Medium Sensitivity (Figure 3).

A pre-screening site visit was therefore conducted to determine if the assessment was accurate and if the studies recommended should be conducted. After the site visit the following was concluded:

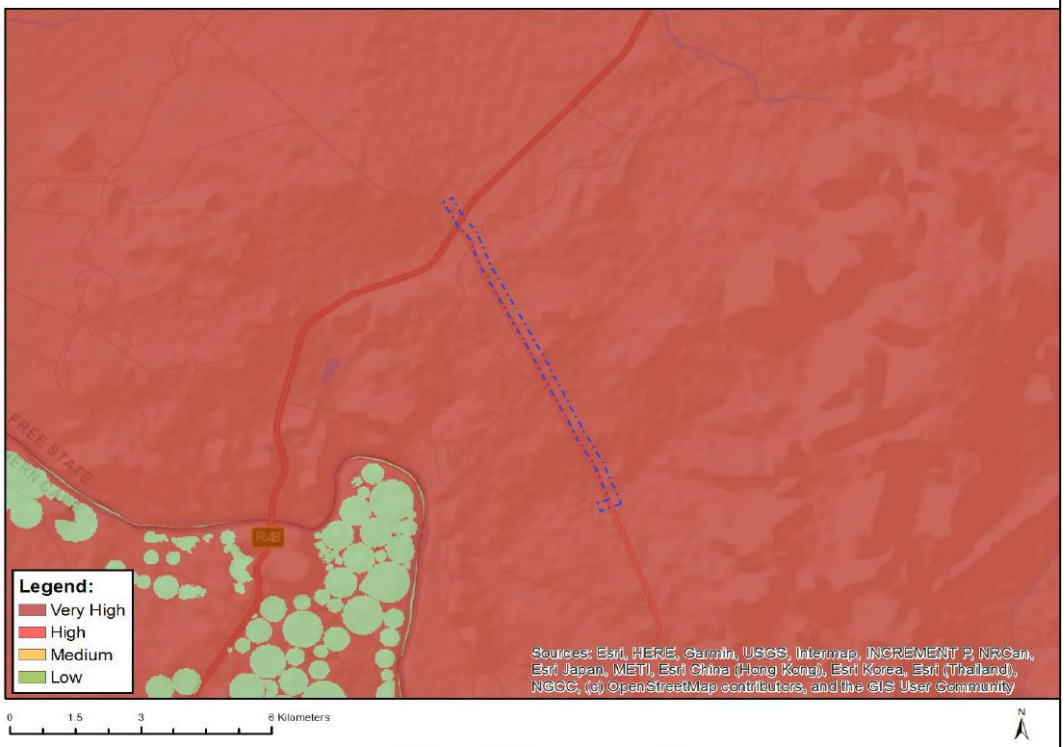
- The site has a HIGH Sensitivity from a terrestrial biodiversity perspective due to the presence of indigenous grassland and wetlands.
- The site has a Medium Sensitivity from an Animal Species Theme Perspective due to the presence of natural fauna habitats.
- The site has a Medium Sensitivity from a Plant Species Theme Perspective due to the presence of indigenous grassland with protected tree species.

After the assessment, it was concluded that a detailed terrestrial biodiversity, plant species theme and animal species theme assessment should be conducted.

This report will include a detailed impact assessment of the proposed power line corridor on the biodiversity of the site. This assessment is essential as it will contribute to meeting the requirements of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) in compliance with Gazette No. 43310 Government Notice R320.

The assignment is interpreted as follows: Compile a terrestrial biodiversity assessment on the flora (vegetation units), fauna and general ecology of the site and determine the potential impacts of the proposed development on the fauna and flora of the area as well as any impacts on the wetlands and proposed mitigation measures. The study will be done according to guidelines and criteria set by Free State Department: Economic, Small Business Development, Tourism and Environmental Affairs and the regulations recently gazetted for biodiversity studies as well as animal and plant species protocols.

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



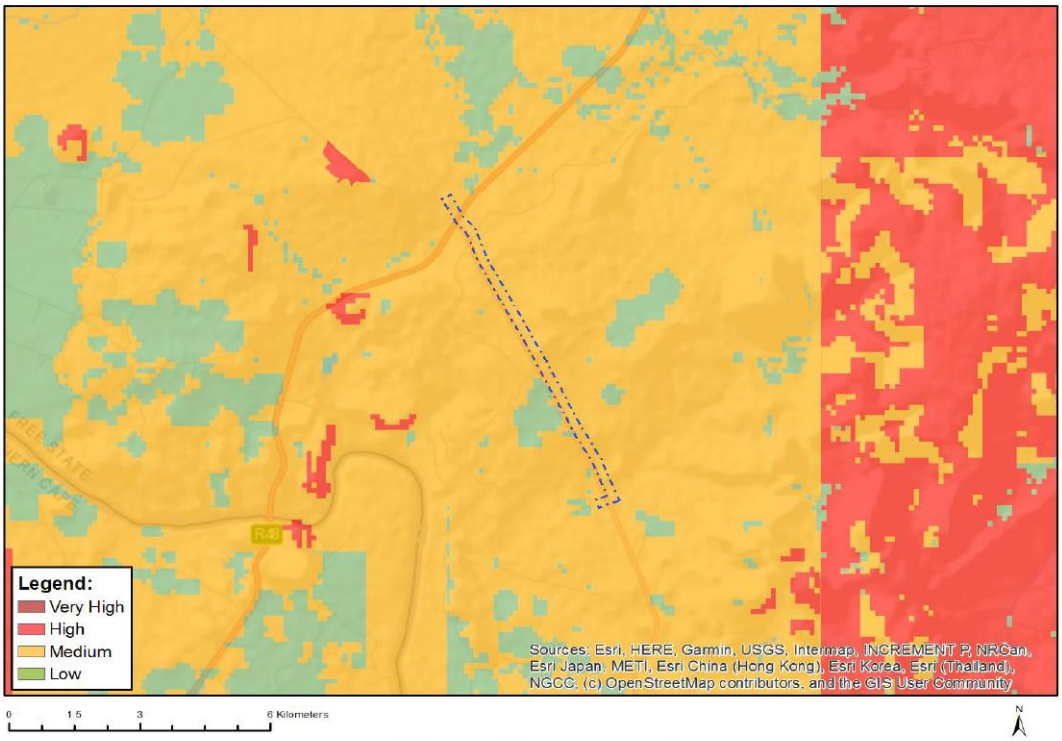
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Ecological Support Area 1

Figure 1. Terrestrial Biodiversity Sensitivity as obtained from the EIA screening tool for the site

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

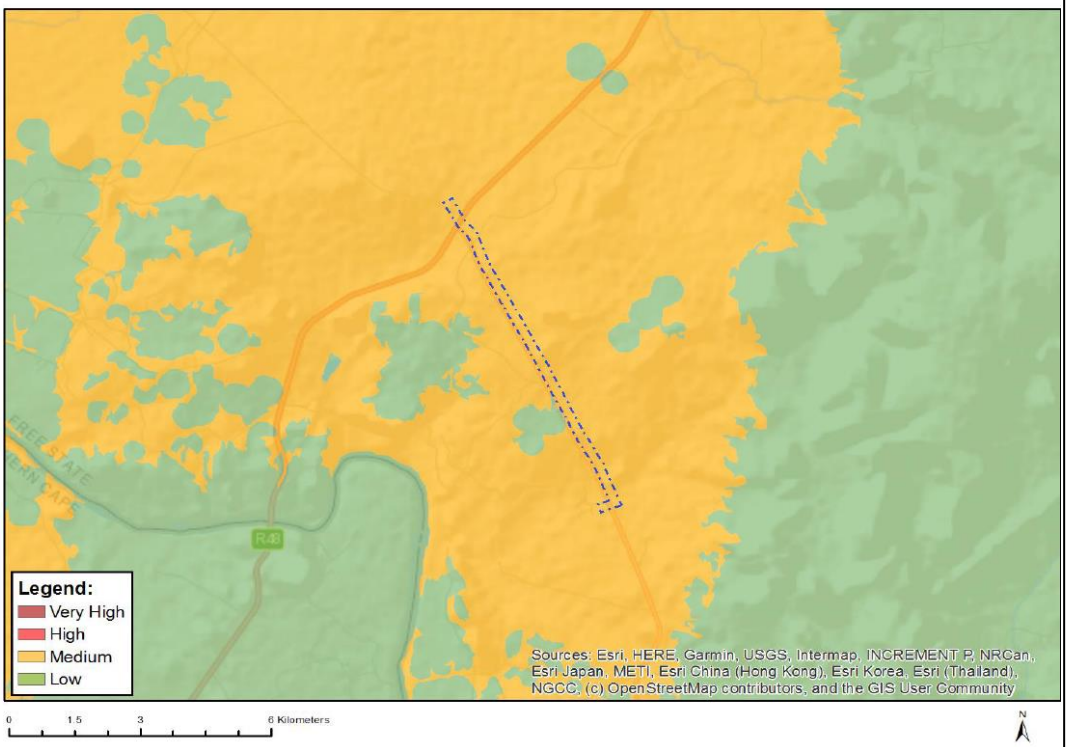
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Medium	Aves-Neotis ludwigii

Figure 2. Animal Species Theme Sensitivity as obtained from the EIA screening tool for the site

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



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Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Tridentea virescens

Figure 3. Plant Species Theme Sensitivity as obtained from the EIA screening tool for the site.

1.1 INFORMATION SOURCES

- All relevant topographical maps, aerial photographs and information (previous studies and environmental databases) related to the ecological components in the study area.
- Requirements regarding the fauna and flora survey as regulated by the newest terrestrial biodiversity, plant species theme and animal species theme protocols (National Environmental Management Act No. 107 of 1998 - Gazette No. 43310 Government Notice R. 320).

- Requirements regarding the fauna and flora survey as requested by Free State Department: Economic, Small Business Development, Tourism and Environmental Affairs.
- Legislation pertaining to the fauna and flora study as relevant.
- Red data species list from the South African National Biodiversity Institute (SANBI), including the species data for the terrestrial biodiversity and the red listed species potentially occurring on site was obtained from the EIA screening tool prior to the site visit.
- Information on plant and animal species recorded for the various Quarter Degree Squares was extracted from the SABIF/SIBIS database hosted by SANBI and the faunal databases hosted by the Animal Demography Unit (ADU). This includes a considerably larger area than the study area, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself has not been well sampled in the past.
- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006) as well as the National List of Threatened Ecosystems (2011), where relevant.
- Critical Biodiversity Areas were obtained from the various coverages produced by the Free State C-Plan (2015).

1.2 REGULATIONS GOVERNING THIS REPORT

1.2.1 National Environmental Management Act, 1998 (Act No. 107 of 1998) - Gazette No. 43310 Government Notice R. 320

This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Gazette No. 43310 Government Notice R. 320. Specialist reports includes a list of requirements to be included in a specialist report for a Terrestrial Biodiversity, Plant Species and Animal Species Assessment

1. A specialist report or a report prepared in terms of these regulations must contain:
    a. Details of
        i. The specialist who prepared the report; and
        ii. The expertise of that specialist to compile a specialist report, including a curriculum vitae.
    b. A declaration that the specialist is independent in a form as may be specified by the competent authority.
    c. An indication of the scope of, and purpose for which, the report was prepared.
    d. The date and season of the site investigation and the relevance of the

season to the outcome of the assessment.

e. A description of the methodology adopted in preparing the report or carrying out the specialized process.

f. The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure.

g. An identification of any areas to be avoided, including buffers.

h. A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.

i. A description of any assumptions made and any uncertainties or gaps in knowledge.

j. A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment.

k. any mitigation measures for inclusion in the EMPr.

l. any conditions for inclusion in the environmental authorisation.

m. any monitoring requirements for inclusion in the EMPr or environmental authorisation.

n. Plant species protocols:

    i.

o. a reasoned opinion –

    i. As to whether the proposed activity or portions thereof should be authorised and

    ii. If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr and where applicable, the closure plan.

p. A description of any consultation process that was undertaken while preparing the specialist report.

q. A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and

r. Any other information requested by the competent authority.

This Act also embraces all three fields of environmental concern namely: resource conservation and exploitation; pollution control and waste management; and land-use

planning and development. The environmental management principles include the duty of care for wetlands and special attention is given to management and planning procedures.

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

This Act regulates the utilization and protection of wetlands, soil conservation and all matters relating thereto; control and prevention of veld fires, control of weeds and invader plants, the prevention of water pollution resulting from farming practices and losses in biodiversity.

1.2.3 National Environmental Management Biodiversity Act (Act 10 0f 2004) (NEMBA)

The following aspects of the NEMBA (2004) are important to consider in the compilation of an ecological report. It:

- Lists ecosystems that are threatened or in need of national protection.
- Links to Integrated Environmental Management processes.
- Must be considered in EMPs and IDPs.
- The Minister may make regulations to reduce the threats to listed ecosystems.

1.2.4 The National Forest Act (Act 84 of 1998) (NFA)

In terms of section 15(1) of the National Forests Act, 1998, no person may cut, disturb, damage, or destroy any protected tree; or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any product derived from a protected tree, except under a licence or exemption granted by the Minister of Agriculture, Forestry and Fisheries.

1.2.5 Free State Nature Conservation Ordinance (1969)

This Act deals with the following:

- To provide for the sustainable utilisation and protection of biodiversity within the Free State Province.
- To provide for professional hunting.
- To provide for the preservation of caves and cave formations.
- To provide for the establishment of zoos and similar institutions.
- To provide for the appointment of nature conservators.
- To provide for the issuing of permits and other authorisations.
- To provide for offences and penalties for contravention of the Act.
- To implement the provisions of the Ordinance and to provide for matters connected therewith.

1.3 TERMS OF REFERENCE

1.3.1 Objectives

1. The primary aim of this report is to investigate options for enhancing and / or maintaining biodiversity to mitigate the impact of the development and related infrastructure with the overall objective of preventing further loss of biodiversity. The product would be a tool for promoting and lobbying for the recognition of the importance of species habitat and habitat conservation. Options available to maintain the current level of floral diversity include:
    a. Protection of native vegetation restored elsewhere in return for unavoidable clearing.
    b. Minimisation of habitat fragmentation.
    c. Minimisation of any threats to the native flora and fauna and their habitats during the construction and operational phases of the developments and.
    d. Rehabilitation to establish plant communities / landscaping that will provide future habitat values.
2. To produce clear and agreed species and habitat priorities for conservation actions. This includes the following:
    i. Determine the ecological impacts and actions the development will have on the biodiversity on a species and habitat level.
    ii. Conduct a risk analyses of the impacts identified to determine the significance of the impacts on the fauna and flora of the study area.
    iii. Protection and enhancement of vegetation / habitats of high conservation value.
    iv. The retention of a substantial amount of native vegetation / habitat of adequate size and configuration to promote the conservation of the existing flora communities.
    v. The retention and / or creation of vegetation links, wildlife corridors and vegetation buffers wherever possible, subject to the appropriate bush fire risk management; and
    vi. The protection of water quality in the locality so as not to threaten native aquatic flora that rely on the watercourse for survival.
3. Provide recommendations on the ecological mitigation measures to be implemented by the developer and the way forward.

1.3.2 Scope

1. Conduct a field study to determine the state of the vegetation on site:
    i. After studying the aerial photograph determine the previous state of the vegetation compared to the current state of the vegetation on site.

ii. Conduct a site visit and list the plant species (trees, shrubs, grasses, succulents and other herbaceous species of special interest) present for plant communities still present after construction.

iii. Identify potential red data plant species, possible encroacher species, medicinal plants of value and exotic plant species.

2. Determine the ecological impact the development will have on the fauna and flora of the site and conduct an impact rating assessment.

3. Fauna scoping
    a. List the potential fauna (mammal species, red data birds, reptiles, amphibians, invertebrates) present linked to the specific potential habitats that occur as identified in the vegetation survey.
    b. Analyse the data and identify potential red data fauna species, as well as other endemic or protected species of importance.
    c. Indicate species mitigation measures and management measures to be implemented to prevent any negative impacts on the fauna of the area.

4. General
    a. Identify and describe ecologically sensitive areas. Create a sensitivity map to indicate specific sensitive areas based on various environmental parameters such as natural vegetation in a good condition, rockiness, slopes, flood lines etc.
    b. Identify problem areas in need of special treatment or management, e.g., bush encroachment, erosion, degraded areas, reclamation areas.
    c. Make recommendations, impact ratings and risk assessments for each specific impact.

1.3.3 Limitations and assumptions

- Maintaining due cognisance of the integrity and accuracy of the ecological survey, it should be stated that the ecological resources identified during the study do not necessarily represent all the ecological resources present within the power line corridor.
- To obtain a comprehensive understanding of the dynamics of communities and the status of endemic, rare or threatened species in an area, ecological studies should ideally be replicated over several seasons and over a few years. However, due to project time constraints such long-term studies are not feasible.
- Most threatened plant species are extremely seasonal and only flower during specific periods of the year,
- Most threatened faunal species are extremely secretive and difficult to survey even during thorough field surveys conducted over several seasons.

- The detailed surveys only focused on the proposed development footprint of the power line.

Thus, even though it might be assumed that survey findings are representative of the ecosystem of the site for the development activities, it should be stated that the possibility exists that individual plants species might have been missed due to the nature of the terrain and size of the study area/power line corridor. Therefore, maintaining due cognisance of the integrity and accuracy of the ecological survey, it should be stated that the ecological resources identified during the study do not necessarily represent all the ecological resources present within the power line corridor.

2 METHODS

2.1 VEGETATION AND PLANT SPECIES SURVEY

Two basic methods were used during the vegetation survey:

- Line transects were walked on the site surveyed to record the plant species present. Rare and threatened plant species and any botanically sensitive sites or habitats were searched for in the various vegetation units.
- The Braun-Blanquet survey technique to describe plant communities as ecological units was also used for this study. It allows for the mapping of vegetation and the comparison of the data with similar studies in the area.

The site surveys were conducted on 20 July 2021. The relevance of the season (summer months) had NO impact on the outcome of the assessment. The vegetation was in a moderate condition and most species could be identified, although some species might have been missed because of the winter conditions (dormant geophytes).

2.1.1 Data recorded:

Plant names used in this report are in accordance with Arnold & De Wet (1993), except for a few newly revised species. A list of all plant species present, including trees, shrubs, grasses, forbs, geophytes, and succulents were compiled. All identifiable plant species were listed. Notes were additionally made of any other features that might have an ecological influence as well as potential fauna habitat that might occur.

2.1.2 Red data species

A species list of the red data species previously recorded in the vicinity of the development was obtained from the EIA screening tool as well as the South African Biodiversity Institute (SANBI), South Africa as classified by the IUCN red data list categories.

2.1.3 Protected trees

A species list of the protected tree species was obtained from the Department of Forestry. These trees are listed by the NFA (Act 84 of 1998) as protected.

2.1.4 Protected plants

A list of protected and specially protected plants was obtained from the Free State Nature Conservation Ordinance.

2.1.5 Data processing

A classification of vegetation data was done to identify, describe and map vegetation types. The descriptions of the vegetation units include the tree, shrub, and herbaceous layers.

Conservation priority of each vegetation unit was assessed by evaluating the plant species

composition in terms of the present knowledge of the vegetation of the Free State Province, as well as the vegetation type.

The following four conservation priority categories were used for each vegetation unit:

- High: Ecologically sensitive and valuable land with high species richness that should be conserved, and no development allowed.
- Medium: Land that should be conserved but on which low impact development could be considered with the provision of mitigation measures.
- Medium-low: Land that has some conservation value but on which development could be considered with limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation be maintained.
- Low: Land that has little conservation value and that could be considered for development with little to no impact on the vegetation / ecosystem.

2.2 FAUNA HABITATS AND ANIMALS' SPECIES SURVEY

The fauna survey was conducted as follows:

- A site survey was done to identify potential habitats after identifying the vegetation units. Fauna observed on site, or any specific indication of species was noted as confirmed in the species lists.
- A scoping survey was then conducted by comparing the habitat types identified within the preferred habitats of species occurring in the area.
- A survey was thereafter conducted to document species occurring in the habitats on site.

2.2.1 Data recorded:

A list of all species of fauna and their status as observed on the site or that could potentially occur on the site was compiled. Notes were made of any specific sensitive or specialised habitats that occur on the site.

2.2.2 Red data species lists

A species list of the red data species of the different faunal classes was obtained from the following references:

- EIA screening tool as relevant for the power line corridor.
- Red Data Book of the Mammals of South Africa (Friedman & Daly, 2004)
- The Atlas of the Southern African Birds - digital data on quarter degree grid data (Avian Demography Unit, University of Cape Town)
- Atlas and red data book of the frogs of South Africa, Lesotho, and Swaziland (Minter et al. 2004)

- South African Red Data Book – Reptiles and Amphibians. National Scientific Programmes Report no. 151.

2.2.3 Data processing

A comparison of the habitats (vegetation units) occurring within the power line corridor was made to the preferred habitats of the faunal species. In addition to species observed on the site, lists of the potential mammal, bird, reptile, amphibian, and insect species were compiled and mitigating measures recommended if needed.

2.3 IMPACT RATING ASSESSMENT MATRIX

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need.

The significance of the impacts will be determined through a synthesis of the criteria below (Plomp, 2004):

Probability. This describes the likelihood of the impact occurring:

- Improbable: The possibility of the impact occurring is very low, due to the circumstances, design, or experience.
- Probable: There is a probability that the impact will occur to the extent that provision must be made, therefore.
- Highly Probable: It is most likely that the impact will occur at some stage of the development.
- Definite: The impact will take place regardless of any prevention plans, and there can only be relied on mitigation actions or contingency plans to contain the effect.

Duration. The lifetime of the impact

- Short term: The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.
- Medium term: The impact will last up to the end of the phases, where after it will be negated.
- Long term: The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.
- Permanent: Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.

Scale. The physical and spatial size of the impact

- Local: The impacted area extends only as far as the activity, e.g., footprint.
- Site: The impact could affect the whole, or a measurable portion of the above-mentioned properties.
- Regional: The impact could affect the area including the neighbouring areas.

Magnitude/ Severity. Does the impact destroy the environment or alter its function?

- Low: The impact alters the affected environment in such a way that natural processes are not affected.
- Medium: The affected environment is altered, but functions and processes continue in a modified way.
- High: Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Significance. This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.

- Negligible: The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.
- Low: The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.
- Moderate: The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
- High: The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The following weights will be assigned to each attribute (Table 1):

Table 1. Impact rating assessment weights

Aspect	Description	Weight
Probability	Improbable	1
	Probable	2
	Highly Probable	4
	Definite	5
Duration	Short term	1
	Medium term	3
	Long term	4
	Permanent	5
Scale	Local	1

Aspect	Description	Weight
	Site	2
	Regional	3
Magnitude/Severity	Low	2
	Medium	6
	High	8
Significance	**Sum (Duration, Scale, Magnitude) x Probability**	
	Negligible	<20
	Low	<40
	Moderate	<60
	High	>60

The significance of each activity will be rated without mitigation measures and with mitigation measures for the development.

The mitigation effect of each impact will be indicated without and with mitigation measures as follows:

- Can be reversed.
- Can be avoided, managed or mitigated.
- May cause irreplaceable loss of resources.

2.4 SENSITIVITY ASSESSMENT

The ecological sensitivity of any piece of land is based on its inherent ecosystem service and overall preservation of biodiversity.

2.4.1 Ecological function

The ecological function relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to ecosystem service (e.g., wetlands) or overall preservation of biodiversity.

2.4.2 Conservation importance

Conservation importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.

2.4.3 Sensitivity scale

- High – sensitive ecosystem with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems or with high species diversity and usually provide suitable habitat for a few threatened or rare

species. These areas should be protected.

- Medium – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems or ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species.
- Low – Degraded and highly disturbed / transformed systems with little ecological function and which are generally very poor in species diversity.

2.5 EIA SCREENING TOOL

The significance of a site or natural feature may only become apparent when it is evaluated in terms of a broader biodiversity context. Put differently, local impacts on biodiversity may seem unimportant, but can become highly significant when interpreted beyond the immediate boundaries of a site. Even if a locality has a history of disturbance such as alien infestation, cultivation, or recurrent fires, and it does not host any plant or animal species of special concern, it may nevertheless be significant for biodiversity conservation when viewed from a landscape or even national perspective.

According to the national web-based environmental screening tool in terms of section 24(5)(h) of the NEMA, 1998 (Act No 107 of 1998) and regulation 16(1)(b)(v) of the EIA regulations, 2014, as amended, the following listed fauna and flora species occur in the power line corridor. The surveys for the power line corridor will focus specifically on these species according to species protocols.

Fauna:

- *Neotis ludwigii* (Ludwig's bustard).
    - Sensitivity: Medium.
    - Status: Endangered.

Flora:

- *Tridentea virescens*
    - Sensitivity: Medium.
    - Status: Rare.

3 BASELINE ENVIRONMENT

3.1 LOCATION AND DESCRIPTION OF ACTIVITY

The activity entails the development of a 132kV single-circuit power line to enable the connection of the authorised Grootpoort Photovoltaic Solar Power Plant (DFFE ref.: 14/12/16/3/3/2/835) to the national grid network. This will enable the evacuation of the generated solar electricity. A 200m wide and 8km long grid connection corridor is being assessed for the placement of the power line route and associated infrastructure. The power line is proposed to connect into the existing existing Canal Substation. A service road and substation associated with the power line are also proposed to be developed.

The grid connection corridor is approximately 17km south-west from the town of Luckhof and falls within the Letsemeng Local Municipality of the Xhariep District Municipality, Free State Province (Figure 1).

Various properties are affected by the grid connection corridor, which includes:

- Grootpoort 168 (Portion 1),
- Dundee 416 (RE, Portion 2 and 4),
- Excelsior 676,
- Lombardsdam 81 (RE),
- Naauwpoort 417 (Portion 5),
- Ou Rondefontein 146 (Portion 2 and 4),
- Rondefontein 99 (Portion 1),
- Fauresmith Rd 1251,
- Fauresmith Rd 1252.

The planned development footprint of the power line was carefully selected after a pre-screening site visit was conducted on the 20th of July 2021. The aerial map of the power line corridor is presented in Figure 5.

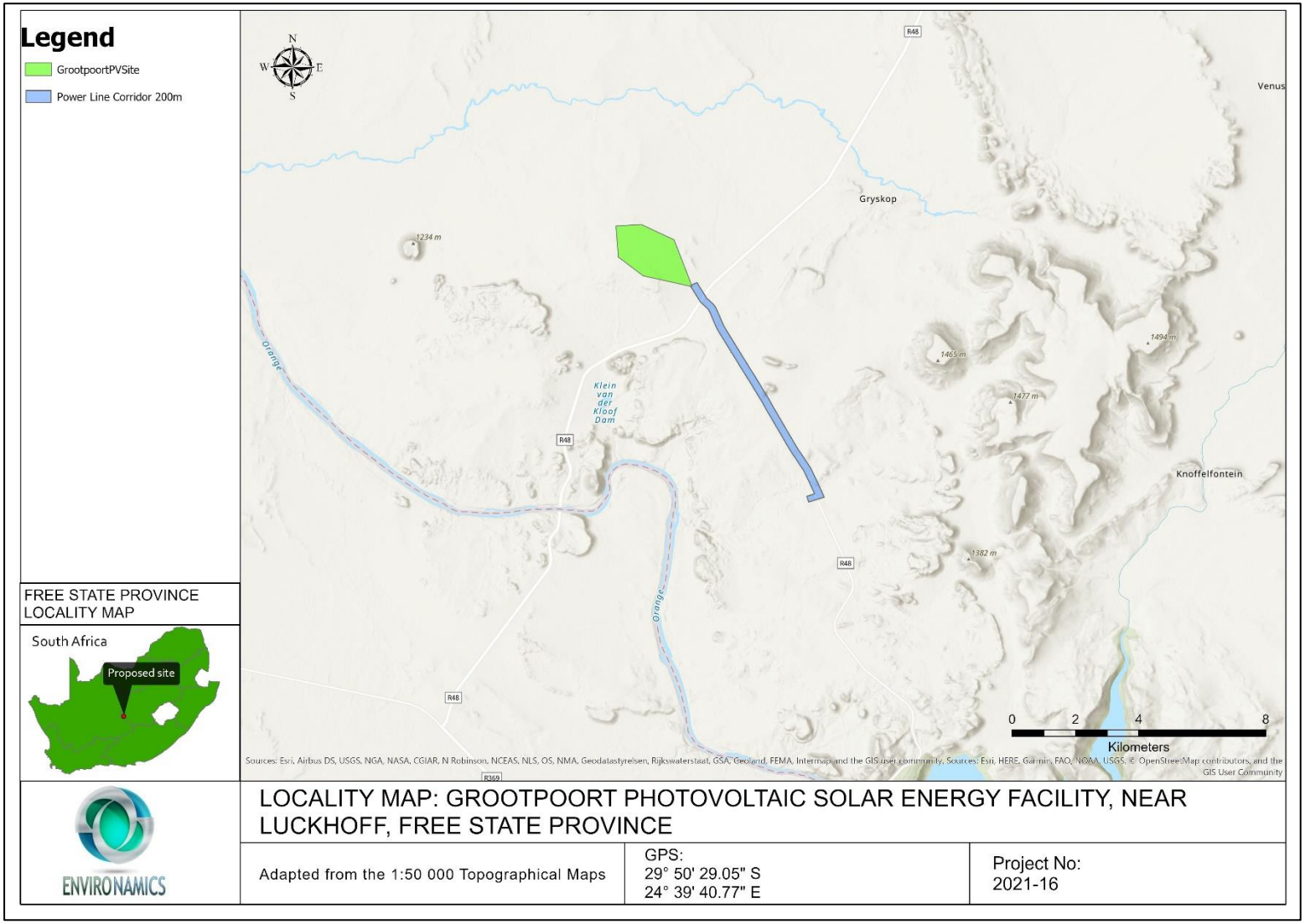

Figure 4. Regional Location Map of the proposed power line corridor

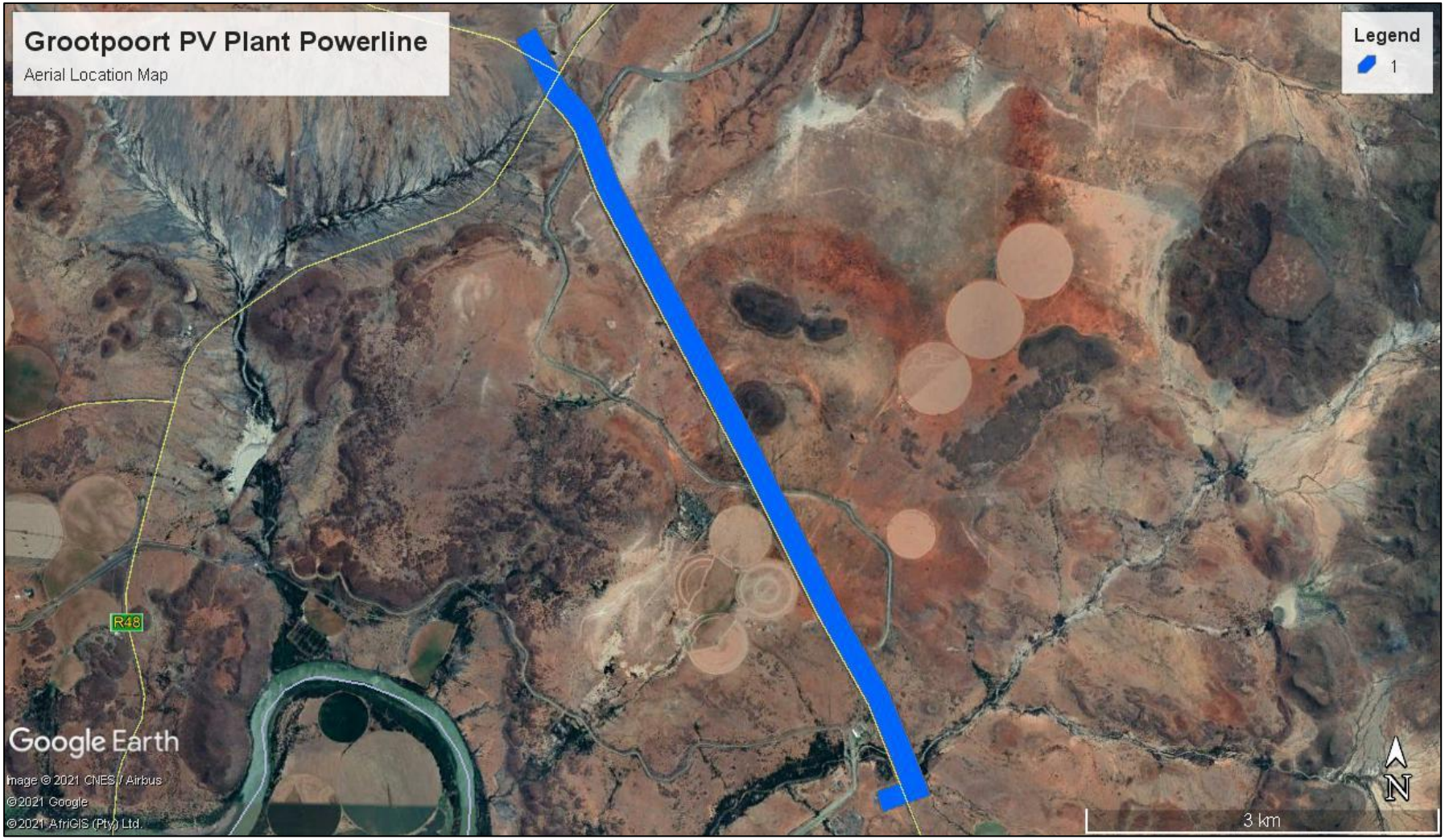

Figure 5. Aerial Map indicating the proposed location of the power line corridor for the Grootpoort PV Plant

3.2 CLIMATE

Climate in the broad sense is a major determinant of the geographical distribution of species and vegetation types. However, on a smaller scale, the microclimate, which is greatly influenced by local topography, is also important. Within areas, the local conditions of temperature, light, humidity and moisture vary greatly, and it is these factors which play an important role in the production and survival of plants (Tainton, 1981). The climate for the region can be described as warm-temperate. In terrestrial environments, limitations related to water availability are always important to plants and plant communities.

The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987). The study area is situated within the summer and autumn rainfall region with very dry winters and frequent frost that occurs during the colder winter months. The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987).

The Mean Annual Precipitation ranges from about 150 mm in the northwest to 350 mm along some grassland margins on the Great Escarpment and in the east. Water concentrates between rocks because of rainfall runoff. Incidence of frost is relatively high but ranging widely from <30 days per year at lower altitudes to >80 days at highest altitudes (Mucina & Rutherford, 2006).

The mean annual temperature for the area is 16. °C, and the mean annual frost days is 37 days. Mean Annual Potential Evaporation is 2615mm, with Mean Annual Soil Moisture Stress of 82%.

3.3 GEOLOGY AND SOIL TYPES

Geology is directly related to soil types and plant communities that may occur in a specific area (Van Rooyen & Theron, 1996). A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type unit represented within the study area include the Ag151 and Fb85 land types (Land Type Survey Staff, 1987) (ENPAT, 2001). The land type, geology and associated soil types is presented in Table 2 below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2000).

Table 2. Land types, geology, and dominant soil types of the proposed power line corridor

Landtype	Soils	Geology
Ag151	Red-yellow apedal freely drained soils, red high base <300 deep	Shale of the Ecca Group, Karoo Sequence with abundant dolerite intrusions.
Fb85	Glenrosa and/or Mispah forms (other soils may occur) lime rare or absent in upland soils but generally present in low-lying soils	Shale, mudstone, sandstone, limestone and coal of the Beaufort Group, Karoo Sequence. Dolerite intrusions are common.

The soils in this area are primarily primitive, skeletal soils in rocky areas developing over sedimentary rocks such as mudstones and arenites of the Adelaide Subgroup of the Karoo Supergroup and to a lesser extent also the Ecca Group (Waterford and Volksrust Formations) as well as Jurassic dolerite sills and dykes and subsummit positions of mesas and butts with dolerite boulder slopes. Almost entirely Ib land type (Mucina & Rutherford, 2006). On site it was found that in areas where drainage lines run off the slope, shale and mudstones of the Adelaide Subgroup are exposed leading to the development of vegetation subcommunities. This varies slightly from the general geology of the vegetation type which area shales of the Volksrust Formation and to a lesser extent the Prince Albert Formation (both Ecca Group) as well as Dwyka Group diamictites form the underlying geology. Jurassic Karoo Dolerite sills and sheets support this vegetation complex in places. Wide stretches of land are covered by superficial deposits including calcretes of the Kalahari Group. Soils are variable from shallow to deep, red-yellow, apedal, freely drained soils to very shallow Glenrosa and Mispah forms. Mainly Ae, Ag and Fc land types.

3.4 TOPOGRAPHY, LANDUSES AND DRAINAGE

The study area lies completely within the Upper Orange Water Management Area (WMA) and entirely within the Nama Karoo ecoregion (Kleynhans et al., 2005).

The topography is characterised by slightly undulating plains with drainage channels bisecting the area. The topography of the site can be described as generally favourable, when considering that most of the area consists of slopes of less than 1:5. The site is located at an altitude of between 1160 and 1220 meters above mean sea level (AMSL).

Most properties situated within a 500m radius are being used for livestock grazing and crop cultivation. The proposed development land is used for livestock farming. The natural vegetation of the site is mostly intact.

The site is located within the D33A quaternary catchment and is situated in the Upper Orange Water Management Area. Drainage occurs as sheet-wash into the drainage channels on site that eventually drains into the major river namely the Orange River that occurs to the south of the site.

3.5 SENSITIVITY ANALYSIS AND CONSERVATION ANALYSIS TOOLS

There are several assessments for South Africa as a whole, as well as on provincial levels that allow for detailed conservation planning as well as meeting biodiversity targets for the country's variety of ecosystems. These guides are essential to consult for development projects and will form an important part of the sensitivity analysis. Areas earmarked for conservation in the future, or that are essential to meet biodiversity and conservation targets should not be developed and have a high sensitivity as they are necessary for overall functioning. In addition, sensitivity analysis in the field based on much finer scale data can be used to ground truth the larger scale assessments and put it into a more localised context.

3.5.1 FREE STATE BIODIVERSITY CONSERVATION PLAN

The purpose of the Free State Biodiversity Conservation Plan is to develop the spatial component of a bioregional plan (i.e., map of Critical Biodiversity Areas (CBA) and associated land-use guidelines). The Free Stare Conservation Plan categories for the development are presented in Figure 6. The following can be concluded regarding the development:

- Most of the proposed power line footprint represent ESA1 areas. The management objective for this area is to maintain ecosystem functionality and connectivity allowing for limited loss of biodiversity pattern.

Figure 6. Free State C-Plan Map (2015) for the power line corridor

3.5.2 PROTECTED AREAS NETWORK AND NATIONAL PROTECTED AREAS EXPANSION STRATEGY (NPAES)

Officially protected areas, either provincially or nationally that occur close to the power line corridor could have consequences as far as impacts on these areas are concerned. For the proposed development and associated infrastructure no protected areas occur in proximity, with the closest being the Rolfontein Game Reserve around the Vanderkloof Dam that occurs to the south of the power line corridor (Figure 7). Based on the distance between the development and the protected area, no impact is expected to occur.

The NPAES are areas designated for future incorporation into existing protected areas (both National and informal protected areas). These areas are large, mostly intact areas required to meet biodiversity targets, and suitable for protection. They may not necessarily be proclaimed as protected areas in the future and are a broad scale planning tool allowing for better development and conservation planning. The power line corridor is located north of the Senqu Caledon NPAES, although the development of the power line will not impede on the NPAES (Figure 7).

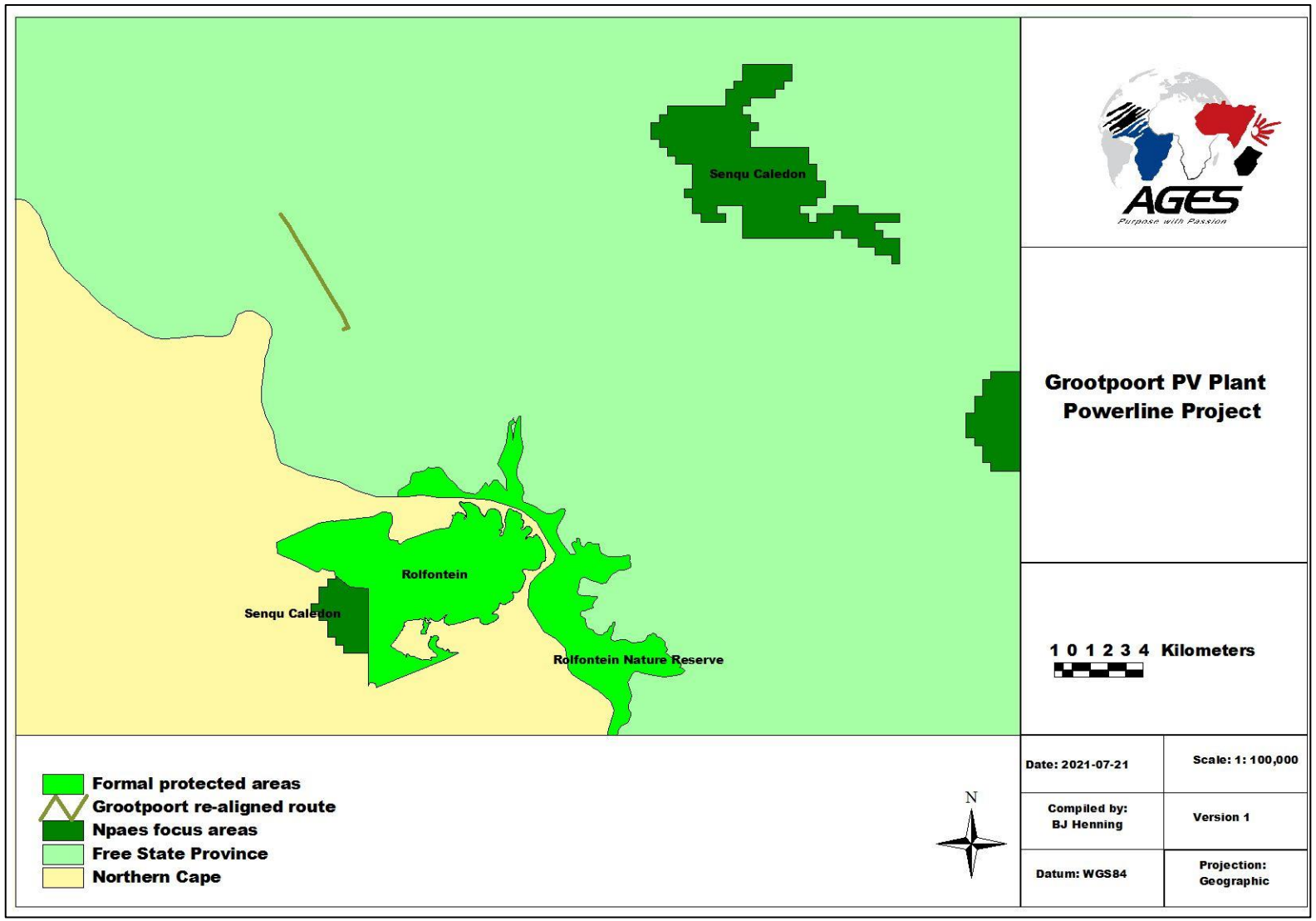

Figure 7. Location of the power line corridor in relation to listed protected areas.

3.5.3 IMPORTANT BIRD AREAS

An Important Bird Area (IBA) is an area recognized as being globally important habitat for the conservation of bird populations. Currently there are about 10,000 IBAs worldwide. At present, South Africa has 124 IBA's, covering over 14 million hectares of habitat for our threatened, endemic and congregatory birds. Yet only million hectares of the total land surface covered by our IBA's is legally protected. The BirdLife SA IBA programme continues a programme of stewardship which will ultimately achieve formal protection (Birdlife, 2013). The power line corridor is not located within an IBA with the Platberg Karoo Conservancy IBA being the closest IBA located to the east of the power line corridor (Figure 8).

This IBA contributes significantly to the conservation of large terrestrial birds and raptors. These include Blue Crane *Anthropoides paradiseus*, Ludwig's Bustard *Neotis ludwigii*, Kori Bustard *Ardeotis kori*, Blue Korhaan *Eupodotis caerulescens*, Black Stork *Ciconia nigra*, Secretarybird *Sagittarius serpentarius*, Martial Eagle *Polemaetus bellicosus*, Verreauxs' Eagle *Aquila verreauxii* and Tawny Eagle *A. rapax*.

A total of 289 bird species are known to occur here. At the time of the IBA's assessment, its 214 pentads had been poorly atlased for SABAP2.

Blue Crane numbers appear to be stable (Camina 2014). The population size of Ludwig's Bustard in the eastern Karoo appears to be slightly higher than the first estimates (Jenkins et al. 2011, Shaw 2013). There is some evidence for a decrease in the populations of Blue Korhaan and Karoo Korhaan *Eupodotis vigorsii*.

In summer, close to 10% of the global population of Lesser Kestrels *Falco naumanni* roost in this IBA. Amur Falcons *F. amurensis* are also abundant and forage and roost with Lesser Kestrels. This IBA is seasonally important for White Stork *Ciconia ciconia*, and CARs indicate high numbers of this species during outbreaks of brown locusts *Locustana pardalina* and armoured ground crickets *Acanthoplus discoidalis*.

Globally threatened species are Blue Crane (c. 1000; R Visagie pers. comm., Camina 2014), Ludwig's Bustard, Kori Bustard, Secretarybird, Martial Eagle, Blue Korhaan, Black Harrier *Circus maurus* and Denham's Bustard *Neotis denhami*. Regionally threatened species are Black Stork, Lanner Falcon *Falco biarmicus*, Tawny Eagle, Karoo Korhaan and Verreauxs' Eagle (Camina 2014).

Biome-restricted species include Karoo Lark *Calendulauda albescens*, Karoo Long-billed Lark*Certhilauda subcoronata*, Karoo Chat *Cercomela schlegelii*, Tractrac Chat *C. tractrac*, Sickle-winged Chat *C. sinuata*, Namaqua Warbler *Phragmacia substriata*, Layard's Tit-Babbler *Sylvia layardi*, Pale-winged Starling *Onychognathus nabouroup* and Black-headed Canary *Serinus alario*. Congregatory species include Lesser Kestrel and Amur Falcon.

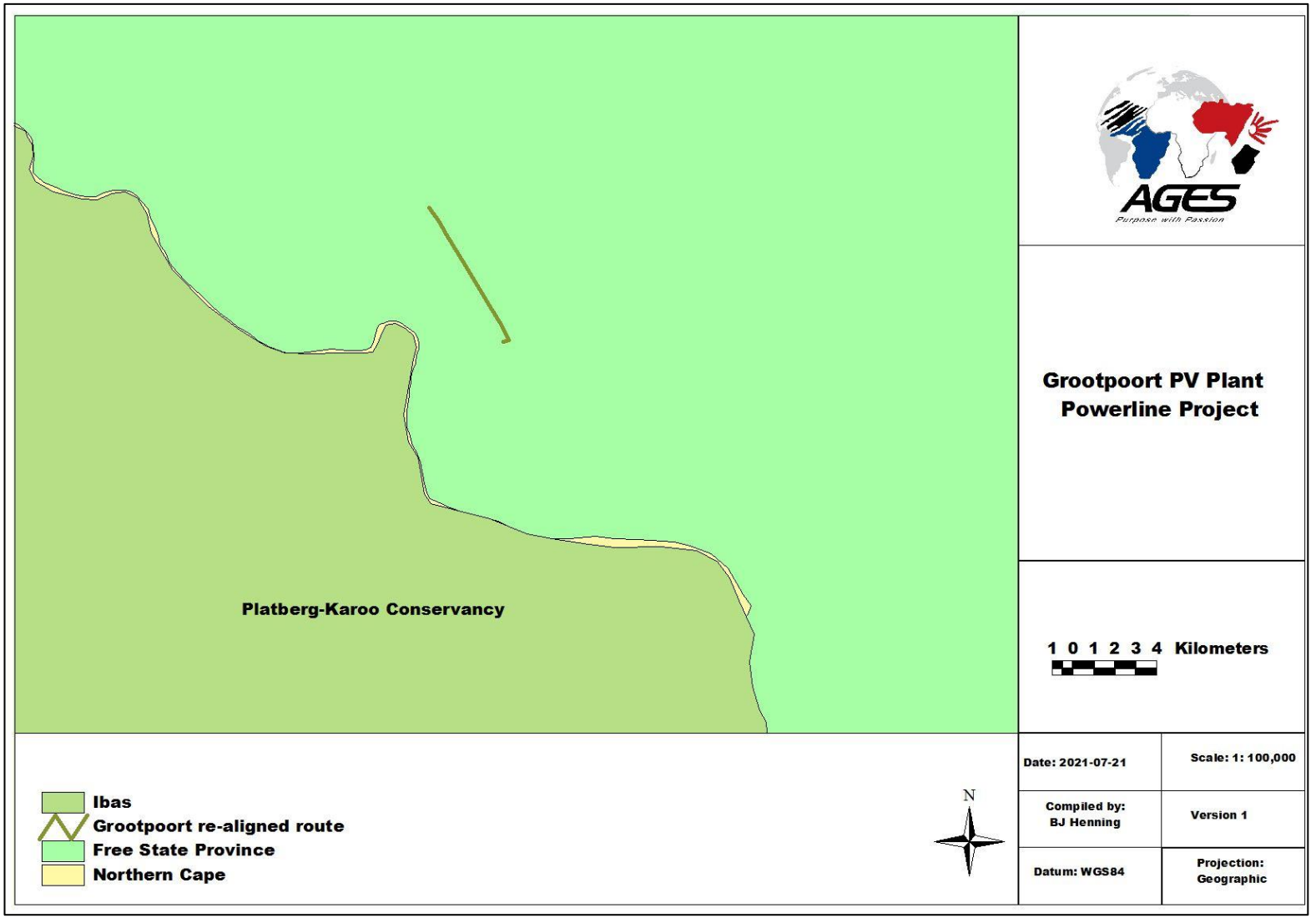

Figure 8. IBAs near the power line corridor (Birdlife SA)

3.5.4 NATIONALLY THREATENED ECOSYSTEMS

The list of national Threatened Ecosystems has been gazetted (NEM:BA: National list of ecosystems that are threatened and in need of protection) and result in several implications in terms of development within these areas. Four basic principles were established for the identification of threatened ecosystems. These include:

- The approach must be explicit and repeatable.
- The approach must be target driven and systematic, especially for threatened ecosystems.
- The approach must follow the same logic as the IUCN approach to listing threatened species, whereby a few criteria are developed, and an ecosystem is listed based on its highest-ranking criterion: and
- The identification of ecosystems to be listed must be based on scientifically credible, practical, and simple criteria, which must translate into spatially explicit identification of ecosystems.

Areas were delineated based on as fine a scale as possible and are defined by one of several assessments: These areas are essential for conservation of the country's ecosystems as well as meeting conservation targets. The power line corridor is NOT located within any listed ecosystem with the Bloemfontein Dry grassland more than 50km north-east of the area being the closest listed threatened ecosystem (Figure 9).

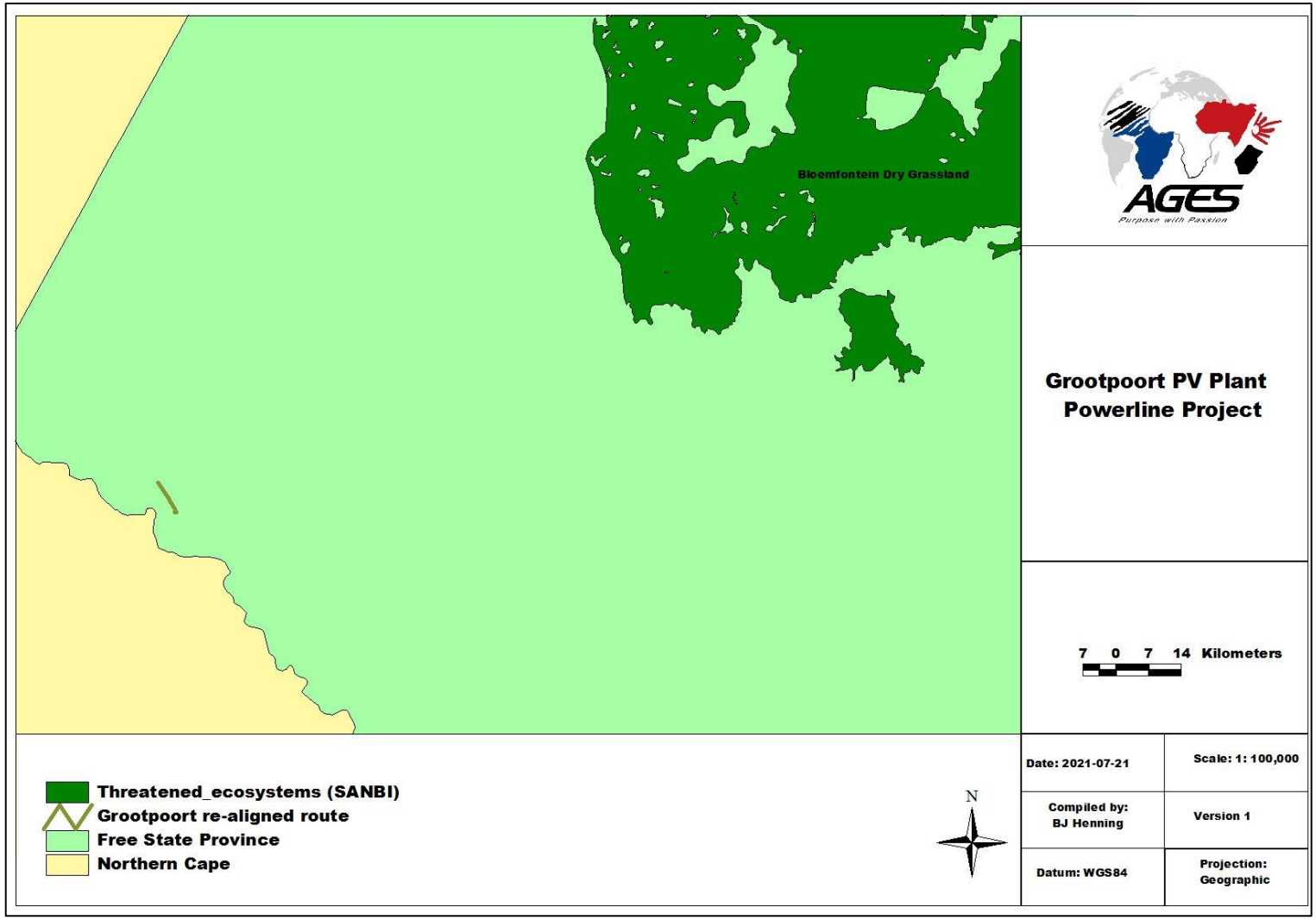

Figure 9. Listed threatened ecosystems in proximity to the proposed power line corridor (SANBI).

3.5.5 STRATEGIC WATER SOURCE AREAS (SWSA), NATIONAL FRESHWATER ECOSYSTEM PRIORITY AEAS (NFEPA) STATUS OF RIVERS AND WETLANDS ON SITE

NFEPA maps provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas, or 'FEPAs'. NFEPA maps were developed using the principles of systematic biodiversity planning, also known as systematic conservation planning (Margules and Pressey 2000). Systematic biodiversity planning is a well-established field of science in which South Africa is considered a world leader (Balmford 2003). The NFEPA maps and supporting information form part of a comprehensive approach to sustainable and equitable development of South Africa's scarce water resources. For integrated water resources planning, NFEPA provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). NFEPA products are therefore directly applicable to the National Water Act, feeding into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives. NFEPA products are also directly relevant to the National Environmental Management: Biodiversity Act (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act. NFEPA products support the implementation of the National Environmental Management: Protected Areas Act (Act 57 of 2003) by informing the expansion of the protected area network.

The power line corridor is located within proximity of a NFEPA river, namely the Orange River. None of the power line corridor is bisected by NFEPA Rivers or wetlands, although some NFEPA pans occur near the power line corridor as indicated in Figure 10.

Strategic Water Source Areas (SWSAs) are now defined as areas of land that either:

- Supply a disproportionate (i.e., relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important; or
- Have high groundwater recharge and where the groundwater forms a nationally important resource; or
- Areas that meet both criteria (a) and (b).

They include transboundary Water Source Areas that extend into Lesotho and Swaziland. All surface water SWSAs are in high rainfall areas where baseflow is at least 11 25 mm/a, which is evidence of a strong link between groundwater and surface water in the SWSAs. The aquifers sustain baseflow, contribute to runoff and, especially, contribute to dry season flows. Sustained river flows are important as they support people and communities who depend directly on rivers for their water, especially during the dry season and droughts.

The 2018 national and transboundary surface-water SWSAs cover about 124 075 km^2 (10%

of the region) and provide a MAR of 24 954 million m^3 (50% of the total). The greatest volume of MAR is generated by the Southern Drakensberg (9% of national and transboundary MAR), followed by the Eastern Cape, Northern Drakensberg and Maloti Drakensberg, and the Boland. The Boland has the highest MAR per unit area (3588 m^3/ha/year), followed by Table Mountain, the Northern Drakensberg and the Mpumalanga Drakensberg.

Seven of these SWSAs are transboundary areas because Lesotho and Swaziland include portions of important SWSAs for South Africa. The portions of the SWSAs that fall within Lesotho (Eastern Cape, and the Southern, Northern and Maloti Drakensberg) cover 18 570 km^2 and generate a MAR of about 3522 million m^3. This MAR sustains the Orange and Caledon Rivers and supplies water to Gauteng via the Lesotho Highlands water supply system. In the case of Swaziland, the portions of the SWSAs falling in this country (Ekangala Drakensberg, Mbabane Hills, Upper Usutu) total 9376 km^2 and produce a MAR of about 2053 million m^3. In total, the SWSAs in these two countries produce about 11% of the total MAR, which is a substantial contribution that needs to be protected.

The power line corridor is not located within any SWSA as indicated in Figure 10.

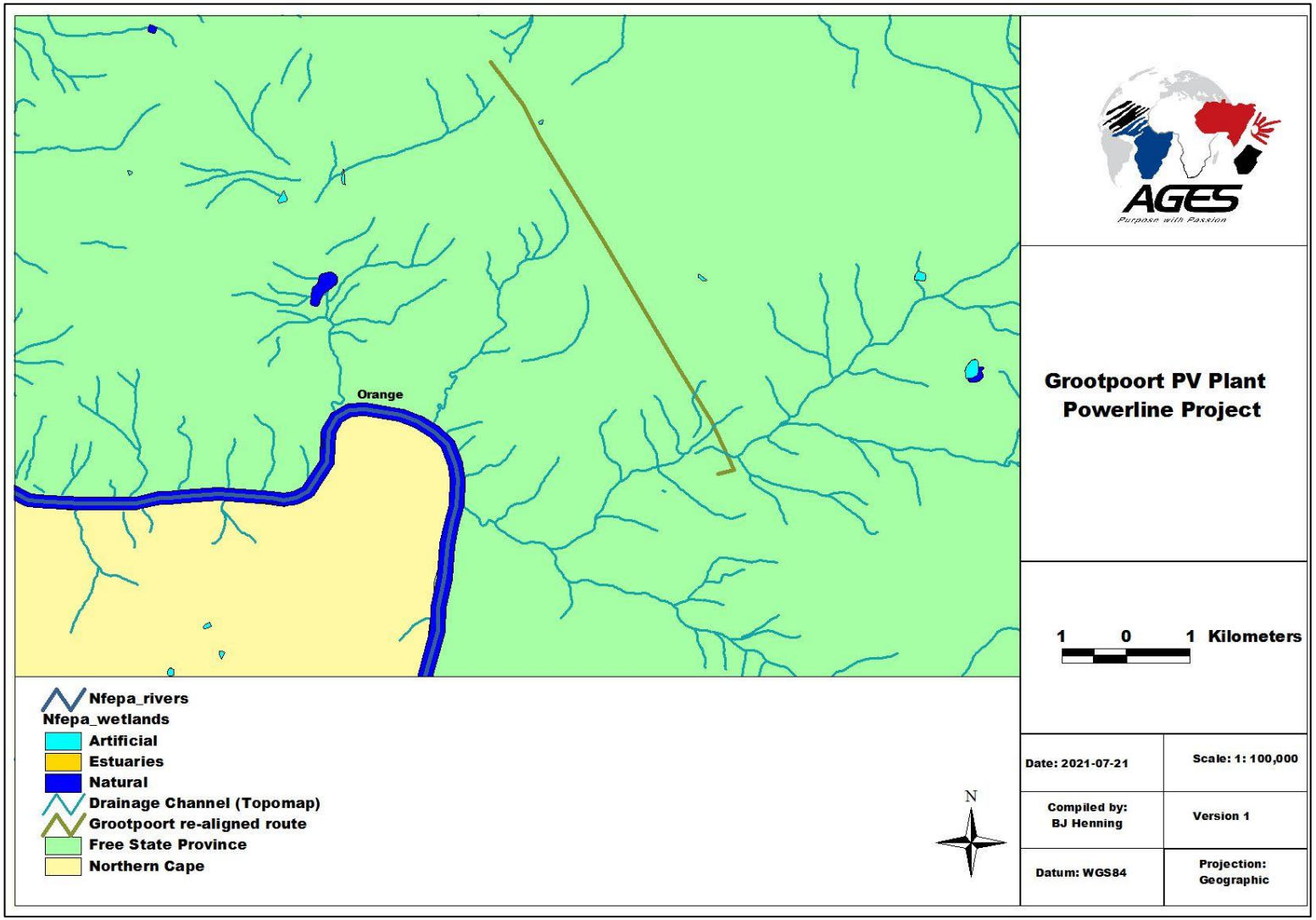

Figure 10. Location of the power line corridor in relation to NFEPA Rivers and SWSA

4 RESULTS

4.1 VEGETATION

4.1.1 Biome and Ecoregion

The Nama-Karoo Biome occurs on the central plateau of the western half of South Africa, at altitudes between 500 and 2000m, with most of the biome failing between 1000 and 1400m. It is the second-largest biome in the region.

The geology underlying the biome is varied, as the distribution of this biome is determined primarily by rainfall. The rain falls in summer and varies between 100 and 520mm per year. This also determines the predominant soil type - over 80% of the area is covered by a lime-rich, weakly developed soil over rock. Although less than 5% of rain reaches the rivers, the high erodibility of soils poses a major problem where overgrazing occurs.

The dominant vegetation is a grassy, dwarf shrubland. Grasses tend to be more common in depressions and on sandy soils, and less abundant on clayey soils. Grazing rapidly increases the relative abundance of shrubs. Most of the grasses are of the C4 type and, like the shrubs, are deciduous in response to rainfall events.

The amount and nature of the fuel load is insufficient to carry fires and fires are rare within the biome. The large historical herds of Springbok and other game no longer exist. Like the many bird species in the area - mainly larks - the game was probably nomadic between patches of rainfall events within the biome. The Brown Locust and Karoo Caterpillar exhibit eruptions under similarly favourable, local rainfall events, and attract large numbers of bird and mammal predators.

Less than 1% of the biome is conserved in formal areas. Urbanization and agriculture are minimal, and irrigation is confined to the Orange River valley and some pans. Most of the land is used for grazing, by sheep (for mutton, wool and pelts) and goats, which can be commensurate with conservation.

4.1.2 Vegetation types

The most recent classification of the area by Mucina & Rutherford (2006) shows that the power line corridor is located within the Northern Upper Karoo and a small section of the vegetation type Besemkaree Koppies Shrubland.

The Northern Upper Karoo vegetation type occurs in patches in the northern Cape and Free State Provinces: Northern regions of the Upper Karoo plateau from Prieska, Vosburg and Carnarvon in the west to Philipstown, Petrusville and Petrusburg in the east. Bordered in the north by Niekerkshoop, Douglas and Petrusburg and in the south by Carnarvon, Pampoenpoort and De Aar. A few patches occur in Griqualand West. Altitude varies mostly from 1 000–1 500 m. (Mucina & Rutherford, 2006). This vegetation type is typically characterised by shrubland dominated by dwarf karoo shrubs, grasses and *Senegalia mellifera subsp. detinens* and some other low trees (especially on sandy soils in the northern

parts and vicinity of the Orange River). Flat to gently sloping, with isolated hills of Upper Karoo Hardeveld in the south and Vaalbos Rocky Shrubland in the northeast and with many interspersed pans. (Mucina & Rutherford, 2006). The Northern Upper Karoo is classified as Least threatened with a target conservation of 21%. None of this vegetation type is currently conserved in statutory conservation areas and about 4% has been cleared for cultivation (the highest proportion of any type in the Nama-Karoo) or irreversibly transformed by building of dams (Houwater, Kalkfontein and Smart Syndicate Dams). Areas of human settlements are increasing in the northeastern part of this vegetation type (Mucina & Rutherford, 2006). Erosion is moderate (46.2%), very low (32%) and low (20%). *Prosopis glandulosa*, regarded as one of the 12 agriculturally most important invasive alien plants in South Africa, is widely distributed in this vegetation type (Mucina & Rutherford, 2006). *Prosopis* occurs in generally isolated patches, with densities ranging from very scattered to medium (associated with the lower Vaal River drainage system and the confluence with the Orange River) to localised closed woodland on the western border of the unit with Bushmanland Basin Shrubland. (Mucina & Rutherford, 2006).

The Besemkaree Koppies Shrubland occurs in the Northern Cape, Free State and Eastern Cape Provinces: On plains of Eastern Upper Karoo (between Richmond and Middelburg in the south and the Orange River) and within dry grasslands of the southern and central Free State. Extensive dolerite-dominated landscapes along the upper Orange River belong to this unit as well. Extends northwards to around Fauresmith in the northwest and to the Wepener District in the northeast. Altitude 1120– 1680 m. It is characterised by slopes of koppies, butts and tafelbergs covered by two-layered karroid shrubland. The lower closed-canopy layer is dominated by dwarf small- leaved shrubs and, especially in precipitation-rich years, also by abundant grasses, while the upper loose canopy layer is dominated by tall shrubs, namely *Searsia erosa, S. burchellii, S. ciliata, Euclea crispa subsp. ovata, Diospyros austro-africana* and *Olea europaea subsp. africana*. The Besemkaree Koppies Shrubland is classified as Least threatened with a target conservation of 28%. Only 5% of this vegetation type is currently conserved in statutory conservation areas and about 3% has been cleared for cultivation (the highest proportion of any type in the Nama-Karoo) or irreversibly transformed by building of dams (Houwater, Kalkfontein and Smart Syndicate Dams).

4.1.3 Vegetation units

The proposed power line corridor occurs on a landscape that varies from slightly undulating to moderately undulating ridges and koppies bisected by drainage channels. The importance to survey the area to have a better understanding of the ecosystem and the potential impact of the power line development on the natural environment was identified as a key factor, and subsequently the footprint areas was completely surveyed. The larger area is used for livestock farming and maize cultivation. The vegetation units on the site vary according to soil characteristics, topography, and land-use. Vegetation units were identified within the power line corridor and can be divided into 8 distinct vegetation units according to soil types, land

use and topography.

The vegetation communities identified within the corridor are classified as physiographic physiognomic units, where physiognomic refers to the outer appearance of the vegetation, and physiographic refers to the position of the plant communities in the landscape. The physiographic-physiognomic units will be referred to as vegetation units in the following sections. These vegetation units are divided in terms of the land-use, plant species composition, topographical and soil differences that had the most definitive influence on the vegetation units. Each unit is described in terms of its characteristics and detailed descriptions of vegetation units are included in the following section. A species list for the site is included in Appendix B, while a plant species list for the quarter degree grid square (QDS) is included in Appendix A. Photographs of each unit is included in the next section to illustrate the grass layer, woody structure, and substrate (soil, geology etc.). The following vegetation units were identified during the survey.

1. *Enneapogon scoparius – Chrysocome cilata* grassy dwarf shrubland.
2. *Stipagrostis obtusa – Eragrostis echinochloidea* arid grassland.
3. *Rhigozum trichotomum* shrubveld.
4. *Vachellia tortilis* degraded woodland.
5. *Searsia erosa – Searsia burchelli* low ridges and footslopes.
6. Searsia erosa steep outcrops.
7. Cultivated land (Maize fields).
8. Drainage features:
    - Floodplains Rivers.
    - Non-perennial drainage channels.
    - Endorheic depressions (offstream dam).
    - Concrete canal.

The vegetation units for the power line development are presented in Figure 11:

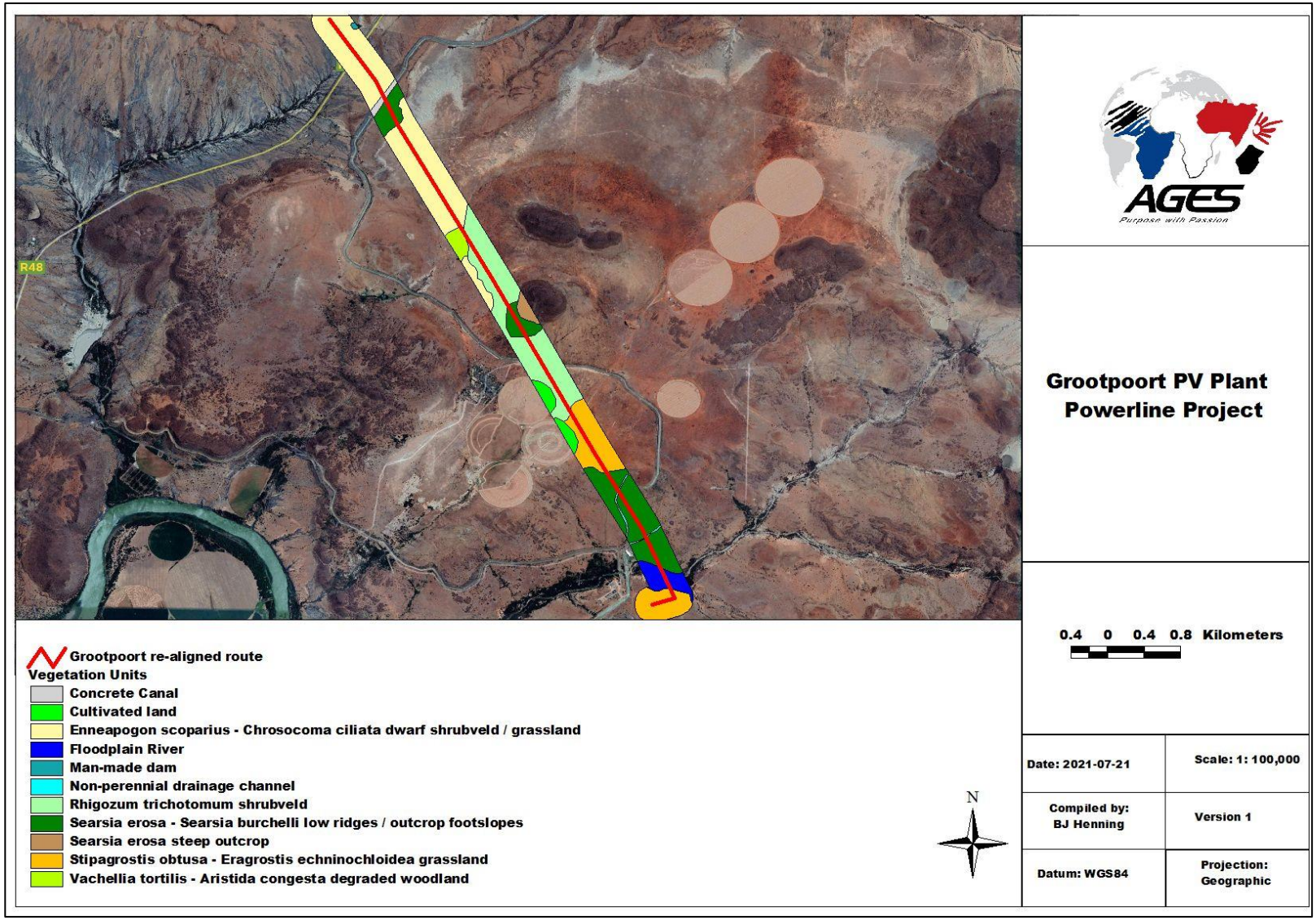

Figure 11. Vegetation Unit Map of the proposed power line corridor

4.1.3.1 *Enneapogon scoparius – Chrysocome cilata* grassy dwarf shrubland

This grassland vegetation unit is described as typical Northern Upper Karoo by Mucina & Rutherford (2006) and occurs in the northern section of the proposed power line corridor on shallow calcareous soils. The vegetation structure is medium tall grassland dominated by grass species such as *Stipagrostis obtusa, Enneapogon scoparius, Enneapogon desvauxii, Eragrostis lehmanniana* and dwarf shrubs such as *Chrysocoma ciliata* and *Pentzia calcarea.* No red data or protected species were documented in the area. The characteristics of this vegetation unit are summarized in Table 3, while the state of the vegetation indicated in photograph 1.

Table 3. Botanical analysis and characteristics of the *Enneapogon scoparius – Chrysocoma cilata* grassy dwarf shrubland

Vegetation unit characteristics	
State of the vegetation:	Grassy dwarf shrubland in a slightly degraded state
Need for rehabilitation	Low
Conservation priority	Medium
Soils & Geology	Shallow calcareous soils of the Hutton / Glenrosah soil forms derived from Limestone
Density of woody layer	Trees: <1% (avg. height: 3-6m) Shrubs:1-2% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 40-50% (avg. height: 0.8-1.2m) Forbs & Dwarf shrubs: 20% (avg. height: 0.8m)
Sensitivity	Medium
Red data species	None observed
Protected species	None observed

The following specific recommendations for the vegetation unit should be adhered to:

- The vegetation unit is classified as having a medium sensitivity due to the widespread status through the larger area.
- The development of the power line is considered suitable in this area.

Photograph 1. *Enneapogon scoparius – Chrysocoma cilata* grassy dwarf shrubland in the power line corridor

4.1.3.2 *Stipagrostis obtusa – Eragrostis echinochloidea* arid grassland

The central and southern section of the power line corridor forms a denser grassland variation with scattered dwarf shrubs underlied by a thicker layer of red-yellow apedal soils (Hutton, Clovelly soil forms) derived from sandstone. The grass layer is well developed and dominated by species such as *Stipagrostis obtusa, Eragrostis echinochloidea* and various dwarf shrubs such as *Galenia africana* and *Pentzia incana*. The state of the vegetation is indicated in photograph 2, while the characteristics of the variations of this vegetation unit are summarized in Table 4.

Table 4. Botanical analysis and characteristics of *Stipagrostis obtusa – Eragrostis echinochloidea* arid grassland

Vegetation unit characteristics	
State of the vegetation:	Indigenous grassland in a slightly degraded state
Need for rehabilitation	Low
Conservation priority	medium
Soils & Geology	Red-yellow apedal sandy soils of the Clovelly / Hutton soils / yellowish soils of the Oakleaf soil form
Density of woody layer	Trees: <1% (avg. height: 3-6m)

Vegetation unit characteristics	
	Shrubs:<1% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 70-80% (avg. height: 0.8-1.2m) Forbs: 5-10% (avg. height: 0.8m)
Sensitivity	Medium
Red data species	None observed
Protected species	None observed

The following specific recommendations for the vegetation unit regarding the proposed development should be adhered to:

- The vegetation unit is classified as having a medium sensitivity due to the widespread status through the larger area.
- The development of the power line is considered suitable in this area.

Photograph 2. *Stipagrostis obtusa – Eragrostis echinochloidea* arid grassland in the power line corridor

4.1.3.3 *Rhigozum trichotomum* shrubveld

The sections around the base of the outcrops of the power line corridor forms a dense shrubveld dominated by *Rhigozum trichotomum*. The woody layer forms a dense shrubveld due to previous overgrazing of the area, and a herbaceous layer typical of the surrounding areas. The substrate is shallow calcrete overlied by sandy soils derived from sandstone. The state of the vegetation is indicated in photograph 3, while the characteristics of the variations of this vegetation unit are summarized in Table 5.

Table 5. Botanical analysis and characteristics of *Rhigozum trichotomum* shrubveld

Vegetation unit characteristics	
State of the vegetation:	Dense shrubveld in an encraoched state
Need for rehabilitation	Low
Conservation priority	Medium
Soils & Geology	Shallow gravelly soils and red-yellow sandy soils
Density of woody layer	Trees: <1% (avg. height: 3-6m) Shrubs:20% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 60-70% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)
Sensitivity	Medium
Red data species	None observed
Protected species	None observed

The following specific recommendations for the vegetation unit regarding the proposed development should be adhered to

- The vegetation unit is classified as having a medium sensitivity due its widespread occurrence in the Nama Karoo Biome.
- The development of the power line development is considered suitable in this area.

Photograph 3. *Rhigozum trichotomum* shrubveld in the power line corridor

4.1.3.4 Vachellia tortilis degraded woodland

A small section of the power line corridor represents an old kraal and areas surrounding the farmstead that form degraded microphyllous woodland on red-yellow apedal soils. The woody layer is dominated by species such as *Vachellia karroo, Vachellia tortilis* and *Ziziphus mucronata*. The woody structure varies from being open woodland to degraded grassland. The grass layer is in a degraded state due to previous overgrazing and dominated by *Aristida congesta* and *Cynodon dactylon*. The state of the vegetation is indicated in photograph 4, while the characteristics of the variations of this vegetation unit are summarized in Table 6.

Table 6. Botanical analysis and characteristics of *Vachellia tortilis* degraded woodland

Vegetation unit characteristics	
State of the vegetation:	Microphyllous woodland in a degraded state
Need for rehabilitation	Medium
Conservation priority	Medium
Soils & Geology	Red-yellow loamy soils of the Hutton soils
Density of woody layer	Trees: 2-5% (avg. height: 3-6m) Shrubs:<1% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 50-60% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)

Vegetation unit characteristics	
Sensitivity	Medium-low
Red data species	None observed
Protected species	None observed

The following specific recommendations for the vegetation unit regarding the proposed development should be adhered to:

- The vegetation unit is classified as having a medium-low sensitivity due to being in a secondary state of succession.
- The development of the power line is considered suitable in this area.

Photograph 4. *Vachellia tortilis* degraded woodland in the power line corridor

4.1.3.5 *Searsia erosa – Searsia burchelli* low ridges and footslopes

Rocky outcrops and ridges in the Nama Karoo biome of South Africa are often habitats for red data and endemic species of an area, while also supporting a unique floral and faunal species composition. The vegetation unit forms part of the low ridges, footslopes of steep outcrops and ridges in the power line corridor. The rocky outcrops provide suitable habitat to protected plants, small mammals and reptiles. The rocky outcrops function as islands within the landscape and are characterized by unique microclimates in which rare species thrive. They are therefore of High Ecological Function and of High Conservational Value for the biodiversity that they support. The habitat type can be considered pristine. No red data species occurs; probably because of the habitat being different compared to the potential red

data species habitat.

This vegetation unit is located slightly undulating hilly terrain in the central and southern section of the power line corridor. The soils are shallow and vary from gravelly to rugged and rocky with small non-perennial drainage channels bisecting the landscape. This woodland type has an open woody structure dominated by *Searsia burchelli, Searsia erosa, Lycium cinereum* and *Diospyros austro-africana* on shallow, gravelly to rocky soils.

The state of the vegetation is indicated in photograph 1 and 2, while the characteristics of the vegetation unit are summarized in Table 7.

Table 7. Botanical analysis and characteristics of the *Searsia erosa – Searsia burchelli* low ridges and footslopes

Vegetation unit characteristics	
State of the vegetation:	Slightly degraded woodland
Need for rehabilitation	Low
Conservation priority	Medium - High
Characteristics	Open to denser woodland on moderately undulating plains and hills / outcrops
Soils & Geology	Shallow rocky soils of the Glenrosa and / or Mispah soil forms derived from Sandstone / dolerite
Density of woody layer	Trees: 2-5% (avg. height: 3-6m) Shrubs: 10% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 40-50% (avg. height: 0.8-1.2m) Forbs: 2-5% (avg. height: 0.8m)
Sensitivity	Medium - High
Red data species	None observed
Protected species	None observed

The following specific recommendations for the vegetation unit regarding the proposed development should be adhered to

- The vegetation unit is classified as having a Medium - High Sensitivity due to being located on slightly undulating rocky terrain and due to the uniqueness of the outcrop areas as part of the larger ecosystem.
- The development of the power line can be supported on the area, although the layout should follow the lower sections of outcrops and should preferably not cross the steeper areas. Where unavoidable, a single pylon can be placed on the outcrop areas.

Photograph 5. *Searsia erosa – Searsia burchelli* low ridges and footslopes in the power line corridor

4.1.3.6 *Searsia erosa* steep outcrops

The steep outcrops (Photograph 6) in the power line corridor are located further away from the proposed power line corridor and therefore no detailed surveys were conducted in the area. The outcrops have a high percentage rockiness with medium to large sized sandstone boulders, and therefore the herbaceous layer on the outcrops is seldom dense. The woody layer is dominated by *Searsia burchelli, Searsia erosa, Lycium cinereum* and *Diospyros austro-africana.*

The following specific recommendations for the vegetation unit regarding the proposed development should be adhered to

- The vegetation unit is classified as having a High Sensitivity due to the steep, rocky slopes and uniqueness of the outcrop areas as part of the larger ecosystem. The area also plays an important role as corridor for fauna and specifically habitat to endemic species such as brown hyena, Verreaux's eagle and leopard.
- The development of the power line should preferably avoid these areas, although where unavoidable, a single pylon can be placed on the outcrop areas or on bare ground areas with lower sensitivity.

Photograph 6. Steep, rocky outcrops in the power line corridor

4.1.3.7 Cultivated land

The croplands in the southern section of the power line corridor form ploughed lands or homogenous stands of crops on sandy soils (Photograph 7). Exotic weeds and pioneer grasses often colonize the areas surrounding the croplands. No detailed survey was considered for this area due to the completely modified state of the vegetation and the area has a low sensitivity.

Photograph 7. Cultivated land in the power line corridor

4.1.3.8 Drainage features

4.1.3.8.1 Depressions

The depression in the power line corridor represents a man-made dam (Photograph 8) classified as endorheic depressions. A depression is classified as a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates. Dominant water sources are precipitation, ground water discharge, interflow and (diffuse or concentrated) overland flow. For 'depressions with channelled inflow', concentrated overland flow is typically a major source of water for the wetland, whereas this is not the case for 'depressions without channelled inflow'. Dominant hydrodynamics are (primarily seasonal) vertical fluctuations. Depressions may be flat-bottomed (in which case they are often referred to as 'pans') or round-bottomed (in which case they are often referred to as 'basins') and may have any combination of inlets and outlets or lack them completely. Water exits by means of concentrated surface flow in channels for exorheic depressions, although the primary means of water still exits as evaporation.

The vegetation associated with depressions is mostly sedges and bulrushes depending on the depth of the water and the substrate. Species such as *Phragmites australis* and *Typha capensis* mostly grow along the shallow edges of dam and pans s in the power line corridor on a muddy substrate. The riparian woodland is characterised by *Vachellia karroo* and *Ziziphus mucronata*.

Photograph 8. Man-made dam in the northern section of the power line corridor

4.1.3.8.2 River channels and floodplains

All rivers and streams with their associated riparian vegetation in the power line corridor are ecologically sensitive, forming important, limited and specialised habitats for several plant and fauna species. The species composition is unique and relatively limited in distribution and coverage. These habitats also form linear corridors linking different open spaces. The drainage channels of the power line corridor (Photograph 9, 10) eventually flow into the Orange River that occurs to the south of the power line corridor. The riverine woodland would be important dry season refuge areas for many fauna species in their natural state. It is also a centre of floral diversity. Riparian areas have been identified as important dry season refuge areas for a variety of large mammal species. The impacts on the sensitive riparian ecosystems, regardless of the source, need to be restricted. Impacts on this system include erosion, habitat loss and degradation and the associated impacts on faunal and floral diversity, dewatering of marshes and wetlands, water abstraction as well as increased sedimentation (SANParks 2003). Continued impacts on the riverine ecosystems may also ultimately reduce the capacity of this system to absorb dramatic flooding events. The band of trees that occurs along the channel can be classified as riparian vegetation. This vegetation is very important for connectivity with adjacent vegetation as well as a migratory route for riparian animals.

Most of the drainage channels on site are non-perennial. Channels are subdivided further within this level of the hierarchy into six geomorphological zones, as defined by Rowntree and Wadeson (2000). These zones are based largely on gradient which influences flow velocity and channel characteristics such as substratum particle size that are important characteristics of riverine habitat types. The following geomorphological zones occur in the power line corridor and described as follows (after Rowntree and Wadeson 2000):

- Lowland River: a low-gradient alluvial fine-bed channel. It may be confined but has a fully developed meandering pattern within a distinct floodplain that develops in unconfined reaches where there is increased silt content in bed or banks. Characteristic gradient: 0.0001- 0.001.
- Lower Foothill River: a lower-gradient mixed-bed alluvial channel with sand and gravel dominating the bed and sometimes locally bedrock-controlled. Reach types typically include pool-riffle or pool-rapid with sand bars common in pools. Pools are of significantly greater extent than rapids or riffles. A floodplain is often present. Characteristic gradient: 0.001-0.005.

The non-perennial drainage channels are characterized by a channel that cuts through a slightly undulating landscape. The non-perennial riverine areas form to narrow channels (Photograph 10). These riverine areas support low riparian woodland dominated by species such as *Vachellia karroo* and various grasses such as *Panicum maximum* and *Eragrostis rotifer*.

Photograph 9. Non-perennial drainage channel in the power line corridor

The major river in the southern section of the power line corridor can be described as a floodplain river or a lowland river. The floodplain is not classified as a floodplain wetland, but a river with some wetland characteristics in the channel and its banks.

A floodplain, is flat or nearly flat land adjacent to a stream or river that stretches from the banks of its channel to the base of the enclosing valley walls and experiences flooding during periods of high discharge (Figure 12). It includes the floodway, which consists of the stream channel and adjacent areas (riparian woodland, hydrophilic grassland, Photograph 10) that carry flood flows, and the flood fringe, which are areas covered by the flood, but which do not experience a strong current. In other words, a floodplain is an area near a river or a stream which floods easily. Floodplains are made by a meander eroding sideways as it travels downstream. When a river breaks its banks and floods, it leaves behind layers of rock and mud. These gradually build up to create the floor of the flood plain. Floodplains generally contain unconsolidated sediments, often extending below the bed of the stream. These are accumulations of sand, gravel, loam, silt, and/or clay, and are often important aquifers, the water drawn from them being pre-filtered compared to the water in the river.

The vegetation associated with the floodplain is mostly microphyllous woodland and hygrophilous grasses in the power line corridor. Species such as *Vachellia karroo, Searsia pyroides, Ziziphus mucronata* and *Searsia lancea* mostly grow in the floodplain area (Photograph 10), together with grass species such as *Eragrostis rotifer*.

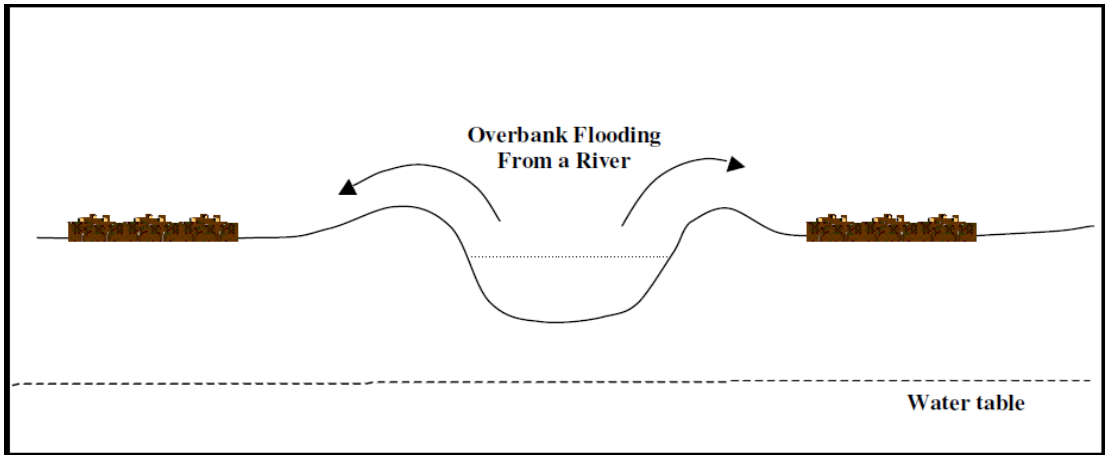

Figure 12. Cross section through a floodplain

Photograph 10 The floodplain river in the power line corridor

4.1.3.8.3 Concrete irrigation canals

The concrete canals in the area (Photograph 11) represent artificial drainage features built many years ago as part of the farmining irrigation scheme in the area. No detailed survey was needed, and the drainage features is not considered as part of the natural drainage regime of the area. It will therefore not form part of any IEWUL application in the future.

Photograph 11. Concrete irrigation canal in the power line corridor

4.2 PLANT SPECIES LEVEL ASSESSMENT

South Africa has been recognized as having remarkable plant diversity with high levels of endemism. The major threats to plants in the study area are urban expansion, non-sustainable harvesting, collecting, overgrazing/browsing, mining and agriculture. The objective of this section was to compile a list of plant species for which there is conservation concern. This includes threatened, rare, declining, protected, and endemic species.

4.2.1 Species of conservation concern

Species of conservation concern are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient – Insufficient Information (DDD). It should also be noted that not all species listed as protected are threatened or vice versa. A list of SCC plant species previously recorded in the study area in which the proposed development is planned was obtained from the Plants of Southern Africa (POSA) database of SANBI. Figure 13 indicates the classification system used by Sanbi for SCC:

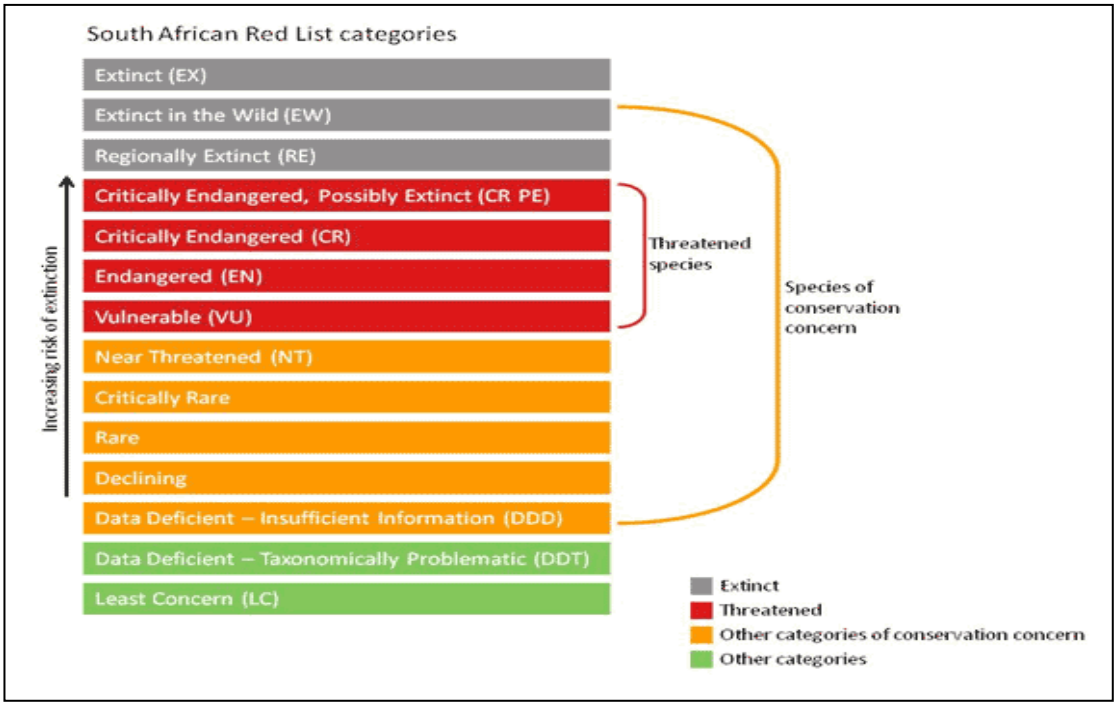

Figure 13. South African red list categories indicating the categories to be used for Species of Conservation Concern

Habitat degradation is one of the main reasons for plant species becoming extinct in a particular area. Threatened species are also seen as indicators of the overall health of an ecosystem (Hilton-Taylor, 1996).

A list of red data plant species previously recorded in the grid square in which the proposed development is planned was obtained from SANBI. No red listed plant species occur in the QDS or was recorded in the power line corridor.

Ecological monitoring should however still be implemented during the construction phase and specific sensitive habitats (riparian) needs to be avoided to ensure that any potential red data species potentially missed during the field surveys are preserved and not potentially impacted on.

The EIA screening tool highlights 1 listed species. Table 8 indicate the listed species for the power line corridor according to the EIA screening tool:

Table 8. Listed flora species for the power line corridor according to the EIA screening tool, status, and habitat.

Species	Status	Habitat
Tridentea virescens	Rare	Stony ground, or hard loam in floodplains.

4.2.1.1 *Tridentea virescens*

This species occurs on stony ground, or hard loam in floodplains. It is a widespread species that occurs as sporadic small subpopulations of up to six plants. No threats are known to impact this species.

Probability of occurrence on site: Moderate due to potential habitat observed on site.

Probability of impact during vegetation clearance: Low, the potential habitat will NOT be impacted on by the proposed development**,** and no population of the species was documented in the area.

4.2.2 Protected Plants (Free State Nature Conservation Ordinance)

Plant species are also protected in the Free State Province according to the Free State Nature Conservation Ordinance. According to this ordinance, no person may pick, import, export, transport, possess, cultivate, or trade in a specimen of a specially protected or protected plant species. The Appendices to the ordinance provide an extensive list of species that are protected, comprising a significant component of the flora expected to occur on site. Communication with Provincial authorities indicates that a permit is required for all these species if they are expected to be affected by the proposed project.

After a detailed survey was conducted during July 2021, no listed species was confirmed within the power line corridor.

4.2.3 Invasive alien species

Invasive alien plants pose a direct threat not only to South Africa's biological diversity, but also to water security, the ecological functioning of natural systems and the productive use of land. They intensify the impact of fires and floods and increase soil erosion. Of the estimated 9000 plants introduced to this country, 198 are currently classified as being invasive. It is estimated that these plants cover about 10% of the country and the problem is growing at an exponential rate.

The Alien and Invasive Species Regulations (GNR 599 of 2014) are stipulated as part of the National Environmental Management: Biodiversity Act (10/2004). The regulation listed a total of 559 alien species as invasive and further 560 species are listed as prohibited and may not be introduced into South Africa. Below is a brief explanation of the four categories of Invasive Alien Plants as per the regulation.

- Category 1a: Invasive species requiring compulsory control. Remove and destroy. 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 Category 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.

The fight against invasive alien plants is spearheaded by the Working for Water (WfW) programme, launched in 1995 and administered through the DWA. This programme works in partnership with local communities, to whom it provides jobs, and with Government departments including the Departments of Environmental Affairs and Tourism, Agriculture, and Trade and Industry, provincial departments of agriculture, conservation and environment, research foundations and private companies.

WfW currently runs over 300 projects in all nine of South Africa's provinces. Scientists and field workers use a range of methods to control invasive alien plants. These include:

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

Vehicles often transport many seeds, and some may be of invader species, which may become established along the roads through the area, especially where the area is disturbed. The construction phase of the development will almost certainly carry the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that invasive alien species such as the seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project. The following alien invasive and exotic plant species were recorded on site during the surveys as stipulated in the Alien and Invasive Species Regulations (GNR 599 of 2014) (Table 9):

Table 9. Declared weeds and invader plants of the study area.

Species	Category
Datura stramonium	1b
Eucalyptus camaldulensis	1b
Opuntia ficus-indica	1b
Opuntia imbricata	1b
Prosopis glandulosa	2
Xanthium strumarium	1b

According to the amended regulations (No. R280) of March 2001 of the Conservation of Agricultural Resources Act 1983 (Act no. 43 of 1983), it is the legal duty of the land user/landowner to control invasive alien plants occurring on the land under their control. The State has the right to clear invasive plants at the landowner's expense if the landowner refuses to remove invasive plants.

4.2.4 General

An important aspect relating to the proposed development should be to protect and manage the biodiversity (structure and species composition) of the vegetation types which are represented within the power line corridor. Vegetation removal should be kept to a minimum during the construction phase of the development and only vegetation on the footprint areas should be removed. Mitigation measures and monitoring should however be implemented should the development be approved.

4.3 FAUNAL HABITAT AND ANIMAL SPECIES ASSESSMENT

4.3.1 Overview

A healthy environment is inhabited by animals that vary from micro-organisms to the birds and mammals. The species composition and diversity are often parameters taken into consideration when determining the state of the environment. A comprehensive survey of all animals is a time-consuming task that will take a long time and several specialists to conduct. The alternative approach to such a study is to do a desktop study from existing databases and conduct a site visit to verify the habitat requirements and condition of the habitat. If any rare or endangered species are discovered in the desktop study that will be negatively influenced by the proposed development, specialist surveys will be conducted.

4.3.2 Results of desktop survey and site visits during July 2021

A survey was conducted during July 2021 to identify specific fauna habitats, and to compare these habitats with habitat preferences of the different fauna groups (birds, mammals, reptiles, amphibians) occurring in the quarter degree grid.

The number of mammal species supported by a plant community depends on several factors like the primary production, seasonal availability of resources, floral heterogeneity, diversity of

plant structure, nature of the substratum and previous history (Delany, 1982). Each mammal species has a particular niche, which can be regarded as the sum of all ecological requirements of a species namely food, space, shelter, and physical conditions. Mills & Hes (1997) stated that the distribution and abundance of animal species does not rigorously follow that of plant communities or biomes. Instead, mammal species seem to have certain preferences for a specific habitat type (Skinner & Smithers, 1990). Several authors have shown this preference of mammals to certain habitats through analysis (Beardall et al. 1984; Ben-Shahar, 1991; Dekker et al. 1996). The area represents a diverse vegetation structure and height class. A detailed species list for the fauna of the area is included in Appendix C, D and E.

4.3.3 Fauna habitats of the power line corridor

Five major fauna habitats were observed in the area namely:

- Grassy dwarf shrubland.
- Microphyllous woodland (including riparian woodland).
- Riparian habitats / drainage channels.
- Croplands.
- Outcrops.

4.3.4 Common fauna documented and potentially occurring within the power line corridor

4.3.4.1 Mammal Habitat Assessment

The Nama Karoo never had the variety of wildlife that you find in the Savanna Biome. But in the past vast herds of Springbok used to migrate through the region in search of water and grazing. These herds were destroyed and replaced with sheep. The fauna of the Nama Karoo is relatively species-poor (Vernon 1999). There are few strict endemics, as most animals have extended their ranges into the Karoo from adjacent biomes. One species of small mammal is strictly endemic to the ecoregion, Visagie's golden mole (*Chrysochloris visagiei*, CR). Five other small mammals are near-endemic, Grant's rock mouse (*Aethomys granti*), Shortridge's rat (*Thallomys shortridgei*, LR), the riverine rabbit (*Bunolagus monticularis*, EN), *Gerbillurus vallinus* and *Petromyscus monticularis*, LR (Hilton-Taylor 2000). The most vulnerable of the Nama Karoo's vertebrates is the riverine rabbit (*Bunolagus monticularis*), classified as "Endangered" in the South African Red Data Book because of habitat destruction by agriculture (Smithers 1986). The quagga, (*Equus quagga*) a Nama Karoo near-endemic, was hunted to extinction in the 19th Century (Skinner and Smithers 1990).

The major large-scale disturbance to the Nama Karoo ecosystem has been grazing, previously by a variety of indigenous migratory ungulates and now by domestic sheep and goats confined within farm boundaries (Skead 1982). Sedentary domestic livestock graze

selectively compared to the catholic tastes of their native nomadic counterparts (Roux and Theron 1986). This change in the grazing regime is thought to be responsible for alterations in both plant species composition and cover (Roux and Theron 1986), which ultimately influence ecosystem functioning. On a smaller scale, disturbances associated with heuweltjies (ancient termitaria) (Moore and Picker 1991) maintain habitat heterogeneity and patchiness within the landscape. Termite activity makes the soils of heuweltjies finer, moister and more alkaline than their surrounds (Midgley and Musil 1990). The plant communities that grow on these mounds are thus very different than the surrounding matrix (Lovegrove 1993). Many animal species may contribute further to the nutrient enrichment of heuweltjies. Aardvark (*Orycteropus afer*) and steenbok (*Raphicerus campestris*) often use them as dung middens; Brant's whistling rats (*Parotomys brantsii*) frequently colonize them; and sheep prefer to graze (and therefore deposit dung) on the mounds (Armstrong and Siegfried 1990, Milton and Dean 1990).

Due to the location of the proposed power line corridor adjacent to the road corridor, the resident fauna is likely to represent only a subset of the species which historically occurred in the area. The low-lying shrublands in the valleys is a herbivore-driven ecosystem and the loss of large herbivores will have a long-term negative effect on this ecosystem. Within the old lands of the study area there is likely to be a highly depauperate vertebrate community because of the low vegetation cover. Persistent species will be those that favour or can tolerate low vegetation cover such as the Cape and Hairy-Footed Gerbil (*Tatera afra* and *Gerbillurus paeba*). Other species such as Scrub Hare and Steenbok will forage on the croplands at night but return to natural vegetation remnants for shelter and protection.

Narrow remnants of bush along fence-lines and roadsides probably provide important corridors for movement for porcupines as well as other mammals and smaller vertebrates. Leopard, brown hyena, and small spotted cat are some of the most important predators in the area.

The connectivity1 of the corridor to the remainder of the larger area is Moderate due to other surrounding areas representing natural vegetation and drainage channels. Of significance is the role of the channels and outcrops as zoogeographical dispersal corridors.

4.3.4.2 Avifauna

The Nama Karoo, like the succulent Karoo, is also primarily a dwarf shrub habitat, but it has higher proportions of grass and, in places, tree cover. It falls within the eastern summer rainfall region. The Red Lark and Sclater's larks are restricted, and the Blackeared Finchlark largely so, to the Nama and Grassy Karoo. The Red Lark has a circumscribed range confined to the Nama Karoo.

Among birds, the ferruginous lark (*Certhilauda burra*, VU) (Dean et al. 1991) and Sclater's

1 C**onnectivity (habitat connectivity)** - Allowing for the conservation or maintenance of continuous or connected habitats, to preserve movements and exchanges associated with the habitat.

lark (*Spizocorys sclateri*, LR) are strictly endemic to this ecoregion, while another five species are near-endemic: Karoo chat (*Cercomela schlegelii*), tractrac chat (*Cercomela tractrac*), red lark (*Certhilauda burra*), Karoo scrub robin (*Cercotrichas coryphaeus*), red-headed cisticola (*Cisticola subruficapillus*), and the Namaqua prinia (*Phragmacia substriata*). Other characteristic speces of the Nama Karoo which are regarded as "Vulnerable" in South Africa are tawny (*Aquila rapax*) and martial (*Polemaetus bellicosus*) eagles, African marsh harrier (*Circus ranivorus*), lesser kestrel (*Falco naumanni*), blue crane (*Anthropoides paradiseus*), kori (*Ardeotis kori*) and Ludwig's (*Neotis ludwigii*) bustards, and the red lark (Dean et al. 1991, McCann 2000, Barnes 2000).

The agricultural habitats of the study area range represent cultivated land. These agricultural habitats sometimes cover extensive areas and have become an artificial habitat that attracts a wide range of generalist species. Herons, storks, ibises, francolins, cranes, korhaans, plovers, pigeons and doves, larks, chats, pipits and starlings are attracted to the more open cultivated areas, while smaller species such as cuckoos, robins, sparrows, widows, finches, canaries and buntings are attracted to secondary growth around cultivation. Young crops attract gamebirds, especially guineafowl and quail, and grazing waterfowl like Spurwinged Goose and Egyptian Goose. Ploughed fields with recently sown grain crops also attract storks and cranes, which feed on the grain and thereby come into conflict with farmers. However, crop farming in Southern Africa has had a profound influence in radically transforming vast areas of land originally under natural vegetation. The changes to the bird communities in these areas have also been profound, with some species benefitting and advancing, and others decreasing and retreating, in the face of these transformations. The impact of livestock grazing in the sub region has been far less dramatic.

There are seven threatened bird species (all VU) and three Near Threatened bird species that have a medium to high probability of utilising available habitats in the study area, either for foraging or breeding. The species likely to use parts of the area for breeding are the Blue Crane, Blue Korhaan, Kori Bustard, Ludwig's Bustard and Secretarybird. The other species, the African Marsh Harrier, Lanner Falcon, Lesser Kestrel, Martial Eagle and Tawny Eagle, may use the area or parts of the area for foraging. Large flocks of Lesser Kestrel have been observed in this area during previous field surveys.

4.3.4.3 Reptiles and Amphibians Assessment

Typical species associated with arid and semi-arid habitat types occur in the study area. Venmous species such as the puff adder and cape cobra are expected to occur in the study area, although the presence of these snakes is dependent on the presence of their prey species (rodents, frogs etc.). The general habitat type for reptiles consists of open shrubveld and grassland with limited available habitat for diurnally active and sit-and-wait predators, such as terrestrial skinks and other reptiles. The lack of trees in the area explains the lack of arboreal species in the area.

The amphibians appear to be poorly represented within the power line corridor and the seasonal pools in the rivers represent the most suitable habitat for the few amphibian species that could occur in the area.

The reptile fauna contains at least 10 species that are regarded as near-endemic to the ecoregion, but only a few are potentially confined to the Nama Karoo, including Karoo dwarf chameleon (*Bradypodion karrooicum*) and Boulenger's Padloper (*Homopus boulengeri*). Many of the endemics, and some of the other species present, are relicts of past drier epochs when desert and savanna biomes expanded to link up with similar biomes in northeast Africa (Werger 1978). This arid corridor enabled flora and fauna to move between the two regions.

4.3.5 Species of Conservation Concern (SCC)

According to the existing databases and field survey the following number of fauna species included in the IUCN red data lists can potentially be found in the study area (Table 10):

Table 10. Red data list of potential fauna for the study area

English Name	Conservation Status	Probability of occurrence within power line corridor
BIRDS		
Crane, Blue	Near Threatened	Medium
Pipit, African Rock	Near Threatened	Medium
Eagle, Tawny	Endangered	Medium
Bustard, Kori	Near Threatened	Medium
Lark, Red	Vulnerable	Medium
Korhaan, Karoo	Near Threatened	Medium
Falcon, Lanner	Vulnerable	Medium
Bustard, Ludwig's	Endangered	Medium
Eagle, Martial	Endangered	Medium
Courser, Double-banded	Near Threatened	Medium
Secretarybird	Vulnerable	Medium
MAMMALS		
Brown Hyena	Near Threatened (2015)	Medium
Southern African Hedgehog	Near Threatened (2016)	Medium
Serval	Near Threatened (2016)	Low
Black-footed Cat	Vulnerable (2016)	Medium
Leopard	Vulnerable (2016)	Medium

The following impacts might occur during the development phase on the fauna populations of the area:

- Destruction/permanent loss of individuals of rare, endangered, endemic and/or protected species through habitat loss or fragmentation.
- Disturbance of remnant terrestrial wild mammal, avian, amphibian and insect fauna would probably occur through physical habitat destruction, noise, traffic, and movement of people.

- Potential increase in feral animals and impact on indigenous fauna e.g., cats, rats.
- Illegal hunting or disturbance.

The following management measures are proposed regarding the conservation of these and other fauna which might occur on the property:

- The development would not have a significant impact on the above-mentioned red data fauna since adequate and natural habitat/vegetation would be available on the peripheral dwarf shrubland, grassland and woodland habitats surrounding the power line corridor. The most probable habitat to find any of the red data species in the study area would be in the more natural areas of the outcrops and natural grassland where little or no disturbances form humans or livestock occur at a regular interval. Fauna will therefore rather move away from the area and utilize adjacent, more natural areas. The importance to preserve the riparian habitat should still be considered a high priority though.
- The removal of vegetation should be confined to the footprint of the proposed power line corridor. This will be on small sections in relation to the total available surrounding habitat for fauna. Development also will not influence the natural feeding and movement patterns of the existing fauna in the area.
- If one considers the habitat descriptions of the red data species, most of them are not directly threatened by habitat loss. The impact of development on the red data species would therefore be less than predicted.
- The protection of different habitat types in the area will be important to ensure the survival of the different animals due to each species' individual needs and requirements. Sufficient natural corridor sections should be protected around the proposed development footprint to allow fauna to move freely between the different vegetation units on the property. The drainage channels and sections of natural vegetation will be preserved as corridors in the area and mitigation measures should be implemented to ensure that the habitats are protected.
- The taller (>3m) indigenous trees within this area also provide resting/perching sites for larger birds like birds of prey, arboreal reptiles and mammals that might occur/pass through the area and should preferably be preserved. These larger trees should be protected as far as possible and be incorporated into the proposed development. The grass layer on the other hand also provides a valuable food source (insects, reptiles, small mammals that occur in/on the grass layer) for fauna.
- A monitoring programme needs to be implemented by a specialist if any rare species are confirmed on the property.

The following practical recommendations with regards to the fauna of the area apply with regards to the construction of the proposed development:

- Where trenches pose a risk to animal safety during construction, they should be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by the constant excavating and backfilling of trenches during the construction.
- No animals may be poached. Many animals are protected by law and poaching, or other interference could result in a fine or jail term.
- Do not feed any wild animals on site.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.
- Walkways and roads should be designed without vertical pavements to allow for the movement of small mammals.
- Waste bins and foodstuffs should be made scavenger proof.
- Monitoring of the environmental aspects is recommended for the future phases of the proposed development should the authorities approve the application. The monitoring phase would ensure that negative impacts on the fauna and flora of the area are limited to a minimum during the construction phase.

4.3.5.1 EIA screening tool listed species (SCC)

Table 11 indicate the listed fauna species for the power line corridor according to the EIA screening tool:

Table 11. Listed fauna for the power line corridor according to the EIA screening tool, status, and habitat.

Species	Status	Habitat
Neotis ludwigii (Ludwig's bustard)	Endangered	Semi-arid shrublands of the Karoo, Namib Desert and Nama Karoo, occasionally visiting cultivated land and the southern Kalahari

4.3.5.1.1 Ludwig's Bustard

This species is classified as Endangered as the population is projected to have undergone a very rapid population decline due to collisions with power lines, a trend which is set to continue as the power grid in southern Africa expands and successful mitigation measures are yet to be implemented.

Near-endemic to southern Africa, occurring from south-western Angola south through western and southern Namibia to the Northern Cape and adjacent provinces. It generally prefers the semi-arid shrublands of the Karoo, Namib Desert and Nama Karoo, occasionally visiting

cultivated land and the southern Kalahari.

Nomad and partial migrant, as it is most common in the arid Namib Desert and Karoo in winter (May-October), while mainly occurring in the east of its distribution in summer (November-April).

Probability of occurrence on site: Moderate probability of occurring on site due to large home ranges, although at very low densities (widely scattered individuals).

Probability of impact during vegetation clearance: Moderate-low, the potential habitat will probably be minimally impacted on by the proposed development**. Mitigation measures should be implemented for the development as stipulated by an Avifauna specialist.**

5 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE FAUNA AND FLORA

An environmental impact is defined as a change in the environment, be it the physical/chemical, biological, cultural and or socio-economic environment. Any impact can be related to certain aspects of human activities in this environment and this impact can be either positive or negative. It could also affect the environment directly or indirectly and the effect of it can be cumulative. There are three major categories of impacts on biodiversity namely:

- Impacts on habitat resulting in loss, degradation and / or fragmentation.
- Direct impacts on fauna and flora and species, for example plants and animals that are endemic / threatened / special to a habitat will not be able to survive if that habitat is destroyed or altered by the development.
- Impact on natural environmental processes and ecosystem functioning. This can lead to an accumulated effect on both habitat and species.

This biodiversity assessment focused on the description of ecosystem- and species-related biodiversity. It can be expected that if ecosystem diversity is managed effectively, species and genetic diversity should also be protected. Emphasis was therefore placed on the ecosystem diversity (landscape/habitat types) within the proposed power line corridor, with reference to biota observed and expected to utilise these landscapes or habitat types.

5.1 POTENTIAL IMPACTS

5.1.1 Direct habitat destruction

5.1.1.1 Description of impact:

The construction phase of the development and associated infrastructure will result in loss of and damage to natural habitats if the vegetation is cleared for the development of the power line. Rehabilitation of some areas would be possible but there is likely to be long-term damage in large areas. Most habitat destruction will be caused during the construction phase. However, re-growth of woody species, grass and dwarf shrubs under the power line will take place. The areas below the power line will have to be cleared (slashed) of excess vegetation at regular intervals to allow access to the area for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the power line conductors and to minimize the risk of fire which can result in electrical flashovers. These activities will have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through modification of habitat.

The impact of power line and specific placement of the poles should be restricted to the proposed line and not over the larger area.

Vegetation communities are likely to be impacted on a small spatial scale in comparison to the extent of the vegetation communities' total area in the region.

The impact of the habitat destruction will be on the flora and fauna of the study area in the

following ways:

- The construction will lead to the loss of individual plants such as grasses, forbs, trees, and shrubs that will be cleared on the footprint area. This will mostly occur during the construction phase.
- Loss of threatened, near-threatened and endemic taxa: The anticipated loss of some of the natural habitats that support endemic species will result in the local displacement of endemic listed flora.
- Due to habitat loss and construction activities animals will migrate from the construction area and animal numbers will decrease.
- Loss of threatened, "near-threatened" and conservation important taxa: The anticipated loss of the natural woodland will result in the local displacement of some fauna species. In some cases, isolated populations of threatened fauna might be removed from the area, although no such populations or knowledge thereof was found in the study area. This impact could also take place because of hunting and snaring of animals in natural areas not used for the power line.
- Changes in the community structure: It is expected that the faunal species composition will shift, due to an anticipated loss in habitat surface area. In addition, it is predicted that more generalist species (and a loss of functional guilds) will dominate the study area. Attempts to rehabilitate will attract taxa with unspecialized and generalist life-histories. It is predicted that such taxa will persist for many years before conditions become suitable for succession to progress.

Table 12 indicate that the impacts will be lowered from a HIGH impact rating to a MODERATE impact rating should mitigation be implemented efficiently.

5.1.1.2 Mitigation measures:

- The removal of indigenous flora should be kept to a minimum necessary. Trim, rather than fell of woody species along the edges of the power line corridor where possible. The clearing and damage of plant growth in the riparian and wetland areas should be restricted to the actual crossing where possible, and not into the sensitive adjacent areas. Where protected flora will need to be cleared or pruned, permits should be obtained from the relevant authority.
- Peripheral impacts around the development corridor on the surrounding vegetation of the area should be avoided and a monitoring programme should be implemented to ensure the impacts are kept to a minimum, while the rehabilitation of the power line route should be prioritized after construction has been completed.
- During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place.

- An avifauna specialist should be consulted to conduct a specialist study for the power line corridor and monitoring of the potential impact of the power line in the future.
- All development activities should be restricted to specific recommended areas. The Environment Control Officer (ECO) should control these areas. Storage of equipment, fuel and other materials should be limited to demarcated areas. Layouts should be adapted to fit natural patterns rather than imposing rigid geometries. The entire development footprint should be clearly demarcated prior to initial site clearance and prevent construction personnel from leaving the demarcated area. This would only be applicable to the construction phase of the proposed development.
- The ECO should advise the construction team in all relevant matters to ensure minimum destruction and damage to the environment. The ECO should enforce any measures that he/she deem necessary. Regular environmental training should be provided to construction workers to ensure the protection of the habitat, fauna and flora and their sensitivity to conservation.
- Where holes for poles pose a risk to animal safety, they should be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by the constant excavating and backfilling during planting of the poles along the lines.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.
- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
- Monitoring should be implemented during the construction phase of the development to ensure that minimal impact is caused to the fauna and flora of the area.
- Placement of pylons should be outside sensitive vegetation units, outcrops and drainage channels.

5.1.2 Habitat fragmentation

5.1.2.1 Description of impact:

The construction of the power line development and associated infrastructure will result in natural movement patterns being disrupted for a limited period and, to a varying degree depending on how different species react to these barriers will result in the fragmentation of natural populations, although the impact will be minimal and restricted to the construction phase.

Table 12 indicate that the impacts will be lowered from a HIGH impact rating to a MODERATE impact rating should mitigation be implemented efficiently.

5.1.2.2 Mitigation measures:

- Use existing facilities (e.g., impacted areas) to the extent possible to minimize the amount of new disturbance.
- Ensure protection of important resources by establishing protective buffers to exclude unintentional disturbance. All possible efforts must be made to ensure as little disturbance as possible to the sensitive features such as surrounding woodland and riparian woodland outside the power line corridor during construction.
- During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place.
- Construction activities must remain within defined construction areas. No construction / disturbance will occur outside these areas.

5.1.3 Increased Soil erosion and sedimentation

5.1.3.1 Description of impact:

The construction activities associated with the development may result in widespread soil disturbance and is usually associated with accelerated soil erosion. Soil erosion promotes a variety of terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous flora.

Table 12 indicate that the impacts will be lowered from a HIGH impact rating to a MODERATE impact rating should mitigation be implemented efficiently.

5.1.3.2 Mitigation measures:

The following mitigation measures should be implemented to prevent erosion during construction:

- The project should be divided into as many phases as possible, to ensure that the exposed areas prone to erosion are minimal at any specific time.
- Cover disturbed soils as completely as possible, using vegetation or other materials.
- Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices.
- Protect sloping areas and drainage channel banks that are susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas.

- Repair all erosion damage as soon as possible to allow for sufficient rehabilitation growth.
- Gravel roads to the construction sites must be well drained to limit soil erosion.
- Control the flow of runoff to move the water safely off the site without destructive gully formation.
- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas.
- Placement of pylons should be outside sensitive soil types and drainage channels.

5.1.4 Soil and water pollution

5.1.4.1 Description of impact:

Construction work for the proposed development will always carry a risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface or ground water, leading to potential medium/long-term impacts on fauna and flora. During the constructional phase heavy machinery and vehicles would be the main contributors to potential pollution problems.

Table 12 indicate that the impacts will be lowered from a MODERATE to a NEGLIGIBLE impact rating should mitigation be implemented efficiently.

5.1.4.2 Mitigation measures:

- Any excess or waste material or chemicals should be removed from the site and discarded in an environmentally friendly way. The ECO should enforce this rule rigorously.
- Hazardous chemicals to be stored on an impervious surface protected from rainfall and storm water run-off.
- Spill kits should be on-hand to deal with spills immediately.
- All vehicles should be inspected for oil and fuel leaks on a regular basis. Vehicle maintenance yards on site should make provision for drip trays that will be used to capture any spills. Drip trays should be emptied into a holding tank and returned to the supplier.

5.1.5 Air pollution

5.1.5.1 Description of impact:

The environmental impacts of wind-borne dust, gases and particulates from the construction activities associated with the proposed development are primarily related to human health and ecosystem damage. The proposed development will typically comprise the following sources and associated air quality pollutants:

- Materials handling operations (truck loading & unloading, tipping, stockpiling).
- Vehicle entrainment on paved and unpaved roads.
- Windblown dust-fugitive emissions.

One of the primary impacts on the biophysical environment is linked to emission of dusts and fumes from the transportation system. Dust pollution will impact the most severe during the construction phase. Construction vehicles and equipment are the major contributors to the impact on air quality. Dust is generated during site clearance for the construction of infrastructure. Diesel exhaust gasses and other hydrocarbon emissions all add to the deterioration in air quality during this phase. Vehicles travelling at high speeds on dirt roads significantly aggravate the problem.

Although the potential for severe fugitive dust impacts is greatest within 100 m of the dust-generating activities, there is still the potential for dust to affect vegetation up to five kilometres or more downwind from the source. Dust deposited on the ground may cause changes in soil chemistry (chemical effects) and may over the long-term result in changes in plant chemistry, species composition and community structure. Sensitivities to dust deposition of the various plant species present in the area are not known. It is therefore difficult to predict which species may be susceptible.

Poor air quality results in deterioration of visibility and aesthetic landscape quality of the region, particularly in winter due to atmospheric inversions.

Table 12 indicate that the impacts will be lowered from a MODERATE to a LOW impact rating should mitigation be implemented efficiently.

5.1.5.2 Mitigation measures:

- A speed limit should be enforced on dirt roads (preferably 30-40km/h).
- Implement standard dust control measures, including periodic spraying (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation.

5.1.6 Spread and establishment of alien invasive species

5.1.6.1 Description of impact:

Continued movement of vehicles on and off the site during the construction phase will result in a risk of importation of alien species. Vehicles often transport many seeds, and some may be of invader species, which may become established along the access road, especially where the area is disturbed. The construction phase carries by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Table 12 indicate that the impacts will be lowered from a MODERATE to a NEGLIGIBLE impact rating should mitigation be implemented efficiently.

5.1.6.2 Mitigation measures:

- Control involves killing the plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion. Weeds and invader plants will be controlled in the manner prescribed for that category by the CARA or in terms of Working for Water guidelines. The control of these species should even begin prior to the construction phase considering that small populations of these species was observed during the field surveys.
- Institute strict control over materials brought onto site, which should be inspected for seeds of noxious plants and steps taken to eradicate these before transport to the site. Routinely fumigate or spray all materials with appropriate low-residual herbicides prior to transport to or in a quarantine area on site. The contractor is responsible for the control of weeds and invader plants within the construction site for the duration of the construction phase. Alien invasive tree species listed by the CARA regulations should be eradicated.
- Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish.
- Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds. Once detected, an eradication/control programme should be implemented to ensure that the species' do not spread to surrounding natural ecosystems.

5.1.7 Negative effect of human activities and road mortalities

5.1.7.1 Description of impact:

An increase in human activity on the site and surrounding areas is anticipated. The risk of

snaring, killing, and hunting of certain faunal species is increased. If staff compounds are erected for construction workers, the risk of pollution because of litter and inadequate sanitation and the introduction of invasive fauna and flora are increased. The presence of many construction workers or regular workers during the construction phase on site over a protracted period will result in a greatly increased risk of uncontrolled fires arising from cooking fires, improperly disposed cigarettes etc.

Large numbers of fauna are also killed daily on roads. They are either being crushed under the tyres of vehicles in the case of crawling species, or by colliding with the vehicle itself in the case of avifauna or flying invertebrates. The impact is intensified at night, especially for flying insects, as result of their attraction to the lights of vehicles.

Table 12 indicate that the impacts will be lowered from a MODERATE to a LOW impact should mitigation be implemented efficiently.

5.1.7.2 Mitigation measures:

- No staff should be accommodated on the site. If practical, construction workers should stay in one of the nearby villages / towns and transported daily to the site.
- The ECO should regularly inspect the site, including storage facilities and compounds and eradicate any invasive or exotic plants and animals.
- Maintain proper firebreaks around entire development footprint.
- Educate construction workers regarding risks and correct disposal of cigarettes.
- More fauna is normally killed the faster vehicles travel. A speed limit should be enforced (preferably 40 km/hour). It can be considered to install speed bumps in sections where the speed limit tends to be disobeyed. (Speed limits will also lessen the probability of road accidents and their negative consequences).
- Travelling at night should be avoided or limited as much as possible.

5.2 IMPACT ASSESSMENT MATRIX

Table 12 indicate the impacts described above and specific ratings of significance the development impact will potentially have on the ecological components of the study area.

The impacts are indicated pre- and post-mitigation in Table 12 that clearly indicates the importance of mitigation needed for each of the potential impacts.

Table 12. Impact assessment Matrix for the proposed development

Nr	Activity	Impact	Without or With Mitigation	Nature (Negative or Positive Impact)	Probability		Duration		Scale		Magnitude/ Severity		Significance		Mitigation Measures	Mitigation Effect
					Magnitude	Score	Magnitude	Score	Magnitude	Score	Magnitude	Score	Score	Magnitude		
Terrestrial Biodiversity Impact Assessment																
Construction & Operational Phases																
1	Clearing of vegetation for construction of infrastructure, access roads etc.	Habitat destruction & Fragmentation	**WOM**	Negative	Definite	5	Permanent	5	Local	1	Medium	6	60	Moderate	Refer to Sections 5.1.1.2 and 5.1.2.2	May cause irreplaceable loss of resources
			WM	Negative	Definite	5	Permanent	5	Local	1	Low	2	40	Low		
2	Topsoil & subsoil stripping, exposure of soils to wind and rain during construction causing erosion and sedimentation in wetlands	Soil erosion and sedimentation	**WOM**	Negative	Definite	5	Permanent	5	Regional	3	Medium	6	70	High	Refer to section 5.1.3.2	Can be reversed
			WM	Negative	Highly Probable	4	Medium term	3	Site	2	Low	2	28	Low		
3	Exposure of soils to rainfall and wind during construction	Dust pollution	**WOM**	Negative	Definite	5	Medium term	3	Site	2	Medium	6	55	Moderate	Refer to section 5.1.4.2	Can be reversed
			WM	Negative	Highly Probable	5	Medium term	3	Site		Low	2	25	Low		
4	Heavy machinery and vehicle movement on site	Spillages of harmful substances	**WOM**	Negative	Highly Probable	4	Long term	4	Regional	3	Medium	6	52	Moderate	Refer to section 5.1.5.2	Can be avoided, managed, or mitigated
			WM	Negative	Probable	2	Long term	4	Site	2	Low	2	16	Negligible		
5	Continued movement of personnel and vehicles on and off the site during the construction phase, as well as occasional delivery of materials required for maintenance	Spreading of alien invasive species	**WOM**	Negative	Highly Probable	4	Permanent	5	Site	2	Medium	6	52	Moderate	Refer to section 5.1.6.2	Can be reversed
			WM	Negative	Probable	2	Medium term	3	Site	2	Low	2	14	Negligible		
6	Construction of infrastructure, access roads etc.	Negative effect of human activties on fauna and flora	**WOM**	Negative	Highly Probable	4	Medium term	3	Site	2	Medium	6	44	Moderate	Refer to section 5.1.7.2	Can be avoided, managed, or mitigated
			WM	Negative	Probable	2	Medium term	3	Site	2	Low	2	14	Negligible		
7	Continued movement of vehicles on and off the site during the construction phase, as well as occasional delivery of materials required for maintenance	Road mortalities of fauna	**WOM**	Negative	Highly Probable	4	Medium term	3	Site	2	Medium	6	44	Moderate	Refer to section 5.1.8.2	Can be avoided, managed, or mitigated
			WM	Negative	Highly Probable	4	Medium term	3	Site	2	Low	2	28	Low		

5.3 CUMULATIVE IMPACTS

The cumulative impacts associated with the Grootpoort PV Plant powerline development in combination with other similar renewable energy development in a 30 kilometer radius indicated in Figure 15 is considered as LOW because of the following:

- Portions of this vegetation type have already been lost due to agricultural activities that are currently occurring adjacent to the site as well as from grazing of livestock on neighbouring farms. However, the footprint of the powerline is relatively small compared to the adjacent land. The additional loss of vegetation will therefore have a Low cumulative impact. The other solar developments are located mostly on degraded land with low conservation value.
- The development of linear developments such as powerlines long roads will limit impacts to roadside servitudes and therefore the impacts will be lower compared to alternatives that bisect areas with pristine ecosystems.

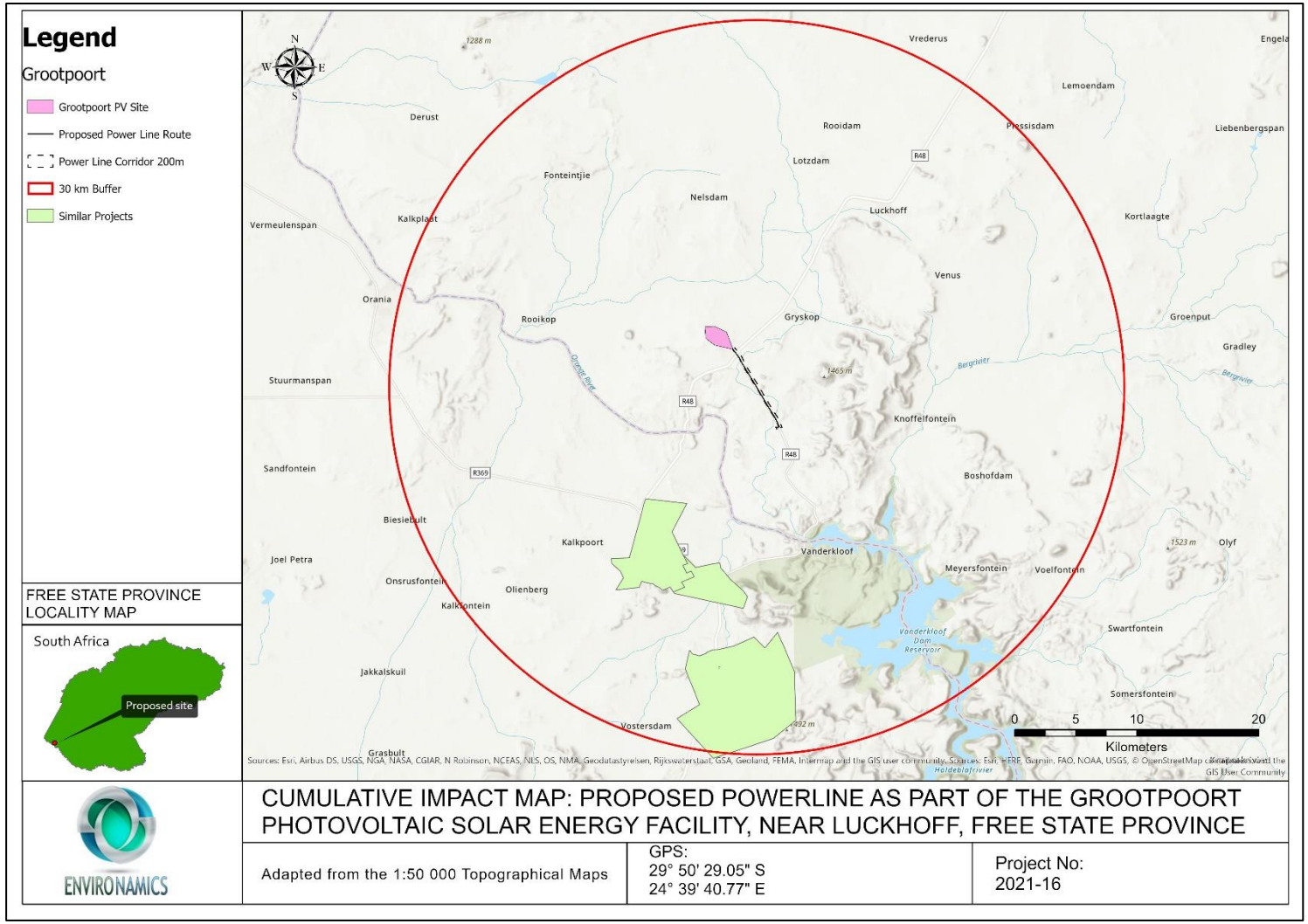

Figure 14. Cumulative impact map of the proposed powerline development in combination with other renewable energy developments in a 30 kilometer radius

6 ECOLOGICAL SENSITIVITY CLASSES

Following the ecological surveys, the classification of the study area into different sensitivity classes and development zones was based on information collected at various levels on different environmental characteristics. Factors which determined sensitivity classes were as follows:

- Presence, density and potential impact of development on rare, endemic and protected plant species.
- Conservation status of vegetation units.
- Soil types, soil depth and soil clay content.
- Previous land-use.
- State of the vegetation in general as indicated by indicator species.

Below included is the sensitivity map for the proposed power line development, (Figure 14). Only criteria applicable to the specific vegetation units were used to determine the sensitivity of the specific unit. Specific mitigation should be implemented around wetlands and drainage features in the area to prevent negative impacts.

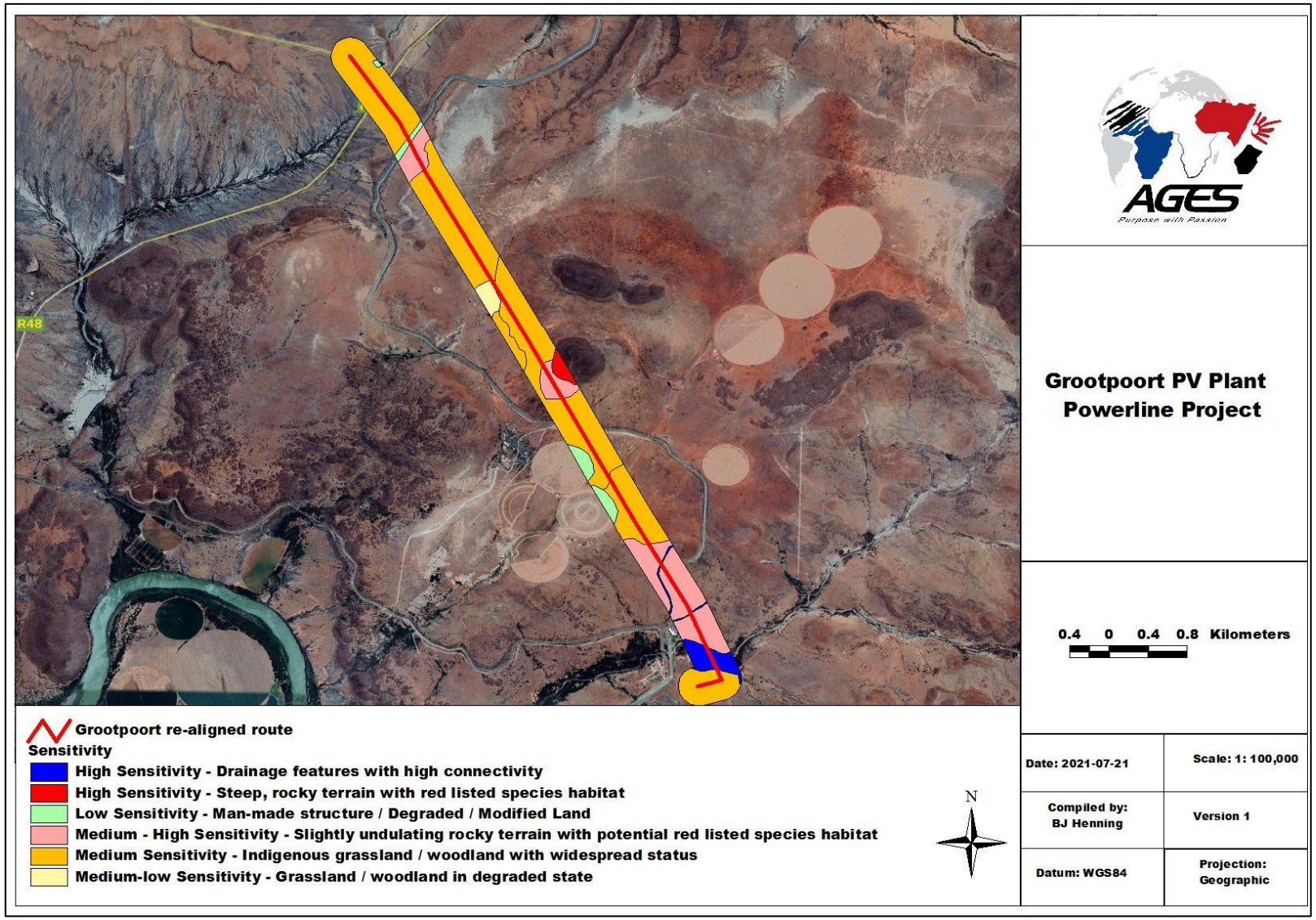

Figure 15. Sensitivity Map of the power line corridor

7 DISCUSSION

Following the investigation and potential ecological impact of the proposed powerline development on the biodiversity (including plant and animal species theme) of the area, the following conclusions are drawn:

All aspects of the environment, especially living organisms, are vulnerable to disturbance of their habitat. The proposed development activities will modify the vegetation and faunal habitats of the power line corridor to a certain extent varying according to the habitats on the site, although in general the vegetation on site where the development footprint is planned are classified slightly degraded to pristine.

Most sensitive sections: It is evident from the distribution of biodiversity, presence of threatened species and sites of scientific interest, that the proposed development has the potential for negative impact on the flora and faunal of the study area. This is particularly true of the sensitive vegetation associated with the riverine and rocky ecosystems and the power line corridor.

Most sensitive habitats: Many threatened species are Nama Karoo and riparian specialists, linked to these habitats either for breeding, feeding or shelter. Major impacts on riverine areas and rocky outcrops should be avoided wherever possible during construction. Where unavoidable impacts will occur on outcrops and riparian zones, strict mitigation measures and legislation should be implemented (placement of pylons as specified by ecologist, IWUL application etc.).

Monitoring of threatened species: Many endemic and protected species have been recorded in region. The EMP for the development should highlight the conservation status of these species and note that steps must be undertaken in conjunction with conservation authorities to protect or translocate any populations encountered during project actions. Ecological monitoring is recommended for the construction phase of the development considering the presence of potential red data fauna on areas surrounding the site.

The importance of rehabilitation and implementation of mitigation processes to prevent negative impacts on the environment during and after the construction phase of the power line development should be considered a high priority. The proposed site for the development varies from being in a completely modified to slightly degraded state.

A sensitivity analyses was conducted to identify the most suitable site for the development. From this investigation and ecological surveys, the following main observations was made:

- The footslopes and low ridges in the power line corridor have a Medium-High Sensitivity, while the steep outcrops have a High Sensitivity. Specific mitigation measures are needed for the pylon location placement in these areas.

- Most of the natural grassy shrubland, grassland and microphyllous woodland have a Medium Sensitivity and development can be supported in the area provided certain mitigation measures are implemented. Where the clearance of the vegetation would cause protected plants or other fauna to be removed, permits should be obtained from the relevant authorities.
- The riparian zones and drainage channels have a high sensitivity and should be preserved as important fauna and flora habitats.
- The croplands and other degraded areas have a low sensitivity.

Some potential rare fauna may also occur in the area, and specific mitigation measures need to be implemented to ensure that the impact of the development on the species' habitat will be low. Specific mitigation relating to red data fauna includes the following:

- Disturbances in close vicinity of the development (periphery) should be limited to the smallest possible area to protect species habitat.
- Corridors are important to allow fauna to move freely between the areas of disturbance.
- Specific mitigation should be implemented around drainage features in the area to prevent negative impacts, while an avifauna specialist study should be conducted for the power line development.

Several potential impacts were identified and assessed. A few of these were assessed as having potentially medium or high significance, including the following:

- Destruction or disturbance to sensitive ecosystems leading to reduction in the overall extent of a particular habitat.
- Increased soil erosion.
- Impairment of the movement and/or migration of animal species resulting in genetic and/or ecological impacts.
- Destruction/permanent loss of individuals of rare, endangered, endemic and/or protected species.
- Soil and water pollution through spillages.
- Establishment and spread of declared weeds and alien invader plants.
- Impacts of human activities on fauna and flora of the area during construction.
- Air pollution through dusts and fumes from construction vehicles (construction phase)

Mitigation measures are provided that would reduce these impacts from a higher to a

lower significance, which will then allow for an acceptable level of impact. Furthermore, the proposed layout plan of the development should be consistent with the sensitivity map and recommendations stipulated in this report, and the impact on the sensitive habitats on site should be kept to a minimum.

8 CONCLUSION

All aspects of the environment, especially living organisms, are vulnerable to disturbance of their habitat. If we can bring about a more integrated approach to living within our ecosystems, we are much more likely to save the fundamental structure of biodiversity. Positive contributions can be made even on a small scale such as within the proposed power line development. All stakeholders, such as business, government and environmental groups need to be involved to the impacts associated with the development from causing a significant loss.

The proposed development should avoid sensitive areas such as riverine areas and outcrops wherever possible, (placement of pylons outside sensitive areas and specialist avifauna impacts for potential impacts on avifauna most important mitigation measures), while also allowing corridors of indigenous vegetation on areas outside the development footprint to be preserved. Where sensitive areas of natural vegetation cannot be avoided, a few mitigation measures have been recommended to minimise and/or offset impacts. Negative impacts can be minimised by strict enforcement and compliance with an Environmental Management Plan which considers the recommendations for managing impacts detailed above.

Provided that the proposed development and layout plan is consistent with the sensitivity map and take all the mitigation measures into consideration stipulated in this report, the planned development can be supported.

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APPENDIX A. PLANT SPECIES IN QDS

Family	Species	IUCN	Ecology
Scrophulariaceae	*Selago paniculata*	LC	Indigenous; Endemic
Cleomaceae	*Cleome gynandra*	LC	Indigenous
Poaceae	*Aristida adscensionis*	LC	Indigenous
Malvaceae	*Hermannia linearifolia*	LC	Indigenous; Endemic
Poaceae	*Eragrostis nindensis*	LC	Indigenous
Campanulaceae	*Wahlenbergia nodosa*	LC	Indigenous; Endemic
Melianthaceae	*Melianthus comosus*	LC	Indigenous
Ptychomitriaceae	*Ptychomitrium cucullatifolium*		Indigenous
Boraginaceae	*Heliotropium curassavicum*		Not indigenous; Naturalised
Solanaceae	*Lycium oxycarpum*	LC	Indigenous; Endemic
Asteraceae	*Oedera humilis*		Indigenous
Scrophulariaceae	*Aptosimum procumbens*	LC	Indigenous
Rubiaceae	*Kohautia cynanchica*	LC	Indigenous
Asteraceae	*Pentzia incana*	LC	Indigenous
Geraniaceae	*Monsonia patersonii*	LC	Indigenous
Poaceae	*Sorghum halepense*	NE	Not indigenous; Naturalised; Invasive
Asteraceae	*Lactuca dregeana*	LC	Indigenous; Endemic
Poaceae	*Oropetium capense*	LC	Indigenous
Asteraceae	*Senecio reptans*	LC	Indigenous; Endemic
Poaceae	*Enneapogon scoparius*	LC	Indigenous
Malvaceae	*Hermannia pulverata*	LC	Indigenous; Endemic
Aizoaceae	*Drosanthemum sp.*		
Poaceae	*Eragrostis homomalla*	LC	Indigenous
Poaceae	*Eragrostis truncata*	LC	Indigenous
Cyperaceae	*Cyperus bellus*	LC	Indigenous
Anacardiaceae	*Searsia ciliata*	LC	Indigenous
Fabaceae	*Indigofera sessilifolia*	LC	Indigenous
Anacardiaceae	*Searsia burchellii*	LC	Indigenous
Malvaceae	*Corchorus schimperi*	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia atropurpurea*	LC	Indigenous
Poaceae	*Brachiaria eruciformis*	LC	Indigenous
Poaceae	*Eragrostis bicolor*	LC	Indigenous
Poaceae	*Sporobolus albicans*	LC	Indigenous
Asphodelaceae	*Trachyandra saltii*	LC	Indigenous
Malvaceae	*Hermannia comosa*	LC	Indigenous
Asteraceae	*Pentzia calcarea*	LC	Indigenous
Hyacinthaceae	*Albuca prasina*		Indigenous
Scrophulariaceae	*Jamesbrittenia albiflora*	LC	Indigenous; Endemic
Anacardiaceae	*Searsia lancea*	LC	Indigenous
Thymelaeaceae	*Lasiosiphon polycephalus*	LC	Indigenous
Scrophulariaceae	*Selago sp.*		
Anacardiaceae	*Searsia erosa*	LC	Indigenous
Fabaceae	*Indigofera alternans*	LC	Indigenous

Family	Species	IUCN	Ecology
Aizoaceae	*Mesembryanthemum noctiflorum*		Indigenous
Asteraceae	*Osteospermum spinescens*	LC	Indigenous
Hyacinthaceae	*Ornithogalum flexuosum*	LC	Indigenous
Poaceae	*Eragrostis lehmanniana*	LC	Indigenous
Colchicaceae	*Colchicum asteroides*	LC	Indigenous; Endemic
Lamiaceae	*Salvia runcinata*	LC	Indigenous
Poaceae	*Leptochloa fusca*	LC	Indigenous
Apocynaceae	*Stenostelma capense*	LC	Indigenous
Aizoaceae	*Trianthema salsoloides*	LC	Indigenous
Aizoaceae	*Drosanthemum pulchrum*	VU	Indigenous; Endemic
Apocynaceae	*Brachystelma circinatum*	LC	Indigenous
Caryophyllaceae	*Dianthus micropetalus*	LC	Indigenous
Aizoaceae	*Tetragonia arbuscula*	LC	Indigenous
Malvaceae	*Hibiscus pusillus*	LC	Indigenous
Asphodelaceae	*Aloe claviflora*	LC	Indigenous
Aizoaceae	*Galenia namaensis*	LC	Indigenous
Poaceae	*Tragus berteronianus*	LC	Indigenous
Asteraceae	*Pegolettia retrofracta*	LC	Indigenous
Apocynaceae	*Stapelia sp.*		
Poaceae	*Tragus koelerioides*	LC	Indigenous
Hyacinthaceae	*Albuca longipes*	LC	Indigenous
Amaranthaceae	*Atriplex vestita*	LC	Indigenous
Asteraceae	*Felicia muricata*	LC	Indigenous
Scrophulariaceae	*Peliostomum origanoides*	LC	Indigenous; Endemic
Poaceae	*Panicum stapfianum*	LC	Indigenous
Ophioglossaceae	*Ophioglossum polyphyllum*	LC	Indigenous
Dipsacaceae	*Scabiosa columbaria*	LC	Indigenous
Poaceae	*Cymbopogon pospischilii*	NE	Indigenous
Malvaceae	*Hermannia bryoniifolia*	LC	Indigenous; Endemic
Solanaceae	*Lycium cinereum*	LC	Indigenous
Apocynaceae	*Pachypodium succulentum*	LC	Indigenous; Endemic
Poaceae	*Aristida congesta*	LC	Indigenous
Asteraceae	*Pteronia erythrochaeta*	LC	Indigenous; Endemic
Fabaceae	*Melilotus albus*	NE	Not indigenous; Naturalised; Invasive
Zygophyllaceae	*Roepera lichtensteiniana*		Indigenous
Brassicaceae	*Rapistrum rugosum*		Not indigenous; Naturalised; Invasive
Poaceae	*Sporobolus ludwigii*	LC	Indigenous
Amaranthaceae	*Atriplex lindleyi*		Not indigenous; Naturalised; Invasive
Campanulaceae	*Wahlenbergia albens*	LC	Indigenous
Poaceae	*Miscanthus ecklonii*	LC	Indigenous
Amaranthaceae	*Salsola glabrescens*	LC	Indigenous
Poaceae	*Sporobolus ioclados*	LC	Indigenous
Aizoaceae	*Titanopsis calcarea*	LC	Indigenous; Endemic
Anacardiaceae	*Schinus molle*	NE	Not indigenous; Naturalised; Invasive

Family	Species	IUCN	Ecology
Resedaceae	*Oligomeris dipetala*	LC	Indigenous
Asteraceae	*Nidorella resedifolia*	LC	Indigenous
Asteraceae	*Euryops subcarnosus*	LC	Indigenous
Hyacinthaceae	*Ornithogalum juncifolium*	NE	Indigenous
Boraginaceae	*Heliotropium ciliatum*	LC	Indigenous
Poaceae	*Puccinellia acroxantha*	LC	Indigenous
Poaceae	*Sporobolus fimbriatus*	LC	Indigenous
Asparagaceae	*Asparagus exuvialis*	NE	Indigenous
Aizoaceae	*Deilanthe peersii*	LC	Indigenous; Endemic
Ruscaceae	*Sansevieria aethiopica*	LC	Indigenous
Cyperaceae	*Afroscirpoides dioeca*		Indigenous
Scrophulariaceae	*Jamesbrittenia sp.*		
Hyacinthaceae	*Drimia physodes*	LC	Indigenous
Geraniaceae	*Monsonia salmoniflora*	LC	Indigenous
Scrophulariaceae	*Selago saxatilis*	LC	Indigenous
Lamiaceae	*Salvia stenophylla*		Indigenous
Lamiaceae	*Stachys hyssopoides*	LC	Indigenous
Verbenaceae	*Chascanum pinnatifidum*	LC	Indigenous
Apocynaceae	*Orbea cooperi*	LC	Indigenous
Fabaceae	*Argyrolobium pauciflorum*	LC	Indigenous
Poaceae	*Sporobolus tenellus*	LC	Indigenous
Amaranthaceae	*Salsola rabieana*	LC	Indigenous
Poaceae	*Urochloa panicoides*	LC	Indigenous
Santalaceae	*Osyris lanceolata*	LC	Indigenous
Pottiaceae	*Trichostomum brachydontium*		Indigenous
Anacardiaceae	*Searsia pyroides*	LC	Indigenous
Amaranthaceae	*Suaeda fruticosa*	LC	Indigenous
Asteraceae	*Pentzia globosa*	LC	Indigenous
Poaceae	*Fingerhuthia africana*	LC	Indigenous
Iridaceae	*Freesia andersoniae*	LC	Indigenous; Endemic
Rubiaceae	*Anthospermum rigidum*	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia aurantiaca*	LC	Indigenous
Poaceae	*Setaria lindenbergiana*	LC	Indigenous
Poaceae	*Panicum coloratum*	LC	Indigenous
Poaceae	*Heteropogon contortus*	LC	Indigenous
Poaceae	*Tragus racemosus*	LC	Indigenous
Asphodelaceae	*Aloe sp.*		
Scrophulariaceae	*Chaenostoma halimifolium*	LC	Indigenous
Scrophulariaceae	*Selago albida*	LC	Indigenous
Asphodelaceae	*Gonialoe variegata*	LC	Indigenous
Cleomaceae	*Cleome angustifolia*	LC	Indigenous
Poaceae	*Eragrostis chloromelas*	LC	Indigenous
Grimmiaceae	*Grimmia pulvinata*		Indigenous
Oxalidaceae	*Oxalis haedulipes*	LC	Indigenous

Family	Species	IUCN	Ecology
Hyacinthaceae	*Ledebouria undulata*	LC	Indigenous
Fabaceae	*Prosopis sp.*		
Asparagaceae	*Asparagus glaucus*	LC	Indigenous
Poaceae	*Sporobolus coromandelianus*	LC	Indigenous
Hyacinthaceae	*Albuca collina*	LC	Indigenous; Endemic
Poaceae	*Aristida congesta*	LC	Indigenous
Asteraceae	*Pentzia calva*	LC	Indigenous
Lobeliaceae	*Lobelia thermalis*	LC	Indigenous
Poaceae	*Cynodon incompletus*	LC	Indigenous; Endemic
Poaceae	*Chloris virgata*	LC	Indigenous
Crassulaceae	*Cotyledon orbiculata*	LC	Indigenous; Endemic
Poaceae	*Eragrostis obtusa*	LC	Indigenous
Oxalidaceae	*Oxalis depressa*	LC	Indigenous
Portulacaceae	*Portulaca quadrifida*	LC	Indigenous
Poaceae	*Digitaria eriantha*	LC	Indigenous
Poaceae	*Eragrostis cilianensis*	LC	Indigenous
Poaceae	*Sporobolus sp.*		
Hyacinthaceae	*Dipcadi glaucum*	LC	Indigenous
Juncaceae	*Juncus rigidus*	LC	Indigenous
Fabaceae	*Senegalia mellifera*	LC	Indigenous
Euphorbiaceae	*Euphorbia arida*	LC	Indigenous; Endemic
Poaceae	*Enneapogon desvauxii*	LC	Indigenous
Malvaceae	*Hermannia bicolor*	LC	Indigenous
Lamiaceae	*Leonotis pentadentata*	LC	Indigenous
Lamiaceae	*Salvia namaensis*	LC	Indigenous

APPENDIX B. PLANT SPECIES FOUND ON SITE

Plant species lists for site
Woody species
Agave sessilana
Diospyros austro-africana
Diospyros lycioides
Eucalyptus camaldulensis
Gymnosporia buxifolia
Lycium cinereum
Lycium cinereum
Opuntia ficus-indica
Prosopis glandulosa
Rhigozum trichotomum
Salvadora australis
Schinus molle
Searsia burchelli
Searsia erosa
Vachellia karroo
Vachellia tortilis
Grass species
Aristida spp.
Cenchrus ciliaris
Chloris virgata
Cynodon incompletus
Digitaria eriantha
Enneapogon desvauxii
Enneapogon scaber
Enneapogon scoparius
Eragrostis lehmanniana
Eragrostis nindensis
Eragrostis rigidior
Eragrostis trichophora
Eragrostis truncata
Fingerhutia africana
Panicum maximum
Schmidtia kalahariensis
Stipagrostis ciliata
Stipagrostis obtusa
Tragus bertertronianus
Forbs and succulents
Aptosimum indivisum
Argemone mexicana
Asparagus suaveolens
Chrysocoma ciliata
Crinum spp.
Cucumis zeyheri

Plant species lists for site
Delosperma spp.
Dicoma anomala
Eriocephalus africanus
Gazania krebsiana
Pentizia globosa
Pentzia calcarea
Pentzia incana
Salsola etoshiensis
Salsola kalii
Salsola rabiena\
Sesamum triphyllum
Tribulis zeyheri
Trichostomum brachydontium
Tripteris aghillana var. aghillana
Urochloa panicoides
Viscum capense
Wahlenbergia nodosa
Zaluzianskya karrooica

APPENDIX C. BIRD SPECIES LIST FOR QDS

Common_group	Common_species	*Genus*	*Species*
	Bokmakierie	*Telophorus*	*zeylonus*
	Brubru	*Nilaus*	*afer*
	Hamerkop	*Scopus*	*umbretta*
	Neddicky	*Cisticola*	*fulvicapilla*
Barbet	Acacia Pied	*Tricholaema*	*leucomelas*
Barbet	Crested	*Trachyphonus*	*vaillantii*
Batis	Pririt	*Batis*	*pririt*
Bee-eater	European	*Merops*	*apiaster*
Bee-eater	Swallow-tailed	*Merops*	*hirundineus*
Bee-eater	White-fronted	*Merops*	*bullockoides*
Bishop	Southern Red	*Euplectes*	*orix*
Bishop	Yellow-crowned	*Euplectes*	*afer*
Bulbul	African Red-eyed	*Pycnonotus*	*nigricans*
Bunting	Cape	*Emberiza*	*capensis*
Bunting	Cinnamon-breasted	*Emberiza*	*tahapisi*
Buzzard	Common	*Buteo*	*buteo*
Buzzard	Jackal	*Buteo*	*rufofuscus*
Canary	Black-throated	*Crithagra*	*atrogularis*
Canary	White-throated	*Crithagra*	*albogularis*
Canary	Yellow	*Crithagra*	*flaviventris*
Chat	Ant-eating	*Myrmecocichla*	*formicivora*
Chat	Familiar	*Oenanthe*	*familiaris*
Chat	Karoo	*Emarginata*	*schlegelii*
Chat	Sickle-winged	*Emarginata*	*sinuata*
Cisticola	Desert	*Cisticola*	*aridulus*
Cisticola	Grey-backed	*Cisticola*	*subruficapilla*
Cisticola	Levaillant's	*Cisticola*	*tinniens*
Cisticola	Zitting	*Cisticola*	*juncidis*
Coot	Red-knobbed	*Fulica*	*cristata*
Cormorant	Reed	*Microcarbo*	*africanus*
Cormorant	White-breasted	*Phalacrocorax*	*lucidus*
Crombec	Long-billed	*Sylvietta*	*rufescens*
Crow	Pied	*Corvus*	*albus*
Cuckoo	Diederik	*Chrysococcyx*	*caprius*
Darter	African	*Anhinga*	*rufa*
Dove	Cape Turtle	*Streptopelia*	*capicola*
Dove	Laughing	*Spilopelia*	*senegalensis*
Dove	Namaqua	*Oena*	*capensis*
Dove	Red-eyed	*Streptopelia*	*semitorquata*
Dove	Rock	*Columba*	*livia*
Drongo	Fork-tailed	*Dicrurus*	*adsimilis*
Duck	African Black	*Anas*	*sparsa*
Duck	White-faced Whistling	*Dendrocygna*	*viduata*

Common_group	Common_species	*Genus*	*Species*
Duck	Yellow-billed	*Anas*	*undulata*
Eagle	African Fish	*Haliaeetus*	*vocifer*
Eagle	Booted	*Hieraaetus*	*pennatus*
Eagle	Verreaux's	*Aquila*	*verreauxii*
Eagle-Owl	Spotted	*Bubo*	*africanus*
Egret	Little	*Egretta*	*garzetta*
Egret	Western Cattle	*Bubulcus*	*ibis*
Falcon	Peregrine	*Falco*	*peregrinus*
Finch	Red-headed	*Amadina*	*erythrocephala*
Firefinch	Red-billed	*Lagonosticta*	*senegala*
Fiscal	Southern	*Lanius*	*collaris*
Flamingo	Lesser	*Phoeniconaias*	*minor*
Flycatcher	Chat	*Melaenornis*	*infuscatus*
Flycatcher	Fairy	*Stenostira*	*scita*
Flycatcher	Fiscal	*Melaenornis*	*silens*
Flycatcher	Spotted	*Muscicapa*	*striata*
Goose	Egyptian	*Alopochen*	*aegyptiaca*
Goose	Spur-winged	*Plectropterus*	*gambensis*
Goshawk	Pale Chanting	*Melierax*	*canorus*
Grebe	Little	*Tachybaptus*	*ruficollis*
Greenshank	Common	*Tringa*	*nebularia*
Guineafowl	Helmeted	*Numida*	*meleagris*
Heron	Black-crowned Night	*Nycticorax*	*nycticorax*
Heron	Black-headed	*Ardea*	*melanocephala*
Heron	Goliath	*Ardea*	*goliath*
Heron	Grey	*Ardea*	*cinerea*
Hoopoe	African	*Upupa*	*africana*
Ibis	African Sacred	*Threskiornis*	*aethiopicus*
Ibis	Hadada	*Bostrychia*	*hagedash*
Kestrel	Lesser	*Falco*	*naumanni*
Kestrel	Rock	*Falco*	*rupicolus*
Kingfisher	Brown-hooded	*Halcyon*	*albiventris*
Kingfisher	Giant	*Megaceryle*	*maxima*
Kingfisher	Malachite	*Corythornis*	*cristatus*
Kingfisher	Pied	*Ceryle*	*rudis*
Kite	Black-winged	*Elanus*	*caeruleus*
Korhaan	Northern Black	*Afrotis*	*afraoides*
Lapwing	Blacksmith	*Vanellus*	*armatus*
Lapwing	Crowned	*Vanellus*	*coronatus*
Lark	Eastern Clapper	*Mirafra*	*fasciolata*
Lark	Sabota	*Calendulauda*	*sabota*
Martin	Brown-throated	*Riparia*	*paludicola*
Martin	Common House	*Delichon*	*urbicum*
Martin	Rock	*Ptyonoprogne*	*fuligula*

Common_group	**Common_species**	***Genus***	***Species***
Mousebird	Red-faced	*Urocolius*	*indicus*
Mousebird	Speckled	*Colius*	*striatus*
Mousebird	White-backed	*Colius*	*colius*
Osprey	Western	*Pandion*	*haliaetus*
Ostrich	Common	*Struthio*	*camelus*
Pigeon	Speckled	*Columba*	*guinea*
Pipit	African	*Anthus*	*cinnamomeus*
Pipit	African Rock	*Anthus*	*crenatus*
Plover	Three-banded	*Charadrius*	*tricollaris*
Prinia	Black-chested	*Prinia*	*flavicans*
Prinia	Karoo	*Prinia*	*maculosa*
Quelea	Red-billed	*Quelea*	*quelea*
Robin-Chat	Cape	*Cossypha*	*caffra*
Scimitarbill	Common	*Rhinopomastus*	*cyanomelas*
Scrub Robin	Kalahari	*Cercotrichas*	*paena*
Scrub Robin	Karoo	*Cercotrichas*	*coryphoeus*
Shelduck	South African	*Tadorna*	*cana*
Shrike	Lesser Grey	*Lanius*	*minor*
Shrike	Red-backed	*Lanius*	*collurio*
Sparrow	Cape	*Passer*	*melanurus*
Sparrow	House	*Passer*	*domesticus*
Sparrow	Southern Grey-headed	*Passer*	*diffusus*
Sparrow-Weaver	White-browed	*Plocepasser*	*mahali*
Spurfowl	Swainson's	*Pternistis*	*swainsonii*
Starling	Cape	*Lamprotornis*	*nitens*
Starling	Common	*Sturnus*	*vulgaris*
Starling	Pale-winged	*Onychognathus*	*nabouroup*
Starling	Pied	*Lamprotornis*	*bicolor*
Starling	Red-winged	*Onychognathus*	*morio*
Starling	Wattled	*Creatophora*	*cinerea*
Stonechat	African	*Saxicola*	*torquatus*
Stork	Abdim's	*Ciconia*	*abdimii*
Sunbird	Dusky	*Cinnyris*	*fuscus*
Swallow	Barn	*Hirundo*	*rustica*
Swallow	Greater Striped	*Cecropis*	*cucullata*
Swallow	Red-breasted	*Cecropis*	*semirufa*
Swallow	South African Cliff	*Petrochelidon*	*spilodera*
Swallow	White-throated	*Hirundo*	*albigularis*
Swift	African Black	*Apus*	*barbatus*
Swift	African Palm	*Cypsiurus*	*parvus*
Swift	Alpine	*Tachymarptis*	*melba*
Swift	Bradfield's	*Apus*	*bradfieldi*
Swift	Common	*Apus*	*apus*
Swift	Horus	*Apus*	*horus*

Common_group	**Common_species**	***Genus***	***Species***
Swift	Little	*Apus*	*affinis*
Swift	White-rumped	*Apus*	*caffer*
Tchagra	Brown-crowned	*Tchagra*	*australis*
Thick-knee	Spotted	*Burhinus*	*capensis*
Thrush	Karoo	*Turdus*	*smithi*
Thrush	Short-toed Rock	*Monticola*	*brevipes*
Wagtail	African Pied	*Motacilla*	*aguimp*
Wagtail	Cape	*Motacilla*	*capensis*
Warbler	African Reed	*Acrocephalus*	*baeticatus*
Warbler	Chestnut-vented	*Curruca*	*subcoerulea*
Warbler	Great Reed	*Acrocephalus*	*arundinaceus*
Warbler	Layard's	*Curruca*	*layardi*
Warbler	Lesser Swamp	*Acrocephalus*	*gracilirostris*
Warbler	Namaqua	*Phragmacia*	*substriata*
Warbler	Rufous-eared	*Malcorus*	*pectoralis*
Warbler	Sedge	*Acrocephalus*	*schoenobaenus*
Warbler	Willow	*Phylloscopus*	*trochilus*
Waxbill	Common	*Estrilda*	*astrild*
Weaver	Scaly-feathered	*Sporopipes*	*squamifrons*
Weaver	Southern Masked	*Ploceus*	*velatus*
Wheatear	Mountain	*Myrmecocichla*	*monticola*
White-eye	Cape	*Zosterops*	*virens*
White-eye	Orange River	*Zosterops*	*pallidus*
Whydah	Pin-tailed	*Vidua*	*macroura*
Woodpecker	Cardinal	*Dendropicos*	*fuscescens*
Woodpecker	Golden-tailed	*Campethera*	*abingoni*

APPENDIX D MAMMAL SPECIES LIST

Family	*Scientific name*	Common name	Red list
Bovidae	*Antidorcas marsupialis*	Springbok	Least Concern (2016)
Bovidae	*Connochaetes gnou*	Black Wildebeest	Least Concern (2016)
Bovidae	*Damaliscus pygargus phillipsi*	Blesbok	Least Concern (2016)
Bovidae	*Oryx gazella*	Gemsbok	Least Concern (2016)
Bovidae	*Raphicerus campestris*	Steenbok	Least Concern (2016)
Bovidae	*Redunca fulvorufula*	Mountain Reedbuck	Least Concern
Bovidae	*Sylvicapra grimmia*	Bush Duiker	Least Concern (2016)
Bovidae	*Taurotragus oryx*	Common Eland	Least Concern (2016)
Bovidae	*Tragelaphus strepsiceros*	Greater Kudu	Least Concern (2016)
Canidae	*Canis mesomelas*	Black-backed Jackal	Least Concern (2016)
Canidae	*Otocyon megalotis*	Bat-eared Fox	Least Concern (2016)
Cercopithecidae	*Chlorocebus pygerythrus*	Vervet Monkey	Least Concern (2016)
Cercopithecidae	*Papio ursinus*	Chacma Baboon	Least Concern (2016)
Equidae	*Equus quagga*	Plains Zebra	Least Concern (2016)
Erinaceidae	*Atelerix frontalis*	Southern African Hedgehog	Near Threatened (2016)
Felidae	*Caracal caracal*	Caracal	Least Concern (2016)
Felidae	*Felis nigripes*	Black-footed Cat	Vulnerable (2016)
Felidae	*Leptailurus serval*	Serval	Near Threatened (2016)
Felidae	*Panthera pardus*	Leopard	Vulnerable (2016)
Hyaenidae	*Hyaena brunnea*	Brown Hyena	Near Threatened (2015)
Hyaenidae	*Proteles cristata*	Aardwolf	Least Concern (2016)
Hystricidae	*Hystrix africaeaustralis*	Cape Porcupine	Least Concern
Macroscelididae	*Elephantulus myurus*	Eastern Rock Elephant Shrew	Least Concern (2016)
Molossidae	*Tadarida aegyptiaca*	Egyptian Free-tailed Bat	Least Concern (2016)
Muridae	*Aethomys namaquensis*	Namaqua Rock Mouse	Least Concern
Muridae	*Desmodillus auricularis*	Cape Short-tailed Gerbil	Least Concern (2016)
Muridae	*Mastomys natalensis*	Natal Mastomys	Least Concern (2016)
Muridae	*Mus (Nannomys) minutoides*	Southern African Pygmy Mouse	Least Concern
Muridae	*Rhabdomys pumilio*	Xeric Four-striped Grass Rat	Least Concern (2016)
Mustelidae	*Ictonyx striatus*	Striped Polecat	Least Concern (2016)
Procaviidae	*Procavia capensis*	Cape Rock Hyrax	Least Concern (2016)
Suidae	*Phacochoerus africanus*	Common Warthog	Least Concern (2016)
Vespertilionidae	*Neoromicia capensis*	Cape Serotine	Least Concern (2016)

APPENDIX E HERPETOFAUNA LIST

REPTILES

Family	Scientific name	Common name	Red list
Agamidae	*Agama aculeata aculeata*	Common Ground Agama	Least Concern (SARCA 2014)
Agamidae	*Agama atra*	Southern Rock Agama	Least Concern (SARCA 2014)
Amphisbaenidae	*Monopeltis capensis*	Cape Worm Lizard	Least Concern (SARCA 2014)
Cordylidae	*Karusasaurus polyzonus*	Karoo Girdled Lizard	Least Concern (SARCA 2014)
Gekkonidae	*Chondrodactylus bibronii*	Bibron's Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Pachydactylus capensis*	Cape Gecko	Least Concern (SARCA 2014)
Lamprophiidae	*Boaedon capensis*	Brown House Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Psammophis notostictus*	Karoo Sand Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Pseudaspis cana*	Mole Snake	Least Concern (SARCA 2014)
Scincidae	*Trachylepis capensis*	Cape Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis occidentalis*	Western Three-striped Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis sulcata sulcata*	Western Rock Skink	Least Concern (SARCA 2014)
Testudinidae	*Homopus femoralis*	Greater Padloper	Least Concern (SARCA 2014)
Testudinidae	*Psammobates tentorius verroxii*	Verrox's Tent Tortoise	
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	Least Concern (SARCA 2014)
Typhlopidae	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	Least Concern (SARCA 2014)
Varanidae	*Varanus albigularis albigularis*	Rock Monitor	Least Concern (SARCA 2014)
Varanidae	*Varanus niloticus*	Water Monitor	Least Concern (SARCA 2014)
Viperidae	*Bitis arietans arietans*	Puff Adder	Least Concern (SARCA 2014)

AMPHIBIANS

Family	*Scientific name*	Common name	Red list
Bufonidae	*Sclerophrys gutturalis*	Guttural Toad	Least Concern (IUCN, 2016)
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina	Least Concern
Pipidae	*Xenopus laevis*	Common Platanna	Least Concern
Pyxicephalidae	*Amietia fuscigula*	Cape River Frog	Least Concern (2017)
Pyxicephalidae	*Cacosternum boettgeri*	Common Caco	Least Concern (2013)
Pyxicephalidae	*Tomopterna cryptotis*	Tremelo Sand Frog	Least Concern