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ECOLOGY & BIODIVERSITY

OLIFANTSHOEK 132KV POWER LINE, NORTHERN CAPE PROVINCE

ECOLOGY AND FRESHWATER RESOURCE STUDY AND ASSESSMENT

Version: 1.0

Date: 12th JUNE 2020

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PROPOSED CONSTRUCTION OF THE OLIFANTSHOEK 132KV POWER LINE, NORTHERN CAPE PROVINCE

Report Title: Ecological and Feshwater Resource Study and Assessment

Authors: Mr. Gerhard Botha

Project Name: Proposed construction of the Olifantshoek 132KV Power Line, Northern Cape Province

Status of report: Version 1.0

Date: 12th June 2020

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I. DECLARATION OF CONSULTANTS INDEPENDENCE

» act/ed as the independent specialist in this application;
» regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
» do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
» have and will not have any vested interest in the proposed activity proceeding;
» have disclosed, to the applicant, EAP and competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
» am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
» have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
» am aware that a false declaration is an offense in terms of regulation 48 of GN No. R. 326.

REPORT AUTHORS

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June 2020

II. REQUIREMENTS REGARDING A SPECIALIST ASSESSMENT

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Sections where this is addressed in the Specialist Report
1. (1) A specialist 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;	Page I and Appendix 6 & 7
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page I
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1 (1.3, 1.4, 1.5)
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2 (2.1 - 2.3)
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6 (6.2 – 6.4)
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 2.6 and 2.8
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modeling used;	Section 2
f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 2 (2.6) and Section 5
g) an identification of any areas to be avoided, including buffers;	N/A
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;	Section 5
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.8
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 or activities;	Section 5 and 6
k) any mitigation measures for inclusion in the EMPr;	Section 6
l) any conditions for inclusion in the environmental authorisation;	Section 6
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 6
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities 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;	Section 7
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A

q) any other information requested by the competent authority.	N/A
2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

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ECOLOGY AND FRESHWATER RESOURCE STUDY AND ASSESSMENT

1. INTRODUCTION

Applicant

Gamagara Local Municipality

Project

The project will be known as the Olifantshoek 132kV Power Line.

Proposed Activity

The Olifantshoek power line will be comprised of the following:

» A new **overhead** 132kV **power line** approximately 36 km long to connect the Emil Switching Station to the new Olifantshoek Substation (soon to be constructed).

The table below (Table 1) provides an overview of the power line components to be constructed:

Table 1: Summary of the different components associated with the proposed power line.

Project Component	Specification	Additional Information
Pylon Type	Steel monopoles and/or self-supporting towers	Poles are established in a vertically staggered configuration and are kept upright by stays.
Line Capacity	132 kilovolts	
Pylon Height	16-20m on average	
Pylon Separation Distance	200m - 400m	Distance can exceed 500m depending on the topography and terrain to be spanned.
Pylon foundation footprint	10mx10m (100m²)	
Conductor attachment height	25-28m	
Conductor Type	Tern Conductor	

Project Component	Specification	Additional Information
Corridor width assessed in this BA Report	300m	
Servitude Width (m)	31m (15.5m on either side)	
Minimal Distances (a) Vertical Distance of structures not forming part of the power line (b) Vertical distance of conductors to the ground (c) Distance between trees and shrubs and the bare phase conductor (d) Minimal clearance to other overhead line conductors (e) Above roads and in towns, proclaimed roads	>3.8m >6.3m >3.8m >2m >7.5m	High voltage power lines require a large clearance area for safety precautions. The Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) provides for statutory clearances.
Access Road	4m wide unsurfaced access road	As far as possible, existing tar and gravel/unsurfaced roads will be used to gain access to the corridor during the construction and operational phase (maintenance purposes) of the project. A new 4m unsurfaced access road will be established in areas where there are no existing roads.

The new proposed Olifantshoek 132kV Power Line (±36 km) will connect the soon to be constructed Olifantshoek Substation near the town of Olifantshoek to the existing Emil Switching Station.

Towers associated with the power line are expected to be an average height of 16m – 20m. The pylons are expected to be steel monopole structures.

The construction of the proposed 132kV overhead power line is likely to follow the following sequence:

» Excavation and concrete work for tower foundations. Due to the dispersed nature of the foundations, it is unlikely for concrete to be batched on site. It is likely that concrete will be ready-mixed and brought in by concrete trucks as and when required.
» Erection of towers in a progressive manner. It is common for materials for several poles to be delivered to the site at the same time. Erection requires the use of a mobile crane to hold prefabricated elements in position. This process is relatively rapid as each pole/pylon is prefabricated off-site.

» Stringing of cables which also requires the use of cranes and mobile hoists to enable workers to fix insulators and attachments and to pull cables between towers.

The above process is relatively clean, rapid, and only affects the area immediately surrounding each tower location as well as the 8m strip along the power line centre line to be cleared (during stringing).

An operating servitude of 31 meters will have to be registered in favour of Eskom Holdings SOC Limited to protect the alignment. The servitude provides Eskom with a 'right of way' and will prevent development and any other use that could compromise the overhead power line. It will not prevent current agricultural uses or access beneath the line.

The following typical dimensions are likely to apply to the project;

» Tower Height: 16-20m subject to tower selection.
» Tower spacing: 200m – 400m subject to terrain.
» Operating servitude: 31m (15.5m x 2)

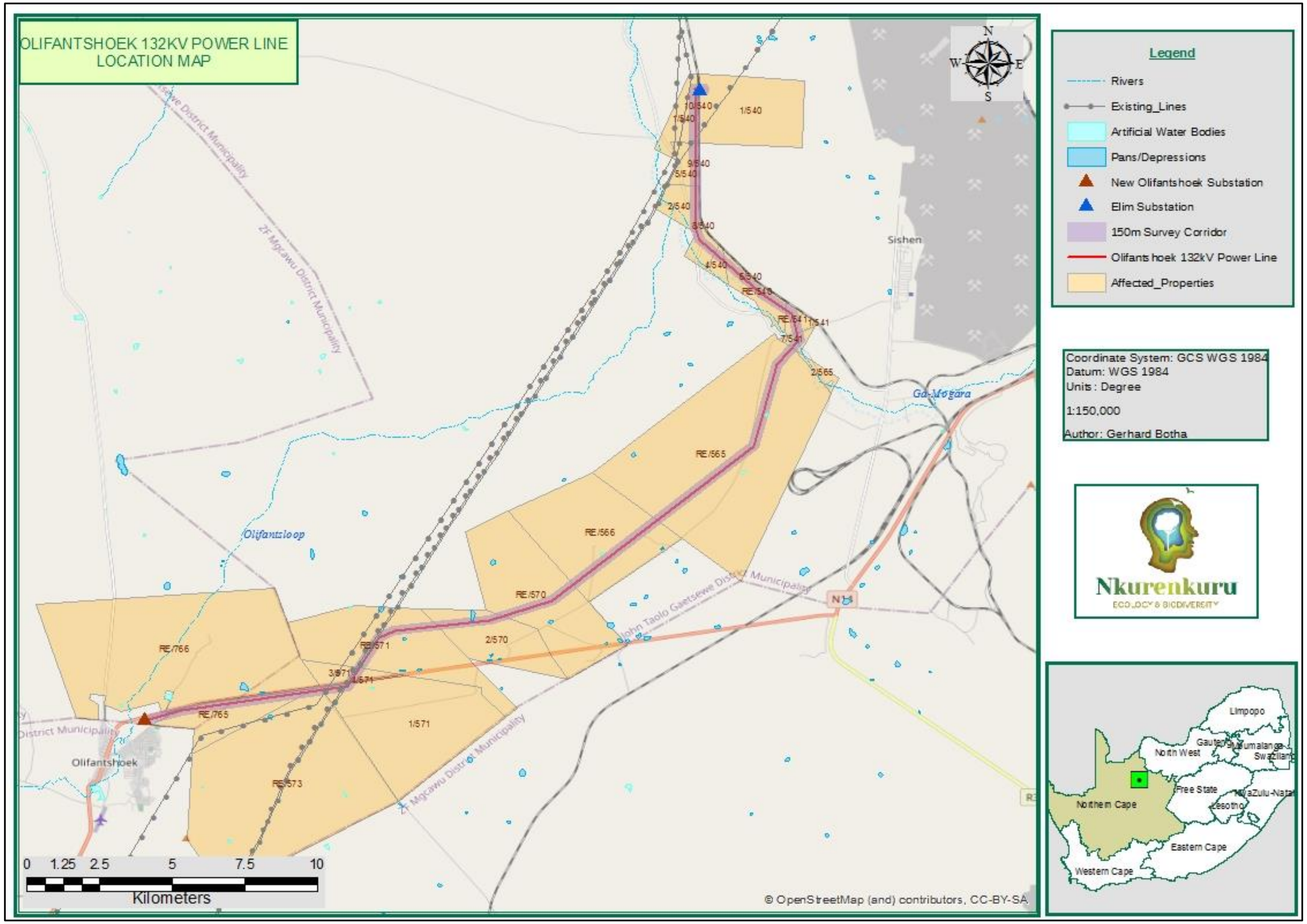

Figure 1: Location map of the proposed Olifantshoek 132kV Power Line.

Terms of reference

To conduct an ecological and surface hydrology study for a basic assessment of the target area, where the Olifantshoek 132kV Power Line is proposed and provide a professional opinion on ecological and surface hydrological issues about the target area and potential mitigation and measures to aid in future decisions regarding the proposed project and to minimalize the significance of identified impacts.

Conditions of this report

Findings, recommendations, and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. No form of this report may be amended or extended without the prior written consent of the author. Any recommendations, statements, or conclusions drawn from or based on this report must clearly cite or refer to this report. Whenever such recommendations, statements or conclusions form part of the main report relating to the current investigation, this report must be included in its entirety.

Relevant legislation

The following legislation was taken into account whilst compiling this report:

Provincial

» The Northern Cape Nature Conservation Act / NCNCA (Act No 9 of 2009) in its entirety, with special reference to:
  - Schedule 1: Specially Protected/Threatened Species
  - Schedule 2: Protected Species

The above-mentioned Nature Conservation Ordinance accompanied by all amendments is regarded by the Northern Cape Department of Environment and Nature Conservation (DENC) as the legally binding, provincial documents, providing regulations, guidelines and procedures with the aim of protecting game and fish, the conservation of flora and fauna and the destruction of problematic (vermin and invasive) species.

National

» National Environmental Management Act / NEMA (Act No 107 of 1998), and all amendments and supplementary listings and/or regulations
» Environment Conservation Act (ECA) (No 73 of 1989) and amendments
» National Environmental Management Act: Biodiversity Act / NEMA:BA (Act No. 10 of 2004) and amendments
» National Forest Act 1998 / NFA (No 84 of 1998)

» National Veld and Forest Fire Act (Act No. 101 of 1998)
» Conservation of Agricultural Resources Act / CARA (Act No. 43 of 1983) and amendments

International
» Convention on International Trade in Endangered Species of Fauna and Flora (CITES)
» The Convention on Biological Diversity
» The Convention on the Conservation of Migratory Species of Wild Animals

2. METHODOLOGY

Assessment Approach and Philosophy

ECOLOGY (BIODIVERSITY)

The assessment will be conducted according to the 2014 EIA Regulations, as amended 7 April 2017, as well as within the best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers et al. (2005).

This includes adherence to the following broad principles:
» That a precautionary and risk-averse approach be adopted towards projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.
» Demonstrate how the proponent intends complying with the principles contained in section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA), which, amongst other things, indicates that environmental management should, in order of priority aim to:
  - Avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;
  - Avoid degradation of the environment;
  - Avoid jeopardising ecosystem integrity;
  - Pursue the best practicable environmental option through integrated environmental management;
  - Protect the environment as the people's common heritage;
  - Control and minimise environmental damage; and
  - Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic, or stressed ecosystems.

These principles serve as guidelines for all decision-making concerning matters that may affect the environment. As such, it is incumbent upon the proponent to show how the proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined by the NEMA.

To adhere to the above principles and best-practice guidelines, the following approach forms the basis for the study approach and assessment philosophy:

The study will include data searches, desktop studies, site walkovers/field survey of the properties and baseline data collection, describing:

» A description of the broad botanical characteristics of the site and its surroundings in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

In terms of pattern, the following will be identified or described:

Community and ecosystem level

» The main vegetation type, its aerial extent, and interaction with neighbouring types, soils or topography;
» Threatened or vulnerable ecosystems (cf. new SA vegetation map/National Spatial Biodiversity Assessment, fine-scale systematic conservation plans, etc).

Species-level

» Red Data Book (RDB) species (giving location if possible, using GPS)
» The viability of an estimated population size of the RDB species that are present (include the degree of confidence in prediction based on the availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, low 0-40% confident) The likelihood of other RDB species, or species of conservation concern, occurring in the vicinity (include a degree of confidence).

Other pattern issues

» Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches, or salt marshes in the vicinity.
» The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than an infestation of undisturbed sites).
» The condition of the site in terms of current or previous land uses.

In terms of process, the following will be identified or described:

» The key ecological "drivers" of ecosystems on the site and in the vicinity, such as fire.

- Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. corridors such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and vegetation boundaries such as edaphic interfaces, upland-lowland interfaces or biome boundaries)
- Any possible changes in key processes e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- Furthermore, any further studies that may be required during or after the EIA process will be outlined.
- All relevant legislation, permits, and standards that would apply to the development will be identified.
- The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image, or map delineated at an appropriate level of spatial accuracy.

FRESHWATER RESOURCES

The delineation and classification of freshwater resources were conducted using the standards and guidelines produced by the Department of Water and Sanitation (DWS) (DWAF, 2005 & 2007) and the South African National Biodiversity Institute (SANBI, 2009). These methods are contained in the attached Appendix 1, which also includes wetland definitions, wetland conservation importance, and Present Ecological State (PES) assessment methods used in this report.

In addition to these guidelines, the general approach to freshwater habitat assessment was furthermore based on the proposed framework for wetland assessment as proposed within the Water Research Commission's (WRC) report titled: "Development of a decision-support framework for wetland assessment in South Africa and a Decision-Support Protocol for the rapid assessment of wetland ecological condition" (Ollis *et. al.*, 2014). A schematic illustration of the proposed decision-support framework for wetland assessment in South Africa is provided in Figure 2 below.

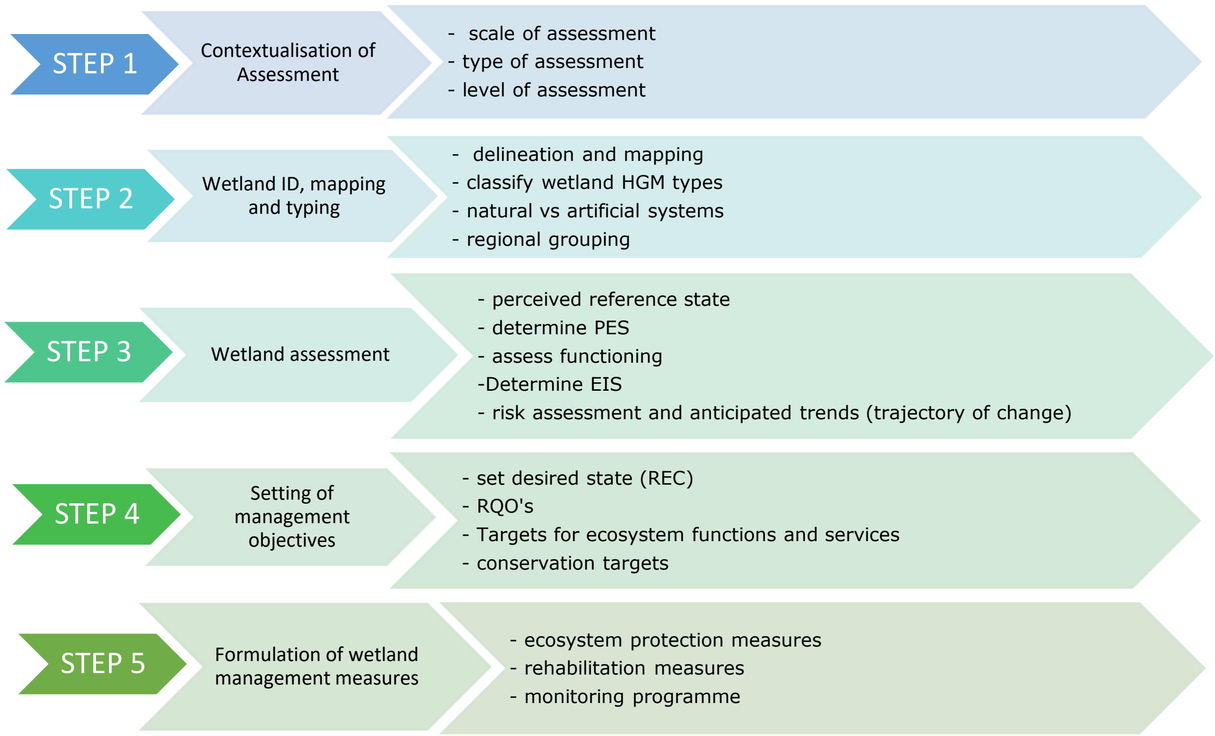

Figure 2: Proposed decision support framework for wetland assessment in South Africa (after Ollis et al., 2014)

Data scouring and review

Data sources from the literature and GIS spatial information was consulted and used where necessary in the study and include the following (also refer to Table 2):

Vegetation:

» 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 for the site and surroundings were extracted (CBA Map for Northern Cape Province obtained from http://bgis.sanbi.org/fsp/project.asp).

» Information on plant and animal species recorded for the surrounding was extracted from the SABIF/SIBIS database hosted by SANBI. This is a considerably larger area than the study area but is necessary to ensure a conservative approach as well as counter the fact that the site itself has probably not been well sampled in the past.

» The IUCN conservation status of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (Version 2017.1).

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Ecosystem:

- Freshwater and wetland information were extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011). This includes rivers, wetlands, and catchments defined under the study.
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).
- Critical Biodiversity Areas were extracted from the Northern Cape Conservation Plan (Oosthuysen & Holness, 2016), available from the SANBI BGIS web portal.

Table 2: Information and data coverages used to inform the ecological and freshwater resource assessment.

	Data/Coverage Type	Relevance	Source
Biophysical Context	**Colour Aerial Photography**	Desktop mapping of habitat/ecological features as well as drainage network.	National Geo-Spatial Information (NGI)
Biophysical Context	**Latest Google Earth™ imagery**	To supplement available aerial photography	Google Earth™ On-line
Biophysical Context	**1:50 000 Relief Line** (5m Elevation Contours GIS Coverage)	Desktop mapping of terrain and habitat features as well as drainage network.	Client
Biophysical Context	**1:50 000 River Line** (GIS Coverage)	Highlight potential on-site and local rivers and wetlands and map local drainage network.	CSIR (2011)
Biophysical Context	**National Land-Cover**	Shows the land-use and disturbances/transformations within and around the impacted zone.	DEA (2015)
Biophysical Context	**South African Vegetation Map** (GIS Coverage)	Classify vegetation types and determination of reference primary vegetation	Mucina & Rutherford (2012)
Biophysical Context	**NFEPA: river and wetland inventories** (GIS Coverage)	Highlight potential on-site and local rivers and wetlands	CSIR (2011)
Conservation and Distribution Context	**NFEPA: River, wetland and estuarine FEPAs** (GIS Coverage)	Shows location of national aquatic ecosystems conservation priorities	CSIR (2011)
Conservation and Distribution Context	**National Biodiversity Assessment – Threatened Ecosystems** (GIS Coverage)	Determination of national threat status of local vegetation types	SANBI (2011)
Conservation and Distribution Context	**Critical Biodiversity Areas of the Northern Cape** (GIS Coverage)	Determination of provincial terrestrial/freshwater conservation priorities and biodiversity buffers	SANBI (2016)
Conservation and Distribution Context	**SANBI's PRECIS (National Herbarium Pretoria Computerized Information System) electronic database**	Determination of plant species composition within the region as well as potential conservation important plants.	http://posa.sanbi.org 2020-06-12_110423452-BRAHMSOnlineData
Conservation and Distribution Context	**Red Data Books (Red Data Lists of Plants, Mammals, Reptiles, and Amphibians**	Determination of endangered and threatened plants, mammals, reptiles and amphibians	Various sources

	Animal Demography Unit	Determination of faunal species composition within the region as well as potential conservation important faunal species	ADU, 2019
	Smither's Mammals of Southern Africa	Compilation of a species list	Apps (ed.) 2012
	The Mammals of the Southern African Subregion	Compilation of a species list	Skinner & Chimimba (2005)
	Field guide to snakes and other reptiles of southern Africa	Compilation of a species list	Branch (1998)
	A Complete Guide to the Frogs of Southern Africa	Compilation of a species list	Du Preez & Carruthers (2009)

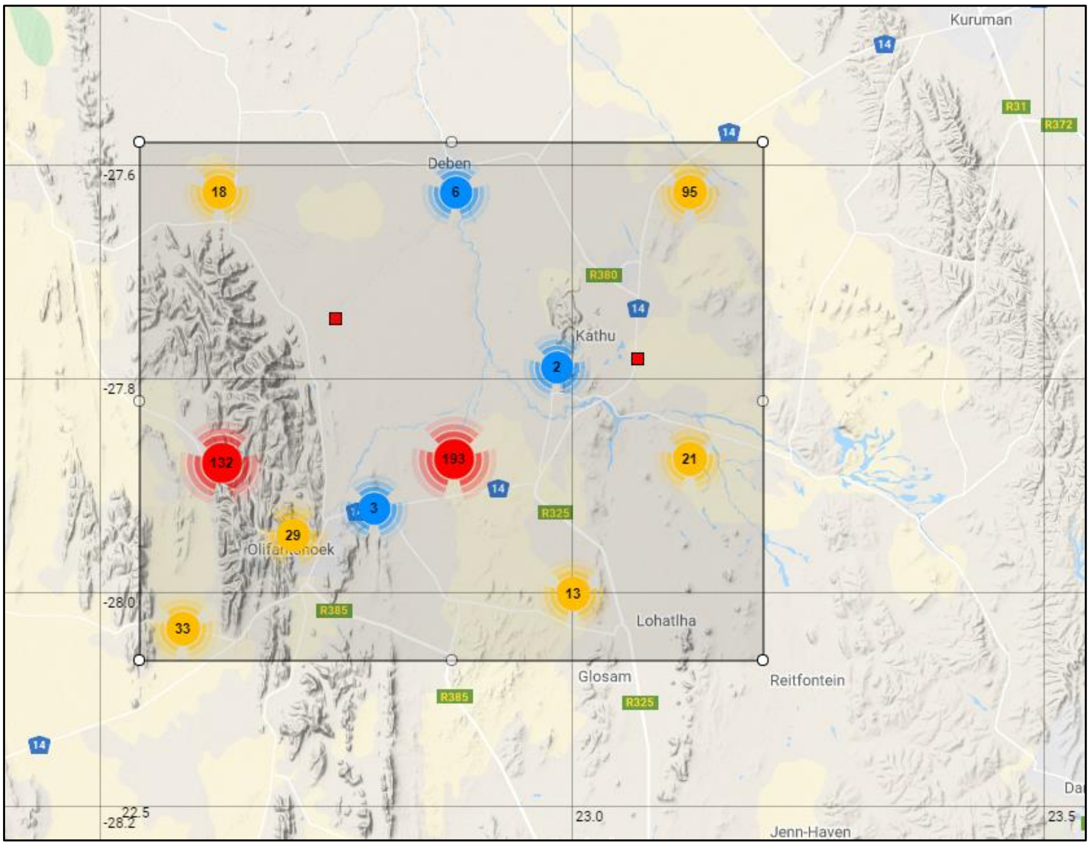

Figure 3: Extracted area and sample locations from POSA. Extracted data was used to compile a plant list of species that may potentially occur within the project site and provide an indication of potential conservation important species that may be found within the area.

Assumptions and Limitations

General Assumptions and Limitations

» This report deals exclusively within a defined area (300m survey area) and the impacts upon biodiversity and natural ecosystems in that area and immediate surrounding landscape including all downstream freshwater/aquatic resources that may potentially be impacted and which fall within the Regulated Area (500m) as defined by the DWS.

- All relevant project information provided by the proponent and engineering design team to the ecological specialist was correct and valid at the time that it was provided.
- Additional information used to inform the assessment was limited to data and GIS coverage's available for the NC Province at the time of the assessment.

Sampling Limitations and Assumptions

- While disturbance and transformation of habitats can lead to shifts in the type and extent of ecosystems, it is important to note that the current extent and classification are reported on here.
- The delineation of the outer boundary of riparian areas is based on several indicators, including topography (macro-channel features), the presence of alluvial deposition and vegetation indicators. The boundaries mapped in this specialist report, therefore, represent the approximate boundary of riparian habitat as evaluated by an assessor familiar and well-practiced in the delineation technique.
- The accuracy of the delineation is based solely on the recording of the relevant onsite indicators using a GPS. GPS accuracy will, therefore, influence the accuracy of the mapped sampling points and therefore resource boundaries and an error of 3 – 5m can be expected. All soil/vegetation/terrain sampling points were recorded using a Garmin etrex Touch 35 Positioning System (GPS) and captured using Geographical Information Systems (GIS) for further processing.
- Infield soil and vegetation sampling were only undertaken within a specific focal area in the vicinity of the proposed development, while the remaining water resource/HGM units were delineated at a desktop level with limited accuracy.
- Any freshwater resources that fall outside of the affected catchment (but still within the 500m DWS regulated area) and are not at risk of being impacted by the specific activity were not delineated or assessed. Such features were flagged during a baseline desktop assessment before the site visit.
- Sampling by its nature means that generally not all aspects of ecosystems can be assessed and identified.
- With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked.
- All vegetation information recorded outside of the immediate development footprint was based on the onsite observations of the author and no formal in-depth vegetation sampling was undertaken (apart from a few focal areas/transects within the riparian zones of the downstream water resources that still fall within the regulated area boundary). Furthermore, the vegetation within these areas' information provided for the areas just outside of the development footprint only gives an indication of the dominant and/or indicator species and only provides a general indication of the composition of the vegetation communities. Thus, the vegetation information provided for these areas is somewhat limited in terms of true botanical applications i.e. accurate

and detailed species list, phytosociological classification, and rare / Red Data Species identification.

- This approach for these areas well outside of the development footprint is however regarded as acceptable as the vegetation structure and composition of these areas will not be impacted by the development and vegetation sampling was merely to inform the riparian boundary and transitional zones and to inform the current Ecological Status.

» No formal aquatic faunal survey was undertaken (including macro-invertebrate sampling).

» No water sampling and analysis was undertaken.

» The lists of amphibians, reptiles, and mammals for the study area are based on those observed in the vicinity of the site as well as those likely to occur in the area based on their distribution and habitat preferences. This represents a sufficiently conservative and cautious approach that takes the study limitations into account.

» Probably the most significant potential limitation associated with such a sampling approach is the narrow temporal window of sampling.
  - Ideally, a site should be visited several times, during different seasons to ensure that the full complement of plant and animal species present is captured.
  - However, this is rarely possible due to time and cost constraints and therefore, the representation of the species sampled at the time of the site visit should be critically evaluated.
  - The site was sampled outside of the wet season.
  - However, the area received a reasonable fair amount of late autumn rain allowing for some geophytes and graminoids to be fairly well represented (distinguishable) during the time of the inspection
  - The footprint was covered in detail with the result that the results are considered highly reliable and it is unlikely that there are any significant species or features present that were not recorded.

Baseline Ecological Assessment – Limitations and Assumptions

» All assessment tools utilised within this study were applied only to the resources and habitats located within the 'survey area/servitude area' and which are at risk of being impacted by the proposed development. Any resource located outside of the servitude area and which is not a risk of being impacted was not assessed.

» It should be noted that the most appropriate assessment tools were selected for the analysis of the specific features and resources that may potentially be impacted by the proposed development. The selection was based on the assessment practitioner's knowledge and experience of these tools and their attributes and shortcomings.

» Furthermore, it should be noted that these assessment techniques and tools are currently the most appropriate currently available tools and techniques to undertake assessments of freshwater resources, the area however rapid assessment tools that rely on qualitative information and expert judgment. While these tools have been subjected to peer review processes, the methodology for these tools is ever-evolving and will likely be further refined in the near future. For the purposes of this assessment, the assessments were undertaken at rapid levels with somewhat limited field verification. It, therefore, provides an indication of the PES of the portions of the affected systems rather than providing a definitive measure.

» PES and EIS were only determined for the affected/regulated areas even though upstream and downstream as well as catchment impacts were considered (based on available desktop information).
» The PES and EIS assessments undertaken are largely qualitative assessment tools and thus the results are open to professional opinion and interpretation. We have made an effort to substantiate all claims where applicable and necessary.
» The Ecological Importance and Sensitivity (EIS) assessment did not specifically address the finer-scale biological aspects of the rivers such as fauna (amphibians and invertebrates).

3. THE IMPORTANCE OF BIODIVERSITY AND CONSERVATION

The term 'Biodiversity' is used to describe the wide variety of plant and animal species occurring in their natural environment or 'habitat'. Biodiversity encompasses not only all living things but also the series of interactions that sustain them, which are termed 'ecological processes. South Africa's biodiversity provides an important basis for economic growth and development; and keeping our biodiversity intact is vital for ensuring the on-going provision of ecosystem services, such as the production of clean water through good catchment management. The role of biodiversity in combating climate change is also well recognised and further emphasises the key role that biodiversity management plays on a global scale (Driver et al., 2012). Typical pressures that natural ecosystems face from human activities include the loss and degradation of natural habitat, invasive alien species, pollution, and waste and climate change (Driver et al.,2012). High levels of infrastructure and agricultural developments typically restrict the connectivity of natural ecosystems, and maintaining connectivity is considered critical for the long-term persistence of both ecosystems and species, in the face of human development and global climatic change. Loss of biodiversity puts aspects of our economy and quality of life at risk and reduces socioeconomic options for future generations as well. In essence, then, sustainable development is not possible without it.

4. CONSERVATION AND FUNCTIONAL IMPORTANCE OF AQUATIC ECOSYSTEMS

Water affects every activity and aspiration of human society and sustains all ecosystems. "Freshwater ecosystems" refer to all inland water bodies whether fresh or saline, including rivers, lakes, wetlands, sub-surface waters, and estuaries (Driver *et al*., 2011). South Africa's freshwater ecosystems are diverse, ranging from sub-tropical in the north-eastern part of the country, to semi-arid and arid in the interior, to the cool and temperate rivers of the fynbos. Wetlands and rivers form a fascinating and essential part of our natural heritage and are often referred to as the "kidneys" and "arteries" of our living landscapes and this is particularly true in semi-arid countries such as South Africa (Nel *et al*., 2013). Rivers and their associated riparian zones are vital for supplying freshwater (South Africa's most scarce natural resource) and are important in providing additional biophysical, social, cultural, economic, and aesthetic services (Nel *et al*., 2013). The health of our rivers and wetlands is measured by the diversity and health of the species we share these resources with. Healthy river ecosystems can increase resilience to the impacts of climate change, by allowing ecosystems and species to adapt as naturally as possible to the changes and by buffering human settlements and activities from the impacts of extreme weather events (Nel *et al.,* 2013). Freshwater ecosystems are likely to be particularly hard hit by rising temperatures and shifting rainfall patterns, and yet healthy, intact freshwater ecosystems are vital for maintaining resilience to climate change and mitigating its impact on human wellbeing by helping to maintain a consistent supply of water and for reducing flood risk and mitigating the impact of flash floods. We, therefore, need to be mindful of the fact that without the integrity of our natural river systems, there will be no sustained long-term economic growth or life (DEA *et al.,* 2013).

Freshwater ecosystems, including rivers and wetlands, are also particularly vulnerable to anthropogenic or human activities, which can often lead to irreversible damage or longer-term, gradual/cumulative changes to freshwater resources and associated aquatic ecosystems. Since channeled systems such as rivers, streams, and drainage lines are generally located at the lowest point in the landscape; they are often the "receivers" of wastes, sediment, and pollutants transported via surface water runoff as well as subsurface water movement (Driver *et al.,* 2011). This combined with the strong connectivity of freshwater ecosystems means that they are highly susceptible to upstream, downstream, and upland impacts, including changes to water quality and quantity as well as changes to aquatic habitat & biota (Driver *et al.,* 2011). South Africa's freshwater ecosystems have been mapped and classified into National Freshwater Ecosystem Priority Areas (NFEPAs). This work shows that 60% of our river ecosystems are threatened and 23% are critically endangered. The situation for wetlands is even worse: 65% of our wetland types are threatened, and 48% are critically endangered (Driver *et al.,* 2011). Recent studies reveal that less than one-third of South Africa's main rivers are considered to be in an ecologically 'natural' state, with the principal threat to freshwater systems being human activities, including river regulation, followed by catchment transformation (Rivers-Moore & Goodman, 2009). South Africa's freshwater fauna also display high levels of threat: at least one-third of freshwater fish indigenous to South Africa are reported as threatened, and a recent southern African study on the conservation status of major freshwater-dependent taxonomic groups (fishes, molluscs dragonflies, crabs, and vascular plants) reported far higher levels of threat in South Africa than in the rest of the region (Darwall *et al*., 2009). Clearly, urgent attention is required to ensure that representative natural examples of the different ecosystems that make up the natural heritage of this country for current and future generations to come. The degradation of South African rivers and wetlands is a concern now recognized by Government as requiring urgent action and the protection of freshwater resources, including rivers and wetlands, is considered fundamental to the sustainable management of South Africa's water resources in the context of the reconstruction and development of the country.

5. STUDY AREA

Regional/Local Biophysical Setting

The project is located in the Olifantshoek region, which falls within the Gamagara Local Municipality and the John Taolo Gaetsewe District Municipality. The study area extends from the Olifantshoek Substation (soon to be constructed) in the south and will terminate into the Emil Switching Station in the north. The proposed power line will be approximately 36km in length. The proposed corridor will, for large sections, run parallel to existing power line infrastructure including a section which will run along the existing Ferrum/Nieuwehoop 400kV and Ferrum/Lewensaar 275kV power lines.

The approximate location (farm properties and geographic coordinates) for the proposed project (power line route including the 300m survey corridor) are as follows:

Proposed connection point to Emil Switching Station

» Farm Property:
  - Portion 10 of the Farm Fritz 540

» Geographical Coordinates
  - -27.736365°; 22.920617°

Proposed connection point to Olifantshoek Switching Station

» Farm Property:
  - Portion 1 of the Farm Neylan 574

» Geographical Coordinates
  - -27.931425°; 22.748489°

Affected Farm Properties (Refer to Figure 1)

- Remaining Extent of the Farm Fritz 540
- Portion 1 of the Farm Fritz 540
- Portion 2 of the Farm Fritz 540
- Portion 4 of the Farm Fritz 540
- Portion 5 of the Farm Fritz 540
- Portion 8 of the Farm Fritz 540
- Portion 9 of the Farm Fritz 540
- Portion 10 of the Farm Fritz 540
- Remaining Extent of the Farm Gamagara 541
- Portion 1 of the Farm Gamagara 541
- Portion 7 of the Farm Gamagara 541
- Portion 1 of the Farm Wright 538
- Remaining Extent of the Farm Dingle 565
- Portion 2 of the Farm Dingle 565
- Remaining Extent of the Farm Smythe 566
- Remaining Extent of the Farm Murray 570
- Portion 2 of the Farm Murray 570
- Remaining Extent of the Farm Cox 571
- Portion 1 of the Farm Cox 571
- Portion 3 of the Farm Cox 571
- Portion 4 of the Farm Cox 571
- Remaining Extent of the Farm Hartley 573
- Portion 3 of the Farm Hartley 573
- Remaining Extent of the Farm Diegaart's Heuwel 765
- Remaining Extent of the Farm Neylan 574
- Portion 1 of the Farm Neylan 574
- Remaining Extent of the Farm Neylan 766
- Portion 3 of the Farm Neylan 766
- Portion 4 of the Farm Neylan 766
- Portion 7 of the Farm Neylan 766
- Remaining Extent of Erf 155 Olifantshoek

Land use within the project site is mostly for farming. Farming practices consist mainly of cattle and game farming. The northern section of the power line route will traverse historically cultivated areas (indications of pivots), however, recruitment of indigenous vegetation has substantially occurred, and succession is in a relatively advanced state. Major land transformation within the survey corridor is due to numerous roads, railway, cleared servitudes for power lines as well as some small-scale mining and borrow pits.

The closest built-up area is the town of Olifantshoek (Figure 1) situated just south of the Olifantshoek Substation.

The study site occurs within the Quaternary Catchment D41J (Lower Vaal Water Management Area), which is drained by the Olifantsloop River and the Ga-Mogara River .

The Olifantsloop River is a relatively short river flowing in a north to north-east direction, terminating into the Ga-Mogara River. The Ga-Mogara River is the most prominent drainage feature within the Quaternary Catchment and feeds into the Kuruman River to the North-East. Both rivers are ephemeral. The proposed route will cross the Ga-Mogara River within its middle reach, west of the Sishen Iron Ore Mine.

A summary of the biophysical features and the setting of the project site and surroundings are summarised in Table 3 below (also refer to Appendix 6 for a more detailed description of the biophysical setting).

Table 3: Summary of the biophysical setting of the projects site as well as the surroundings

Biophysical Aspect	Desktop Biophysical Details			Source
Physiography				
Av. Elevation a.m.s.l	1207m			Google Earth & ArcGis
Max. Elevation a.m.s.l	1287m			Google Earth & ArcGis
Min. Elevation a.m.s.l	1158m			Google Earth & ArcGis
Av. slope	1.1%; -1.0%			Google Earth & ArcGis
Maximum slope	6.8%; -4.8%			Google Earth & ArcGis
Landscape Description	Undulating plain covered by aeolian (regic) red sand. Typographical variations due to low hills, ridges, areas where thinning of the sand have exposed calcrete, chert and lava surfaces, and the Ga-Mogara River. Small depression wetlands/" Pans" are also a prominent feature of the landscape, although only three such features are located within the surveyed corridor. The most prominent geographical features within the area are the Langeberg Mountain Range to the west and the Ga-Mogara River. The most prominent anthropogenic features within the area are the town of Olifantshoek and the Sishen Iron Ore Mine.			Google Earth & Mucina and Rutherford, 2006
Land Type Classification	Ae6	Ae7	Ag110	ARC
Terrain Type	Symbol	Description		ARC
	A2	Level plains or plateaus with some relief		
	B2	Rolling or broken plains or plateaus with some relief (mostly found south of the N14 route and areas of exposed calcrete, chert, and lava surfaces).		
Geomorphic Province	Southern Kalahari			Partridge et al., 2010
Geology	Andesitic lava, chert, jasper (Ongeluk Formation), surface limestone of Tertiary to Recent age, and coarse-grained brown quartzite (Matsap Formation).			ARC & SA Geological Dataset
Soils (General)	Red to flesh-coloured wind-blown sand with high base status (structureless). Soils of the Ga-Mogara River are characterised by bleached to light coloured alluvial soils.			ARC
Prominent Soil Forms	Hutton, Mispah, exposed rock			ARC
Susceptibility to Wind Erosion	Class	Description		ARC
	2b	Susceptible (Sand dominant): most of the southern section.		

	1b	Highly susceptible (Pure Sand): Area associated with Ag110 land type. Dominant land type to the north.		
	3b	Moderate susceptibility (Loamy Sand). Most of the central portion of the power line route (associated with Ae7 land type)		
Climate				
Mean annual temperature	18.6°C			Climate-data.org
Warmest Month & Av. Temp.	January: 25.3°C			Climate-data.org
Coldest Month & Av. Temp.	July: 10.8°C			Climate-data.org
Rainfall Seasonality	Late Summer (Highest in March)			DWAF, 2007
Mean annual precipitation	395 mm			Schulze, 1997
Mean annual runoff	2.9 mm			Schulze, 1997
Mean annual evaporation	2200-2600 mm			Schulze, 1997
Surface Hydrology				
DWA Ecoregions	Level 1	Level 2		DWA, 2005
	Southern Kalahari Ecoregion	31.02		
Wetland vegetation group	Albany Thicket Valley			CSIR, 2011
Water management area	Lower Vaal			DWA
				DWA
Quaternary catchment	Name (Symbol)	Extent (km^2)		DWA
	D41J	4952		
Sub Quaternary Catchments	Name (Symbol)	Extent (km^2)		DWA
	2511	930		
	2464	986		
	2419	337		
Main collecting river(s) in the catchment	Quaternary catchment	Sub quaternary catchment		CSIR, 2011
	Olifants and Ga-Mogara	Kuruman		
Closest river to the project site	Ga-Mogara			Google Earth
Geomorphic Class	Symbol	Description	Slope (%)	CSIR, 2011
	V3	Lowland River	0.0001 - 0.001	
Length of river	±88.037 km			CSIR, 2011
Distance (nearest point from development site)	The proposed power line will cross a section of the river. GPS Point: -27.815458°; 22.949310°			Google Earth
Vegetation Overview				
Biome	Savanna Biome (Eastern Kalahari Bushveld Bioregion)			Mucina & Rutherford, 2011
Vegetation Types (Figure 4)	Kuruman Thornveld (SVk 9), Kathu Bushveld (SVk 12) & Olifantshoek Plains Thornveld (SVk 13)			Mucina & Rutherford, 2011
Vegetation & Landscape Feature	Olifantshoek Plains Thornveld: A very wide and diverse unit on plains with usually open tree and shrub layers with, for example, *Vachellia luederitzii, Boscia albitrunca,* and *Searsia tenuinervis* and wit a usually sparse grass layer. Kathu Bushveld: Medium-tall tree layer with *Vachellia erioloba* in places, but mostly open and including most important shrubs such as *Senegalia mellifera*, *Diospyros lycioides, Lycium hirsutum*. The grass layer is variable in cover. Kuruman Thronveld: Flat rocky plains and some sloping hills with very well-developed, closed shrub layer and well-			Mucina & Rutherford, 2006

	developed open tree stratum consisting of *Vachellia erioloba*.		
BODATSA Data	Regional: Total Species Observed	Immediate area: Total Species Observed	2020-06-12_110423452-BRAHMSOnlineData
	770	166	
	Indigenous Flora	Endemic Flora	
	695	68	
	Non-indigenous Flora	Red Data (IUCN) Flora	
	34	3	
	Provincially Protected Flora (Schedule 1 and 2)	National Protected Trees	
	59	3	

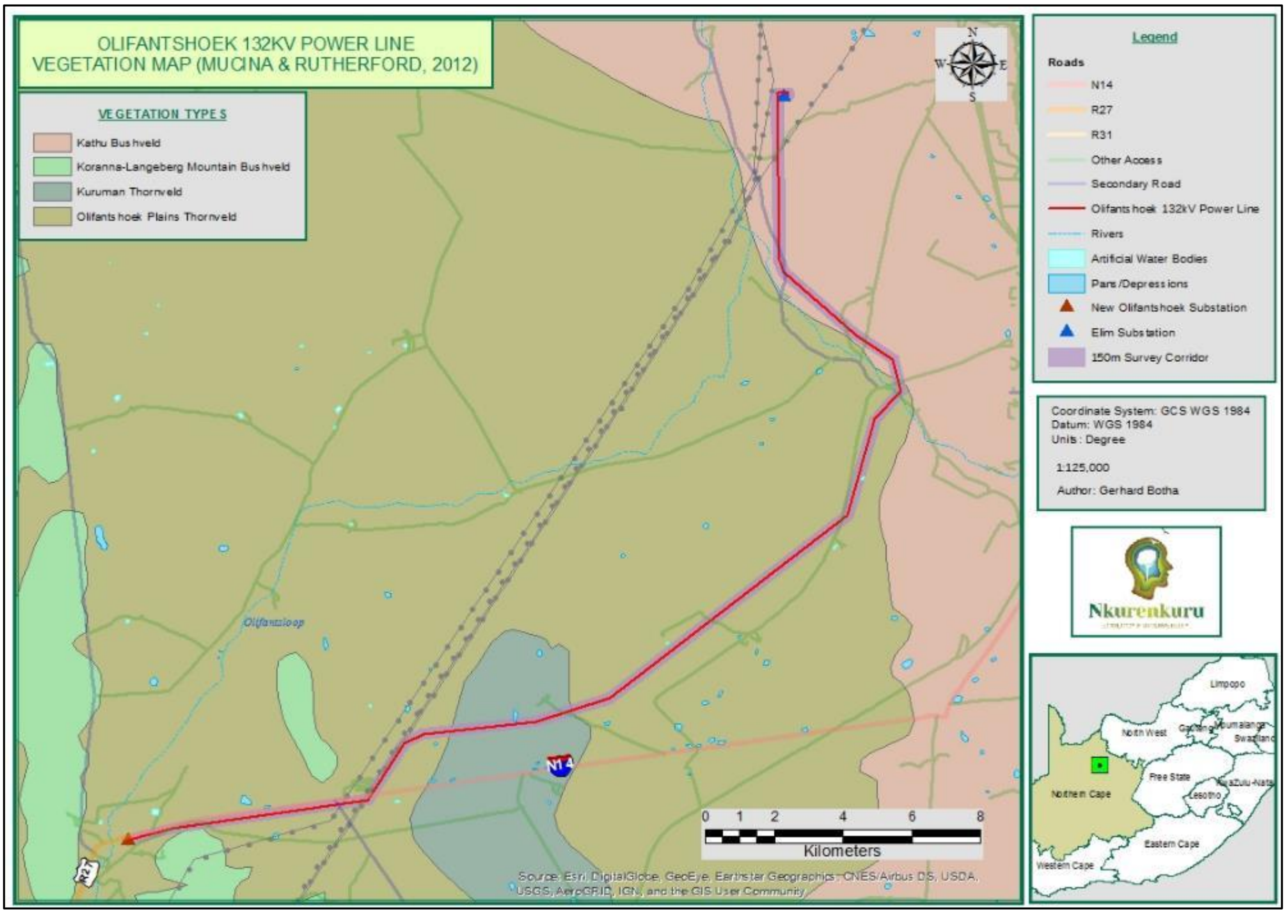

Figure 4: Broad-scale overview of the major vegetation units (according to Mucina and Rutherford, 2012) found within and around the study site (survey corridor).

Conservation Planning / Context

Understanding the conservation context and importance of the study area and surroundings is important to inform decision making regarding the management of the aquatic resources in the area. In this regard, national, provincial, and regional conservation planning information available and was used to obtain an overview of the study site (Table 3) (Also refer to Appendix 7 for a more detailed description of the conservation planning context).

Table 4: Summary of the conservation context details for the study area.

Conservation Planning Dataset		Relevant Conservation Feature	Location in Relationship to Project Site	Conservation Planning Status
NATIONAL LEVEL CONSERVATION PLANNING CONTEXT	National Protected Areas Expansion Strategy	Focus Area	Outside Focus Area: ± 18.4km south-east of Eastern Kalahari Focus Area	Not Classified
		Informal Protected Area	Outside IPA: ± 342km west of Mafikeng Nature Reserve.	Not Classified
		Formal Protected Area	Outside FPA: ± 66km north-west of the Witsand Nature Reserve.	Not Classified
	Vegetation Types	Olifantshoek Plains Thronveld	Vegetation of Study Area	Least Threatened
		Kathu Bushveld	Vegetation of Study Area	Least Threatened
		Kuruman Thornveld	Vegetation of Study Area	Least Threatened
	Threatened Ecosystems	Not Classified	Ecosystems of Study Area	Not Classified
	National Freshwater Ecosystem Priority Area	River FEPA	Ga-Mogara River	Upstream FEPA
		Wetland FEPA	Small artificial water bodies (Dams and reservoirs) and natural depression wetlands	Not Classified
PROVINCIAL AND REGIONAL LEVEL	NCBSP: Critical Biodiversity Areas	Ecological Support Areas	Ga-Mogara River Habitat.	ESA
		Ecological Support Area	Ridges, hills, and outcrops	ESA

National Protected Areas Expansion Strategy

According to the NPAES spatial data (Holness, 2010), the proposed development footprint is located well outside of any Focus Area (Figure 9) with the closest focus area located approximately 18km to the north-west (Eastern Kalahari Focus Area). The nearest Informal Protected Area is located approximately 342km to the east (Mafikeng Private Nature Reserve) whilst the nearest Formal Protected Area, Witsand Nature Reserve is located approximately 66km south-east of the project area.

Subsequently, no NPAES Focus Areas will be impacted by the development.

National Level of Conservation Priorities (Threatened Ecosystems)

According to Mucina and Rutherford (2006), the impacted vegetation types are classified as Least Threatened and is furthermore not listed within the Threatened Ecosystem List (NEMA:BA). It is highly unlikely that this development will have an impact on the status of the Ecosystem as well as Vegetation Type Status due to the extent of the development.

Critical Biodiversity Areas and Broad Scale Ecological Processes

The presence of the line would not compromise the functioning of the ESAs (Figure 5) in any way, especially as it would run mostly along the existing line infrastructure. As the footprint of the power line is relatively low, the impact of the development of the Olifantshoek power line is not likely to result in significant disruption of any broad-scale ecological processes.

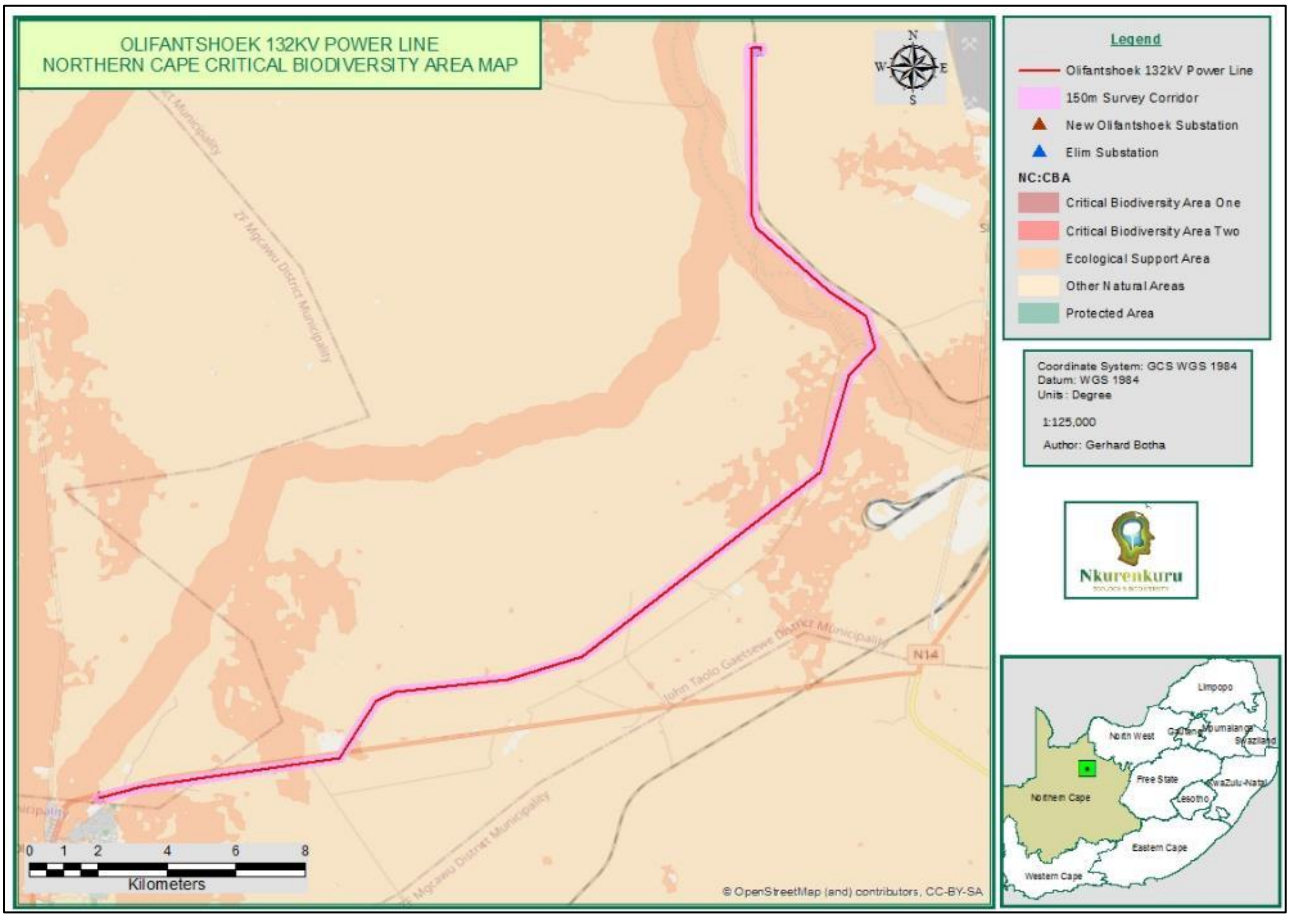

Figure 5: Map showing the location and extent of CBAs in relationship to the proposed development footprint identified according to the Northern Cape Biodiversity Conservation Plan.

6. FINDINGS OF THE FRESHWATER RESOURCE BASELINE ASSESSMENT

Desktop Mapping and Wetland/Watercourse Risk Screening

Water resources (wetland and watercourses) within a radius of 500m around the proposed Olifantshoek 132kV power line route were mapped and classified at a desktop level followed by a desktop rating of risk associated with the proposed activities. This was undertaken to guide field assessments and inform water use identification for the proposed project. Several water resources were identified and rated and include wetland features in the form of endorheic depression wetlands and sections of the Ga-Mogara River (ephemeral) that fall within the 500m regulated area.

The main risks associated with the construction and operations of the proposed activity are:

» Potential direct physical modification/destruction of wetlands within/in the vicinity of the footprint of the crossed by the proposed power line installation.
» Potential direct physical loss and/or modification of watercourses within the development site, both planned and accidental;
» Potential direct physical alteration of flow characteristics of watercourses within the development site and associated erosion and sedimentation impacts;
» Alteration of catchment surface water processes / hydrological inputs and associated erosion and sedimentation impacts; and
» Surface runoff contamination and local watercourse water quality deterioration.

The risk ratings for each of the mapped water resources are presented in Table 5 and Figure 6-12 below. The proposed activities pose a potential high risk to a few depression wetlands located within the 300m grid connection corridor as well as a small section of the Ga-Mogara River, where the power line is to cross this river. Due to the extent of the development, water resources located outside of the 300m grid connection corridor(surveyed area) are unlikely to be impacted by the development and were subsequently assessed as being at low or very low risk. Water resources located within the 300m grid connection but do not fall within the direct, planned route of the power line itself were assessed as being at medium risk and can be sufficiently avoided.

Note: The risk ratings provided relates to the likelihood that a water resources unit may be measurably negatively affected to inform the legal processes. Thus, this is essentially risk screening, **not a risk assessment and risk ratings are not a representation of impact intensity/magnitude of the change.**

Table 5: Preliminary risk ratings for the mapped wetland units including rationale.

Risk Class	Water Resource Number	Water Resource	Name	Rationale
High	22	Drainage Line		These water resources will be crossed by the proposed power line according to the current layout and are likely to incur direct and indirect (secondary impacts). Direct impacts may include the loss or modification of freshwater habitat (i.e. within the construction servitude) whereas expected secondary impacts are likely to be linked with construction runoff, road run-off, water quality, and sedimentation of freshwater habitat.
	24	Drainage Line		
	26	Drainage Line		
	39	Depression Wetland		
	45	Ephemeral River	Gamogara River	
	46	Ephemeral River	Gamogara River	
Medium	6	Drainage Line		These water resource units are located within the 300m grid connection corridorare located either directly downslope/downstream or directly adjacent to the grid connection corridorroute. No direct impacts are expected although indirect secondary impacts linked with road run-off, water quality, and sedimentation of freshwater habitat are likely to occur.
	7	Drainage Line		
	11	Drainage Line		
	21	Drainage Line		
	23	Drainage Line		
	30	Depression Wetland		
	31	Depression Wetland		
	32	Depression Wetland		
Low	1	Ephemeral River	Gamogara River	These water resource units are either located in separate micro-catchments or some distance downslope or downstream of the proposed development. Risk form secondary impacts are low and measurable impacts on these water resources are unlikely.
	2	Ephemeral River	Olifants River	
	3	Riparian Woodland	Olifants River	
	4	Riparian Woodland	Gamogara River	
	4	Riparian Woodland	Gamogara River	
	4	Riparian Woodland	Gamogara River	
	5	Drainage Line		
	8	Drainage Line		
	9	Drainage Line		
	10	Drainage Line		
	12	Drainage Line		
	13	Drainage Line		
	14	Drainage Line		
	15	Drainage Line		
	16	Drainage Line		
	17	Drainage Line		
	18	Drainage Line		
	19	Drainage Line		

	19	Drainage Line		
	20	Drainage Line		
	20	Drainage Line		
	25	Drainage Line		
	27	Drainage Line		
	28	Drainage Line		
	33	Depression Wetland		
	34	Depression Wetland		
	35	Depression Wetland		
	37	Depression Wetland		
	38	Depression Wetland		
	40	Depression Wetland		
	41	Depression Wetland		
	42	Depression Wetland		
	43	Alluvial Sediments		
	44	Alluvial Sediments		
	47	Riparian Woodland	Olifants River	
	48	Riparian Woodland	Olifants River	

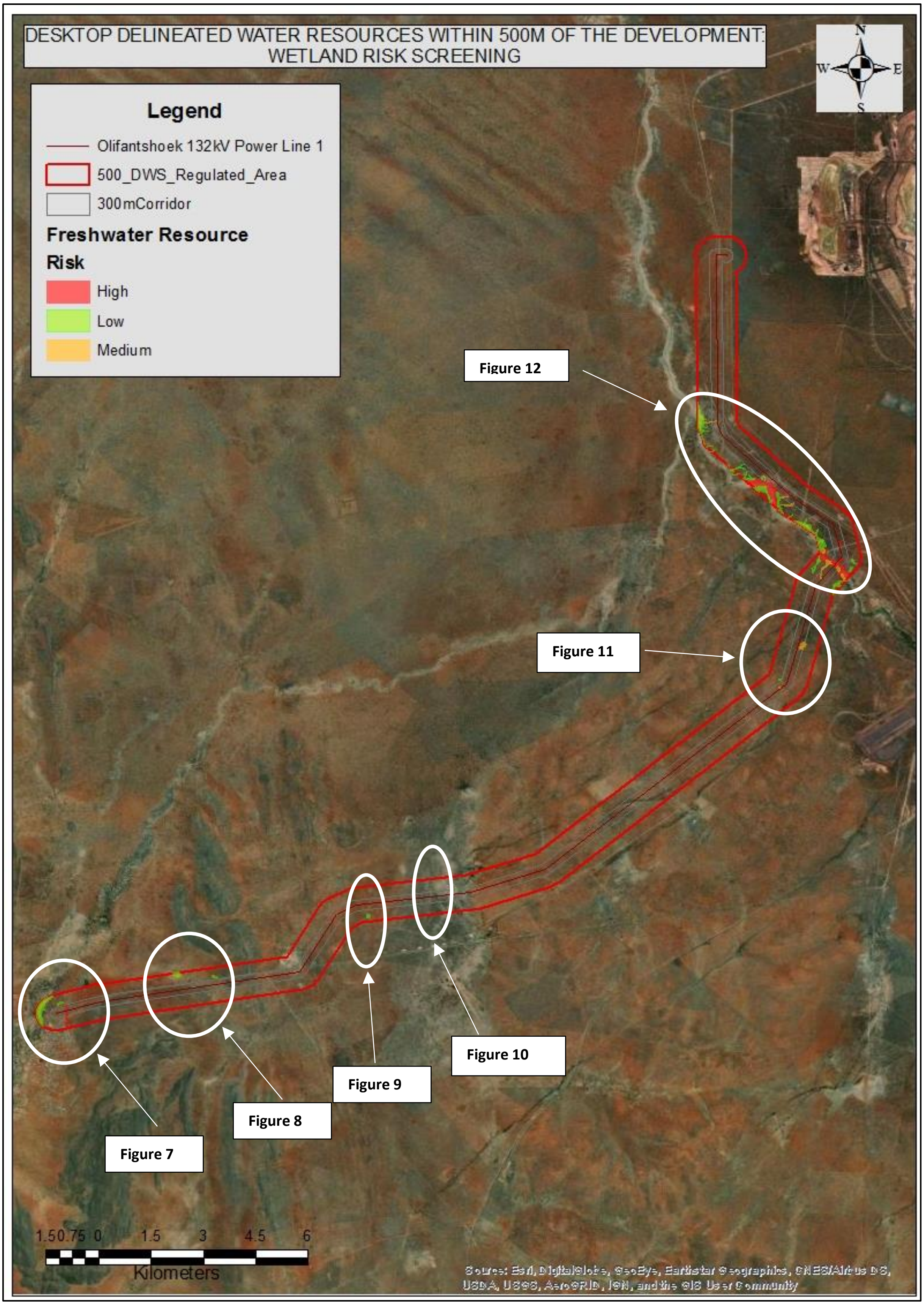

Figure 6: Desktop delineated wetlands and watercourses within 500m of the proposed development with risk screening ratings.

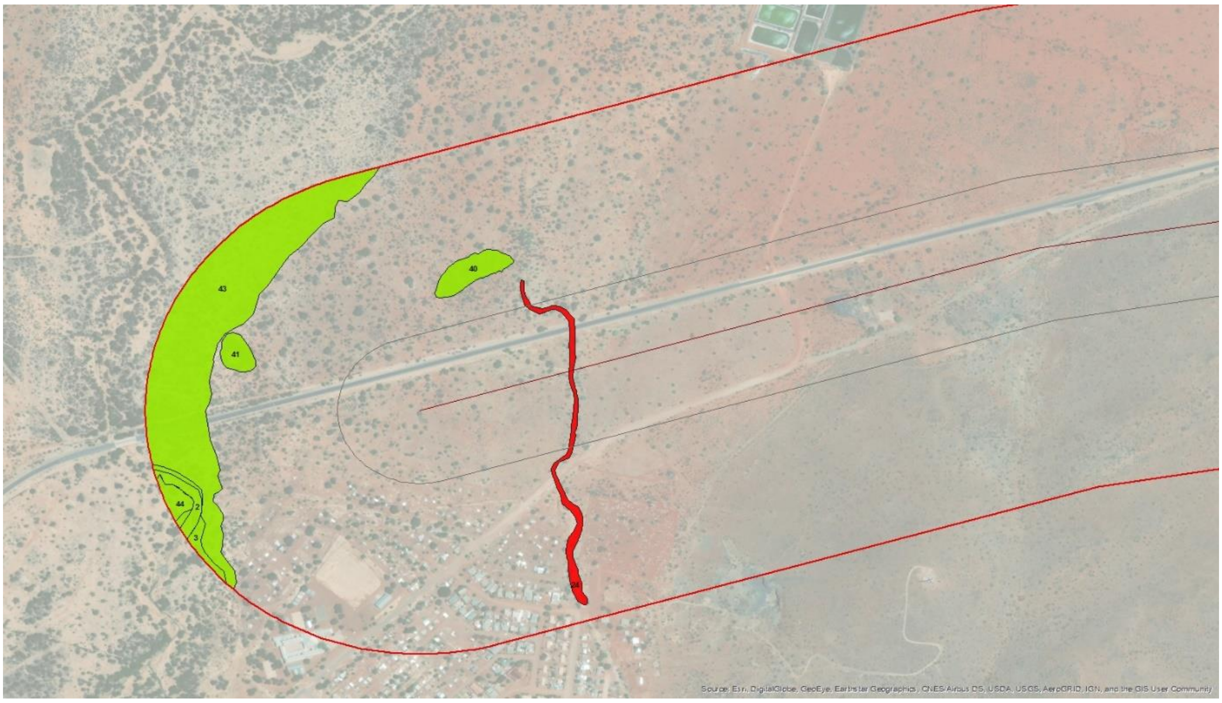

Figure 7: Desktop delineated wetlands and watercourses located within the southern portion of the project site.

Figure 8: Desktop delineated depressions located within the southern portion of the grid connection corridor

Figure 9: Desktop delineated depression located north of the N14 national road.

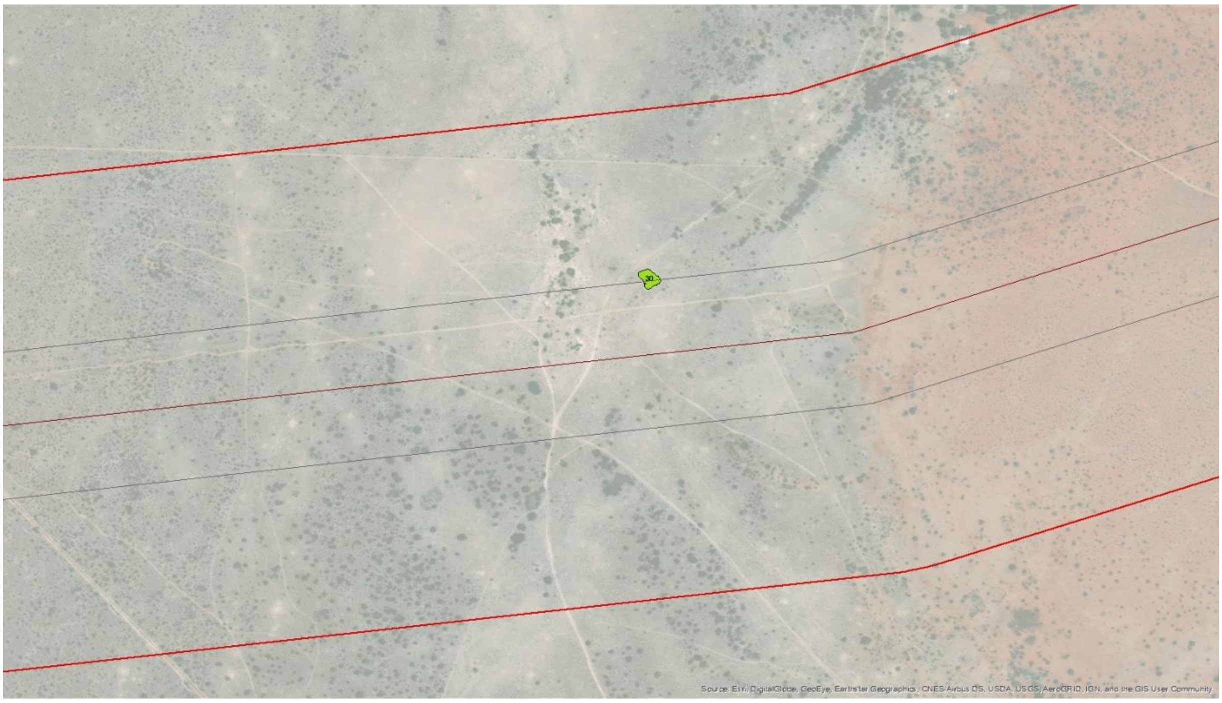

Figure 10: Desktop delineated depression located within the midsection of the power line route.

Figure 11: Desktop delineated depressions located just south of the Ga-Mogara River crossing.

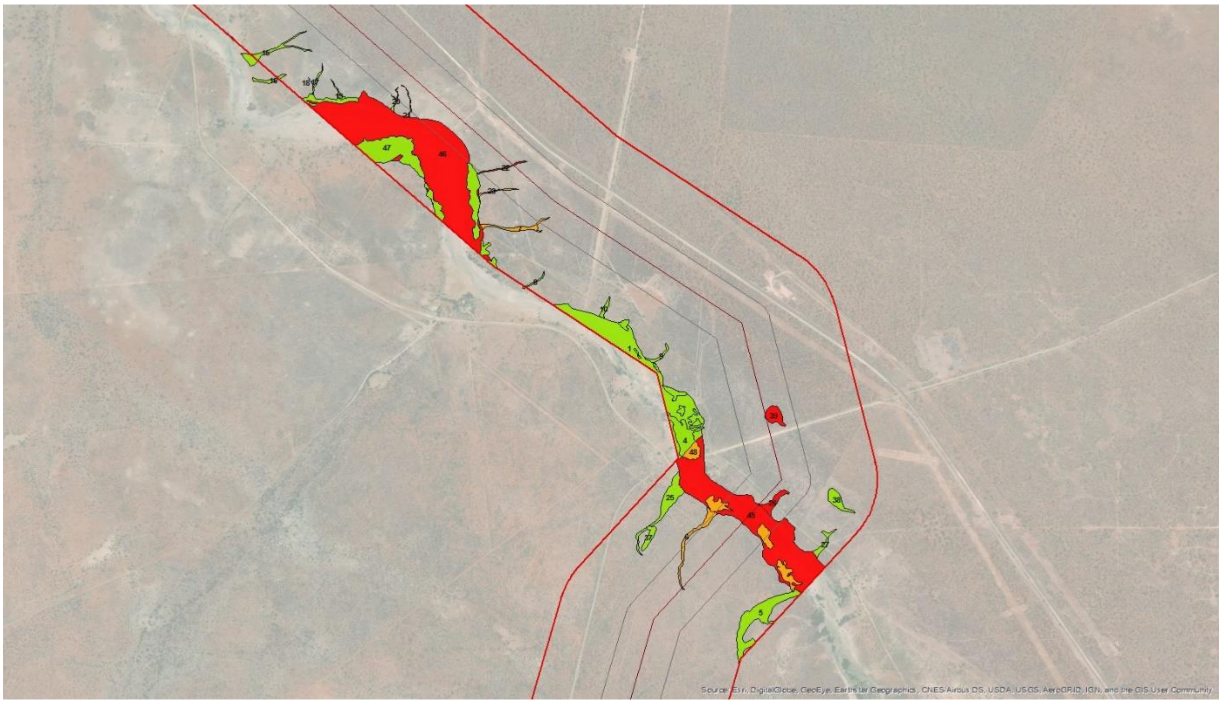

Figure 12: Desktop delineated depressions and watercourses located within the northern section of the power line route.

Classification, Delineation, and Description of High and Medium Risk Water Resources.

Ga-Mogara Non-Perennial Watercourse and Riparian Fringe (Power Line Crossing Point)

The Ga-Mogara River is a non-perennial or ephemeral system (88.037km long) which originates as smaller tributaries within the Asbestos Mountains north-east of the town of Danielskuil and flows in a north-western direction past smaller settlements as well as the southern portion of the Sishen mining area (Dingelton) to finally flow into the Kuruman River (also non-perennial) near Hotazel.

The Ga-Mogara River is the most prominent hydrological feature within the region. The reach section surveyed was comprised of a relatively well-defined river channel and bank. The Ga-Mogara River is moderately broad (±131m) in this section comprising of a channel with regular micro typographical variations.

A small, narrow low flow section (low flow channel) is located approximately in the middle of the channel and is likely episodically inundated with shallow water following sufficient rainfall events. However, inundation does not last for long periods. This, lower-lying area is covered by moisture-loving grasses and sedges such as *Juncus rigidus, Cyperus longus* var. *tenuiflorus* and *Panicum coloratum* as well as forbs such as *Helichrysum aureonitens* and *Stachys spathulata.*

This narrow lower-lying section is fringed by fairly broad marginal areas which will only be inundated during years of abnormally high rainfall events. These areas are characterized by grasses and forbs and are extensively grazed by livestock and game, especially during the dry seasons. Some small-scale cultivation also occurs within these zones. This zone of the Ga-Mogara River is subsequently extensively utilized and is in most areas in a degraded state. Key species of this zone include *Cynodon dactylon, Panicum coloratum, Tribulus terrestris, Eragrostis trichophora, Eragrostis echinochloidea, E. truncata, Salvia runcinata,* and *Pentzia calcarea.* Towards the outer edges of the marginal zone shrubs and dwarf shrubs such as *Vachellia hebeclada, Felicia muricata, Selago dinteri,* and *Lycium cinerium* becomes more prominent.

Both the low flow microchannel and the marginal zone comprise relatively deep sandy loam soils with slightly higher clay and silt content.

Within the upper zone, the soil thins out slightly exposing calcretes and other rock types in certain localities. This zone contains a mixture of graminoids, forbs, and dwarf shrubs including *Eragrostis echinocloidea, E. truncate, E. trichophora, Cynodon dactylon, Felicia muricata, Vachellia hebeclada, Selago dinteri, Lycium cinerium, Pentzia calcarea, Nolettia* *ciliaris, Urochloa oligotricha, Chrysocom ciliata,* and *Nidorella spp.* Shrubby forms of *Vachellia karroo* are also found scattered within this zone. Also, found within the outer boundary *of the watercourse where the geophytes; Nerine laticoma, and Crinum foetidum.*

Patches of tall, dense Vachellia woodlands are found along the Ga-Mogara River and comprise of tall trees such as *Vachellia karroo, V. erioloba, and Ziziphus mucronata.* The forb layer is strongly influenced by the nature of the tree canopy. Where the tree canopy is more open, grasses such as *Eragrostis echinocloidea, Enneapogon desvauxii, Eragrostis lehmanniana, Setaria verticillata,* and *Sporobolus fimbriatus* are more prominent. Riparian woodlands with a denser canopy contain an herb layer represented with a higher diversity of forbs such as *Acharanthes aspera, Pupalia lappacea, Pavonia burchelli, Melhania virescens* and *Sida cordifolia* as well as the shrub *Asparagus exuvialis and Asparagus cooperi.*

The Present Ecological State scores (PES) for this portion of the watercourse and associated riparian fringe were rated as C (Moderately Modified) due to activities associated upstream which have sufficiently modified the hydrology and geohydrology of the system downstream, as described above.

Ecological Importance and Sensitivity for this section of the Ga-Mogara River can be summarised as follows:

Conservation status	» High » Relatively high diversity, presence of keystone species/individual trees » Niche habitats » Some species restricted to these areas
Ecosystem function	» Absorption and reduction of occasional flash floods. » Important corridor for abiotic and biotic material transfer, as well as for wildlife. » Keystone species maintain habitat and create specific microhabitats for a multitude of organisms. » Large *Acacia erioloba* (Camelthorn) provide nesting space. » Dense herbaceous vegetation helps slow down floods, 'catch' sediments and retain nutrients. » Vegetation filters out possible pollutants to prevent their discharge into the Orange River. » A permanent vegetation cover is necessary to maintain the functionality and stability of this ecosystem

Stability	» Medium to high if habitat is kept intact, despite the potential effect of occasional flash floods » Excessive erosion, loss of seed resources, high undesirable invisibility and slow regeneration of natural vegetation will result from clearing this vegetation
Reversibility of degradation	» Limited, slow and will be subject to high inputs of erosion control and invasive species management
Levels of acceptable Change	» Acceptable change within channel habitat may only include vegetation disturbance within the immediate footprint area and servitude. An absolute minimal loss of riparian habitat should be allowed with clearing allowed underneath the power line where these species may interfere with the operation of the power line. No pylons may be placed within the riparian habitat as well as within the channel and subsequently, no habitat loss may be allowed due to such placement. No vegetation disturbance may be allowed due to the construction of the new service road if there is a possibility of utilising the existing service roads. No morphological change of the channel may be allowed due to erosion and no change in the quality of surface water may be allowed due to an increase in sediments and potentially hazardous chemicals and pollutants.
Rating	» ***High sensitivity***

Site Photos

Photo 1: Lower lying area inundated with water.

Photo 2: Transition from the marginal to the upper zone of the channel.

Photo 3: Dense thicket type of *Acacia karroo* riparian fringe

Photo 4: Trampled (by cattle) and overgrazed section of the marginal zone

Small depression wetlands

The only natural wetlands in the project area (within the 500m radius around the proposed development) are small, endorheic (closed depressions) pans.

These depressions form due to micro-topography variations of the underlying substrates (shallower soils over calcrete), giving rise to low grasslands on pan bottoms (may even be devoid of vegetation). The outer belt of these pans comprises of a mixture of tall shrubs and trees. The pan-like alluvium consists of sandy loam with a fairly high content of calcium and phosphate. The pan soils consist of white (washed) sand and are exposed for most of the year and carry shallow pools for a short period following sufficient rains.

These depressions are characterised by a low growing vegetation layer, mainly grasses and dwarf shrubs such as *Cynodon dactylon, Panicum coloratum, Aristida congesta, A. adscensionis, Enneapogon desvauxii, Eragrostis echinochloidea, E. lehmanniana,* *Chrysocoma ciliata, Pentzia ciliata, and Persicaria serrulata*. These grassy depressions are typically surrounded by a fringe of small to medium-sized trees such as *Vachellia karroo, Senegalia mellifera, Ziziphus mucronata, Grewia flava,* and *Diospyros lycioides*.

Most of these depressions are still largely natural. Some of these depressions contain low gravel obstructions which were constructed in an attempt to contain the surface water for long periods following rainfall events although these structures have not greatly affected the functioning and character of the wetlands.

The Present Ecological State scores (PES) for these depression wetlands were rated as B (Largely Natural) with small modifications due to the obstructions and farm roads traversing some of these depressions.

Ecological Importance and Sensitivity of the depression wetlands can be summarised as follows:

Conservation status	» High » Niche habitats » Some species restricted to these areas
Ecosystem function	» Collection and retention of runoff and associated resources after large rainfall events. » Seasonal preferential grazing » Niche habitat ensures the persistence of organisms and provides seasonal water and food to migrating fauna. » Larger shrubs and small trees on the periphery provide nesting space for birds and shelter/breeding areas for fauna.
Stability	» High if habitat is kept intact, despite very variable seasonal herb cover » Loss of functionality will result from clearing this vegetation and altering the surface » Easily invaded by weeds and alien invasive species » Cover may vary significantly from one year to the next » Easily degraded by excessive trampling and overgrazing
Reversibility of degradation	» The rehabilitation of the herb layer will only be possible if the existing microtopography and topsoil characteristics of this and the immediately surrounding environment is maintained
Levels of acceptable Change	» Most of these wetlands are situated within the outer fringes of the proposed grid connection corridor and subsequently can be left intact. Subsequently, no change in the morphology and vegetation structure of these

depressions and their associated vegetation, including the shrubby periphery of these wetlands, should be allowed.

Rating	» ***High***

Site Photos	
 **Photo 5**: Small depression with very sparse vegetation cover	 **Photo 6:** Larger depression wetland with a relative tail woody periphery.
 **Photo 7:** Larger depression wetland with a relative tail woody periphery.	 **Photo 8:** Larger depression wetland with a relative tail woody periphery.

7. FINDINGS OF THE TERRESTRIAL BIODIVERSITY BASELINE ASSESSMENT

Terrestrial Habitats

In this section, the different habitats and vegetation patterns observed within the study site are described. As these are field-based observations taken directly from the site, they are of greater reliability and pertinence than the results of the National Vegetation Map which is at a coarse scale and does not represent the detail of the site adequately. The habitat map derived for the study site is provided in Figures 13 -14 and their sensitivity ratings are provided in Figure 15.

The most important ecological drivers responsible for habitat diversity within the project site are geology, edaphic, and moisture. Smaller variations within theses habitat types are a result of biotic influences such as grazing and land use.

Depth of soil, soil texture, and underlying geology are the main ecological drivers responsible for variations in the grass to woody plants and shrub to tree interactions. The broad, major terrestrial habitats were defined according to the classification of Savanna types as described by Scholes & Archer (1997) and comprised of:

» Tree Savanna:

These savannas occupy deep, red, sandy to sandy-loam soils found within the southern and northern portions of the project site and comprise of an open, medium-tall woody component (*Vachellia erioloba, Vachellia tortilis, and Ziziphus mucronata*). Small trees and shrubs are also co-dominant characterised by *Trachonanthus camphoratus, Senegalia mellifera, Grewia flava,* and *Boscia albitrunca*. The herb layer has been significantly impacted by the drought of the previous years and is relatively sparse and dominated by a relatively high diversity of forbs as well as *Stipagorstis uniplumis*. The density of the grass cover can also be related to grazing intensity with grass cover decreasing as grazing intensity increases. Key/diagnostic species of the herbaceous layer includes *Senna italica, Tribulus terrestris, Tallinum caffrum, T. crispatulum, Melhania prostrata, Pentzia incana, P. calcarea, Kyphocarpa angustifolia, Indigofera daleoides, I. holubii, Justicia divaricate, Gnidia capitate, Kohautia caespitose, Oxygonum delagoense, Eragrostis lehmanniana, Tragus racemosus, Aristida congesta* and *Eragrostis echinochloidea*.

Eight vegetation units have been identified within this savannah type namely:

a. *Stipagrostis uniplumis – Vachellia erioloba* open tree savannah:
   This unit occurs on deep sandy soils within the southern portion of the project site and is characterized by a medium tall, open tree layer with some minor variations in the dominant small tree/shrub layer. Sub-vegetation units can be distinguished according to the dominant/diagnostic species within the layer.

   - The *Boscia albitrunca* sub-unit is found within the southernmost portion of the project site, closest to the town of Olifantshoek. This sub-unit has been subjected to severe grazing pressure which has impacted the density of grasses, resulting in a sparse herbaceous layer dominated by a relatively high diversity of forbs.

This sub-unit is regarded as **Medium Sensitive** due to the fairly natural state as well as the presence of conservation important plant populations (*Boscia albitrunca, Vachellia erioloba, Boophone disticha,* and *Tridentea* spp.) However, these species have a relatively wide distribution range within the region and the proposed development will not pose a threat to the local populations as well as the status of these species.

- The *Vachellia haematoxylong* sub-unit is located within a deep sandy, low lying area between two ridges and contains a much less disturbed herbaceous layer with a dense cover of especially *Stipagrostis uniplumis*.

  This sub-unit is regarded as **Medium Sensitive** due to the fairly natural state, as well as the presence of conservation important plant populations (*Boscia albitrunca, Vachellia erioloba, V. haematoxylon. Boophone disticha* and *Tridentea* spp.) However, these species have a relatively wide distribution range within the region and the proposed development will not pose a threat to the local populations as well as the status of these species.

- The *Trachonanthus camphoratus* sub-unit occurs as patches of open woodland, throughout the project site and especially within deep sandy pockets within the shrubland savanna.

  This sub-unit is regarded as **Medium Sensitive** due to the fairly natural state, as well as the presence of conservation important plant populations (*Boscia albitrunca, Vachellia erioloba, and Boophone disticha*). However, these species have a relatively wide distribution range within the region and the proposed development will not pose a threat to the local populations as well as the status of these species.

b. *Stipagrostis uniplumis – Vachellia tortillis* open tree savannah:
This unit occurs between the N14 national road and the exposed calcrete bed and is found on sandy-loam soils. This unit is characterised by a taller tree component (*Vachellia tortillis and V. erioloba*) and a well-developed shrub layer (*Trachonanthus camphoratus, Senegalia mellifera, and Grewia flava*). Again this vegetation unit can be further classified into two sub-units according to the dominant shrub.

- The *Vachellia erioloba* sub-unit contains fairly large specimens *of V. erioloba* which may be equally as dominant as *V. tortillis*.

  This sub-unit is regarded as **Medium Sensitive** due to the fairly natural state, as well as the presence of conservation important plant populations (*Boscia* *albitrunca* and *Vachellia erioloba*). However, these species have a relatively wide distribution range within the region and the proposed development will not pose a threat to the local populations as well as the status of these species.

- The *Trachonanthus camphoratus* sub-unit contains a lower cover of *V. erioloba* with *T. camphoratus* becoming quite dense.

  This sub-unit is regarded as **Medium Sensitive** due to the fairly natural state, as well as the presence of conservation important plant populations (*Boscia albitrunca* and *Vachellia erioloba*). However, these species have a relatively wide distribution range within the region and the proposed development will not pose a threat to the local populations as well as the status of these species.

c. *Senegalia mellifera – Vachellia tortillis* tree savannah:
This unit is quite similar in structure to the *S. uniplumis – V. tortillis – T. camphoratus* unit, however, the shrub unit is dominanted by a relative dense cover of S. mellifera. This unit is found just north and south of the N14 route and the dense coverage of S*. mellifera* has reduced the grazing potential of this unit when compared to the other *V. tortillis* units.

This vegetation unit has been classified as **Low Sensitive** due to the degree of degradation associated with this area and the fact that species of conservation importance (*Boscia albitrunca, Vachellia erioloba)* occur at very low densities and impact on these populations are likely to be very low.

d. *Tribulus terrestris – V. erioloba* tree savannah:
Between the Emil switching station and the Dibeng road, there are some previously cleared areas that were apparently used for centre pivot agriculture. These have since been abandoned and with a lot of young Vachellia erioloba trees have recruited in this area.

The overall sensitivity of this area is considered fairly low on account of the previous transformation. However, the recruitment of significant numbers of *Vachellia erioloba* in this area increases the sensitivity to **Medium Sensitive**, as a result of the protected status of *V. erioloba*.

e. *Vachellia erioloba – Trachonanthus camphoratus* tree savannah:
This vegetation unit is found on deep red sandy soils within the northern portion of the project site and comprises of numerous medium-tall *V. erioloba* specimens and a well-developed shrub layer dominated by *T. camphoratus*.

Due to the significant numbers of *Vachellia erioloba* in this area the sensitivity to **Medium Sensitive**, as a result of the protected status of *V. erioloba*.

f. *Trachonanthus camphoratus – Ziziphus mucronata* tree savannah:
   This vegetation unit occupies the deeper sandy pockets found within the exposed calcrete bed (central portion of the project site) and is characterized by an open medium-tall tree layer dominated by *Z. mucronata*. The herbaceous layer has been significantly impacted by the drought and overgrazing and is dominated by dwarf, karroid type shrubs.

   This sub-unit has been classified as **Low Sensitive** due to the degree of degradation associated with this area and the fact that species of conservation importance (*Vachellia erioloba)* occur at very low densities and impact on these populations are likely to be very low.

The following two Tree Savanna vegetation units are associated with small drainage systems, draining surface water from the higher-lying areas into the Ga-Mogara-River.

Both of these vegetation units are considered to be **Medium Sensitivity** and may only contain surface water for a very limited and short period during exceptional rainfall events (however this is very unpredictable). These drainage systems and their associated vegetation are responsible for the accumulation and filtering of runoff before the water enters the larger intermittent streams.

g. *Senegalia mellifera – Vachellia karoo* tree savannah:
   This vegetation unit occupies drainage systems characterized by shallower, rockier soils. The tree layer is relatively low within the upper portions of these drainage lines but increases in height towards the lower portions where the soils tend to become deeper and less rocky. *Senegalia mellifera* my form relative dense stands in some locations

h. *Ziziphus mucronata – Vachellia erioloba* tree savannah:
   This vegetation unit occupies drainage systems characterized by deeper sandy soils and is characterized by a moderately tall tree layer comprising *of Z. mucronata, V. erioloba,* and *Vachellia karroo*.

Site Photos

Photo 9: Recruitment of *V. erioloba* within the historically ploughed area

Photo 10: *V. erioloba* tree savanna within the northern portion of the projects site comprising of medium-tall trees.

Photo 11: *Vachellia tortillis* Tree Savanna comprising of medium to tall *V. tortillis* and *V. erioloba* specimens.

Photo 12: Deep sandy drainage line comprsing of medium-tall *V. erioloba, Z. mucronata, and V. karroo* specimens.

Photo 13: A fairly large specimen of *B. albitrunca*

Photo 14: *Vachellia haematoxylon*

» <u>Savanna Shrubland:</u>

The shrubland savanna occurs on rocky ridges and hills or where the reddish sand becomes thinned out exposing rock beds. The type of geology and soil depth determines the composition and structure of this savanna type. Large trees are mostly absent from these areas or are scattered as singular species. The shrub layer is typically between 1.7m and 2.5m. Key shrub species include *Senegalia mellifera, Trachonanthus camphoratus, Grewia flava,* and *Rhigozum tricotomum*.

Five vegetation units have been identified within this savannah type namely:

a. *Euphorbia mauritanica – Senegalia mellifera* Shrubland Savanna:

This unit occupies the outcrops (mostly andesitic lava and chert outcrops) located south of the N14 national road. This unit is characterised by an open shrubland, with *Senegalia mellifera* being the dominant shrub species. Dwarf shrubs and succulents are also well represented within this vegetation unit. Key species include; *A. mellifera, Grewia flava, Ehretia rigida, Searsia tridactyla, Euclea undulata, Asparagus laricinus, Rhigozum tricotomum, Aloe hereroensis, A. grandidentata, Euphorbia mauritanica, Hermannia erodioides, H. tomentosa, Sida spp., Gisekia spp., Stipagrostis uniplumis, Eragrostis nindensis,* and *Stipagrostis obtusa*.

This vegetation unit has been rated as having a **Medium Sensitivity** as these rocky ridges and outcrops contribute to habitat, niche, and species diversity and act as fauna refuge areas, aided by surrounding savanna plains with sources of food. Furthermore, these areas contain conservation important plant populations (*Boscia albitrunca, Euphorbia mauritanica, Ruscia cradockensis, Aloe hereroensis,* and *A. grandidentata*). However, these species have a relatively wide distribution range within the region and the proposed development will not pose a threat to the local populations as well as the status of these species. Disturbance to these rocky areas should be limited, and the destruction of outcrops avoided as far as possible. This can be effectively achieved by located the proposed power line as close as possible to the existing access road and the existing power line.

b. *Rhigozum tricotomum – Senegalia mellifera* Shrubland Savanna:

This vegetation unit occupies shallow gritty soils, typically overlying andesitic lava, brown quartz and chert. This is a species-poor unit and is dominated by dense stands of *S. mellifera*. Shrubs are also usually not higher than 1.5m, with trees mostly absent from this unit. *S. mellifera* forms a relatively dense canopy. The herbaceous layer is sparse and mostly comprise of forbs. Keys species include *S. mellifera, R. tricotomum, Trachonanthus camphoratus, Corbichonia decumbens, Boerhavia diffusa, Enneapogon desvauxii, E. scoparius, Oropetium capense,* and *Aristida congesta*.

This savanna shrubland is considered to be of **Low Sensitivity** as this habitat type contain very few listed or protected species and the significance of impacts on vegetation within these areas is likely to be relatively low.

c. *Trachonanthus camphoratus – Senegalia mellifera* Shrubland Savanna
and

d. *Senegalia mellifara Trachonathus camphoratus Shrubland Savanna:*

These two vegetation units are similar in species composition however, the dominant shrub is different, with the one unit dominated by a dense *S. mellifera* cover whilst the other unit is slightly more open and is dominated by *Trachonathus camphoratus*. *T. camphoratus – S. mellifera* unit tends to occupy slightly grittier soils whilst *the S. mellifera – T. camphoratus* unit is located in slightly deeper soils with less grit.

The *T. camphoratus – S. mellifera* shrubland is considered to be of **Low Sensitivity** as this habitat type contain very few listed or protected species and the significance of impacts on vegetation within these areas is likely to be relatively low. On the other hand, the *S. mellifera – T. camphoratus* shrubland has been classified as **Medium Sensitive** as this vegetation unit contains a few scattered *Vachellia erioloba* specimens and provide more grazing capability to game.

e. *Eragrosis nindensis – Trachonanthus camporatus* Shrubland Savanna:
This vegetation unit occupies the transitional land between the exposed calcrete bed and the deeper sandy-loam soils dominated by tall tree species.

This shrubland is considered to be of **Low Sensitivity** as this habitat type contain very few listed or protected species and the significance of impacts on vegetation within these areas is likely to be relatively low.

Site Photos	
 **Photo 15**: Open shrubland savanna dominated by *Senegalia mellifera*	 **Photo 16:** Dense shrubland savannah
 **Photo 17:** *Open shrubland savannah dominated by Trachonanthus camphoratus*	 **Photo 18:** Shrubland Savanna with relative tall *T. camphoratus* specimens

Photo 19: Very dense *S. mellifera* shrubland

Photo 20: Andesitic lava outcrop

» Savanna Woodland:

This savannah type comprises of a tall woody component with a light canopy. Such woodlands are associated with deep sandy pockets surrounded by shrubland savannah and the riparian patches associated with the Ga-Mogara River as well as the tree fringes around the larger depression wetlands.

Three vegetation units have been identified. As the savannah woodlands associated with the riparian patches of the Ga-Mogara River as well as the peripheries of the depression wetlands have already been discussed within the surface hydrological section, these vegetation units will not be discussed below:

a. *Trachonanthus camphoratus – Vachellia erioloba* Woodland Savanna:
This unit occupies deep sandy pockets surrounded by savannah shrublands and is characterised by tall tree species such as *Vachellia erioloba, V. karroo,* and *Ziziphus mucronata*. When compared to the other units within this savannah type this vegetation type contain a more open canopy allowing for the persistence a fairly dense shrub layer characterised by *T. camphoratus.*

This vegetation unit has been rated as having a **Medium Sensitivity** as these tall woodlands contribute to habitat, niche, and species diversity and act as fauna refuge areas, aided by surrounding savanna plains with sources of food. Furthermore, these areas contain large specimens of *Vachellia erioloba*. However, these species have a relatively wide distribution range within the region and the proposed development will not pose a threat to the local populations as well as the status of these species. Disturbance to these areas should be avoided as far as possible.

b. *Lycium bosciifolium – Ziziphus Mucronata* Woodland Savanna:
This woodland savannah type is associated with the peripheries of larger pan depression wetlands. Refer to the surface hydrological section for a description of this vegetation type.

This vegetation unit is considered to have high conservation value as these peripheral fringes create microhabitats, facilitating the persistence of other plants as well as fauna. Furthermore, this area contributes to habitat, niche, and species diversity and adds to the resilience of the system and supports pollinator populations during different seasons. Large shrubs and trees provide preferred nesting sites. Due to these contributing factors, this vegetation unit has been classified as **High Sensitivit**y. These depression wetlands with their peripheral fall outside of the power line route but some wetlands are located within the 300m corridor. These areas should be regarded as **No-Go** areas.

c. *Ziziphus mucronata – Vachellia karroo* Woodland Savanna:

This woodland savannah type represents the riparian fringes of the Ga-Mogara River. Refer to the surface hydrological section for a description of this vegetation type.

This vegetation unit is considered to have high conservation value as riparian fringes create microhabitats, facilitating the persistence of other plants as well as fauna. Furthermore, this area contributes to habitat, niche, and species diversity and adds to the resilience of the system and supports pollinator populations during different seasons. Large shrubs and trees provide preferred nesting sites. Due to these contributing factors, this vegetation unit has been classified as **High Sensitivity**. These riparian patches fall outside of the power line route, but some patches are located within the 300m grid connection corridor. These areas should be regarded as **No-Go** areas.

<table>
<tr><th colspan="2">Site Photos</th></tr>
<tr><td colspan="2">
Photo 21: Woodland savanna associated with deeper sand pockets surrounding by shrubland savanna</td></tr>
<tr><td>
Photo 22: Densely wooded periphery associated with one of the larger depression wetlands</td><td>
Photo 23: A more open woodland savanna</td></tr>
</table>

» Dwarf-Shrubland Savanna:

This savannah type is located on exposed calcrete bedrock and has been significantly degraded through overstocking and overgrazing and has resulted in the encroachment of dwarf, karroid shrubs. The tree layer is very open with scattered medium-sized tree species, mostly *Ziziphus mucronata*. Small-scale clustering of these trees with shrubs such as *Trachonanthus camphoratus, Diospyros lycioides*, and the invasive alien tree, *Prosopis glandulosa* are also a common feature. As mentioned, the herbaceous layer has been significantly transformed and is characterized by a low cover of grasses and a high cover of karroid types dwarf shrubs such as *Lycium cinereum, Pentzia incana, P. calcarea, Pteronia glauca,* and *Hirpicium echinus*. Forbs recorded within this unit include; *Tribulus terrestris, Kohautia caespitose, Limeum sulcatum,* and *Indigofera daleoides*.

This shrubland is considered to be of **Low Sensitivity** as this habitat type is in a relative degraded state and contains very few listed or protected species and the significance of impacts on vegetation within these areas is likely to be relatively low.

Site Photos	
 Photo 24: *Prosopus glandulosa*	 Photo 25: Dwarf-shrubland savanna

Photo 26: Dwarf-shrubland savanna

» <u>Moist Grassland Savanna:</u>

This grassland is associated with ephemeral water resources (depression wetlands and ephemeral rivers) and tree and shrub species are almost absent from these areas apart from a few lonely *V. karroo* and *Z. mucronata* specimens that can be found within these areas. These open grassland systems are valuable resources, especially as winter grazing, and is subsequently subjected to severe grazing pressure during the dry seasons. Some of these areas have also been transformed into cultivation. Two vegetation units have been identified and as these units have been discussed within the surface hydrological section; therefore, these vegetation units will not be discussed below. Furthermore, these vegetation units have been classified as **High Sensitive**. Refer to the surface hydrology section for an explanation of the sensitivity classification and development recommendations.

The vegetation units identified within this savanna type are:

a. *Cynodon dactylon – Panicum coloratum* depression wetlands:

b. _*Eragrostis echinochloidea – Panicum coloratum*_ _Ga-Mogara River Bed_

Species of Conservation Concern

Species of conservation concern are species of flora (plants) and fauna (animals) that have high conservation importance in terms of preserving South Africa's high biological diversity and include not only threatened species that have been classified as 'at high risk of extinction in the wild' (i.e. Critically Endangered (CR), Endangered (EN), Vulnerable (VU) but also those classified in the categories Near Threatened (NT)), Critically Rare, Rare, Declining and Data Deficient. Protected species are listed in international conventions, national acts, and provincial ordinances that regulate activities such as the hunting, collection, and trade of species. If a sub-population of a species of conservation concern is found to occur on a proposed development site, it would be one indicator that development activities could result in significant loss of biodiversity, bearing in mind that loss of sub-populations of these species will either increase their extinction risk or may contribute to their extinction

Flora of conservation significance

As previously mentioned, a species list was obtained from the SANBI database (POSA) for the study area and surrounding environment. According to this list, a total of 3 red data species and 59 protected plant species is known to occur in the broad area surrounding the site.

During the site survey, no listed Red Data floral species were recorded within the surveyed site. A total of 11 species were however recorded which are protected within either the National Forest Act or within the Northern Cape Nature Conservation Act. Refer to the table below for a list of these species.

The most likely species to be impacted is *Vachellia erioloba*, especially where these species occur in large densities. It is unlikely that *Boscia albitrunca* and *Vachellia haematoxylon* will be impacted by the development as these species are mostly restricted to the southern portion of this unit where they occur in relatively low densities and make avoidance of these species possible

Table 6: Conservation Important Flora Species recorded within the surveyed site. National Forest Act (NFA), Northern Cape Nature Conservation Act (NCNCA).

SPECIES	GROWTH FORM	STATUS
Babiana hypogea	Geophytic herb	NCNCA
Boscia albitrunca	Small Tree	NFA, NCNCA
Boophone disticha	Geophytic herb	NCNCA
Crinum macowanii	Geophytic herb	NCNCA

Euphorbia mauritanica	Succulent Forb	NCNCA
Nerine laticoma	Geophytic herb	NCNCA
Ruscia cradockensis	Succulent Forb	NCNCA
Vachellia erioloba	Medium to large tree	NFA
Vachellia haematoxylon	Small Tree	NFA
Aloe hereroensis	Succulent Forb	NCNCA
Aloe grandidentata	Succulent Forb	NCNCA
Tridentea spp.	Succulent Forb	NCNCA

Site Photos

Photo 27: *Aloe hereroensis*

Photo 28: *Boophone disticha*

Photo 29: *Aloe grandidentata*

Photo 30: Seed pods of *Vachellia haematoxylon*

Photo 31: Seed pods of *Vachellia erioloba*

Photo 32: *Nerine laticoma*

Photo 33: *Boscia albitrunca*

Photo 34: *Tridentia spp.*

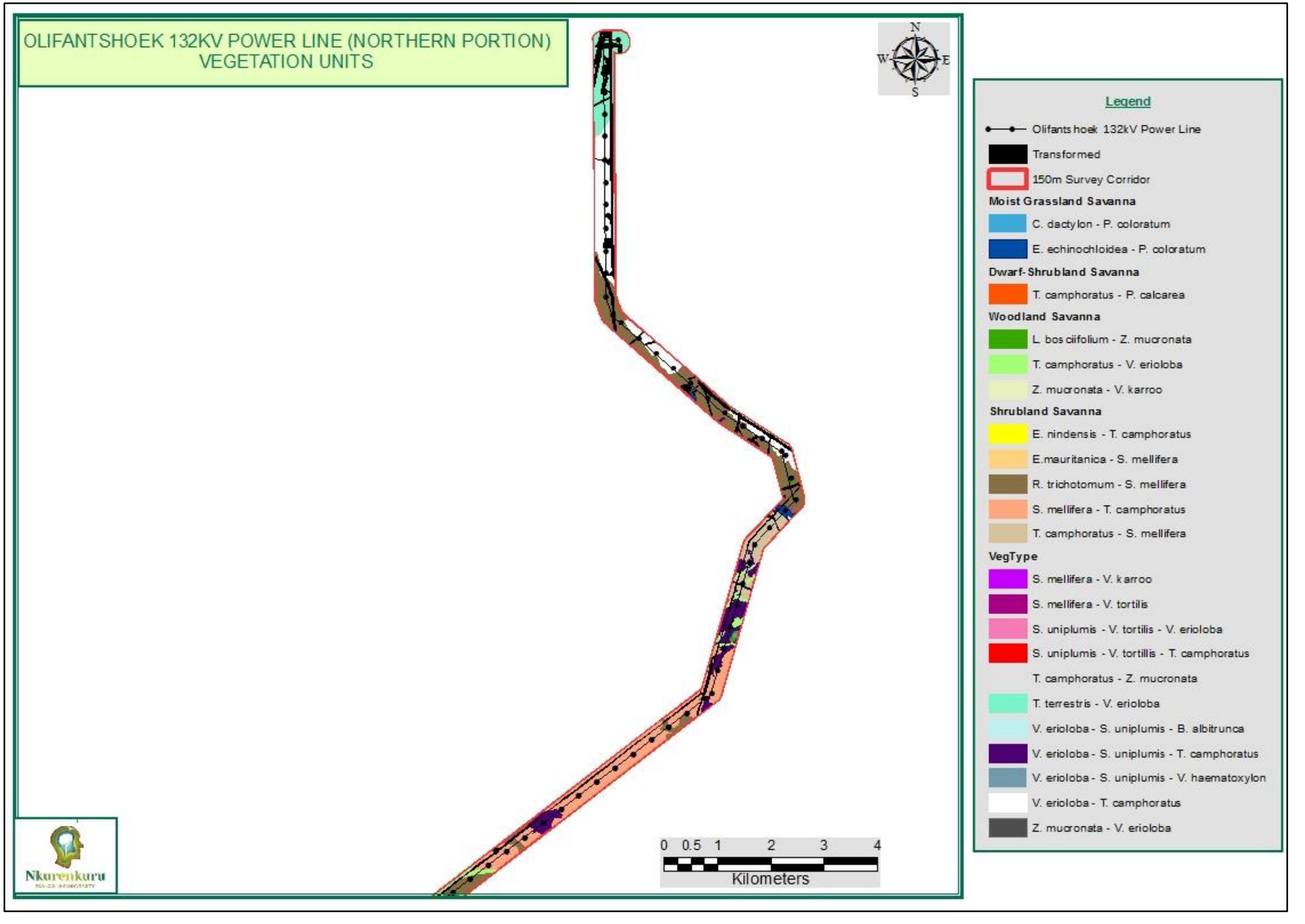

Figure 13: Map illustrating the vegetation units identified within the northern half of the power line route.

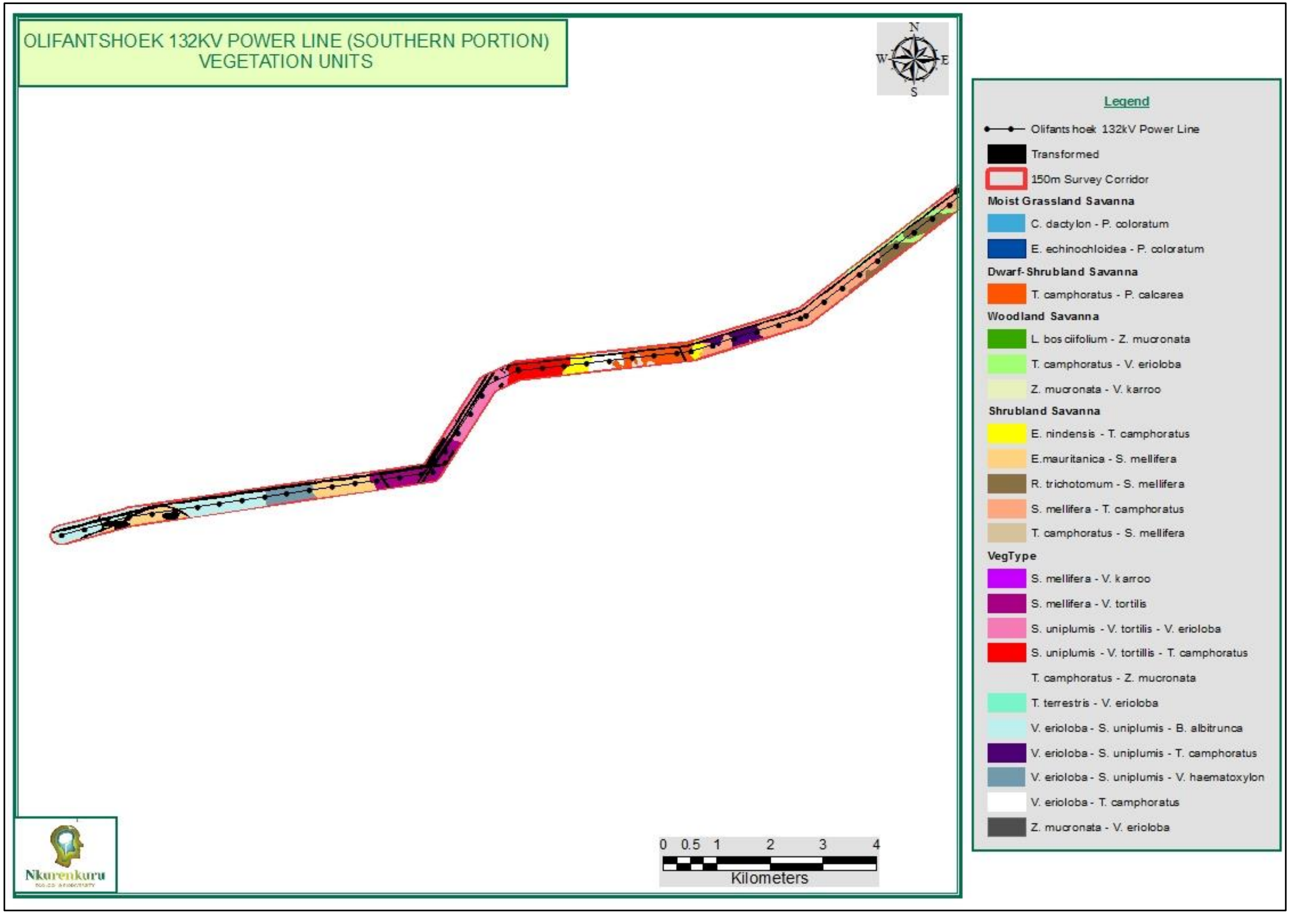

Figure 14: Map illustrating the vegetation units identified within the southern half of the power line route.

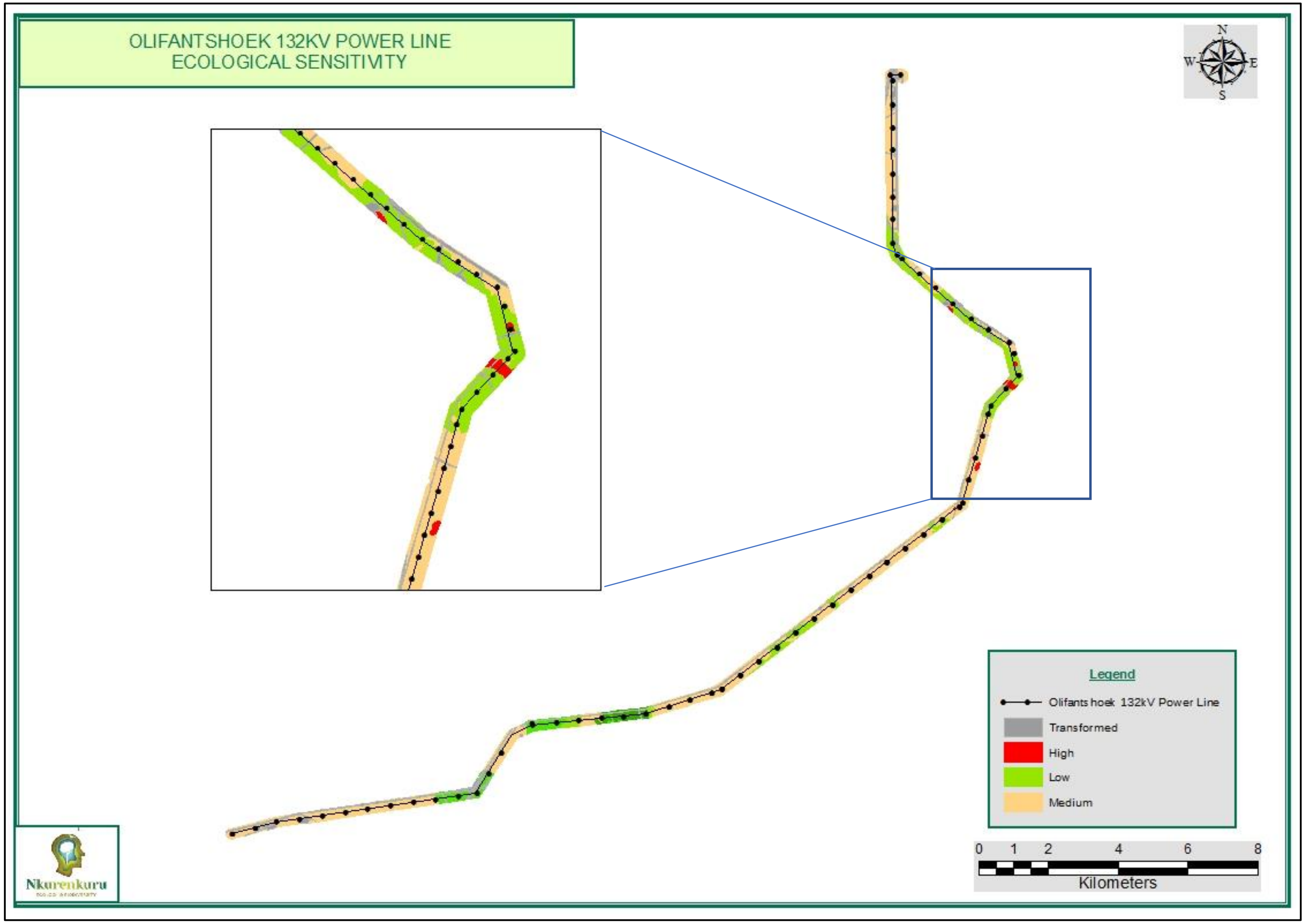

Figure 15: Map illustrating the Ecological Sensitivity of the grid connection corridor.

Faunal Communities

Reptiles and Amphibians

According to the SARCA, ADU data, and other literature approximately 37 reptile species are known to occur in the area, indicating that the potential reptilian diversity for the area is likely to be moderate.

As for amphibian diversity, 6 species are known from the area (historical records – SARC and ADU database). Due to the prevailing aridity of the area, amphibian abundance in the power line corridor is likely to below. However, depression wetlands and regular inundated sections of the Ga-Mogara River are regarded as important amphibian habitats. All depression habitats should be avoided and regarded as No-Go areas. Furthermore, no pylons may be placed within the channel of the Ga-Mogara River, and existing access routes should be utilized avoiding the creation of additional service routes within the Ga-Mogara River channel.

Species observed within the project site as well as the surrounding environment include:

- Rocky Outcrops: Western rock skink (*Mabuya sulcata*)
- Woodland- and Tree Savanna: Rock Monitor (*Varanus albigularis albigularis*), Spotted sandveld lizard (*Nucras intertexta*), Spotted sand lizard (*Padioplanis lineoocellata pulchella)*, Bushveld lizard (*Heliobolus lugubris*), Ground agama (*Agama aculeata*), Variable skink (*Mabuya varia*), Kalahari tree skink (*Mabuya spilogaster*)
- Shrubland Savanna: Bushveld lizard (*Heliobolus lugubris*), Spotted sand lizard (*Padioplanis lineoocellata pulchella)*
- Dwarf-Shrubland Savanna: Bushveld lizard (*Heliobolus lugubris*)
- Depression Wetlands: Marsh Terrain (*Pelomedusa subrufa*), Tandy's Sand Frog (*Tomopterna tandyi*)
- Ga-Mogara River: No observations

No species of conservation concern are known to occur in the area and impacts on reptiles and amphibians are likely to be restricted largely to minor habitat loss and disturbance within the development footprint. Potential impacts on reptiles are likely to be local in nature and restricted largely to the construction phase.

Site Photos

Photo 35: *Ground agama*

Photo 36: Plain Sand lizard

Photo 37: *Kalahari tree skink*

Photo 38: Bushveld Lizard

Photo 39: *Western rock skink (Male)*

Photo 40: Western rock skink (Female)

Mammals

The site falls within the distribution range of 49 terrestrial mammals, indicating that the mammalian diversity in the area is of moderate to high potential. Areas of specific significance for mammals are likely to be outcrops, depression wetlands, ephemeral watercourses, and associated riparian fringe. which provide greater cover as well as moisture and forage availability. The intervening veld is not considered highly sensitive from a faunal perspective as similar habitat is widely available in the area.

Several antelope species have been recorded by the ADU (Animal Demographic Unit) within the relevant Degree Grids. Most of these antelope species are confined by fences and occur only where farmers have introduced them or allow them to persist and should be considered as part of the farming system rather than as wildlife per se. Some of these South African indigenous antelope species do not have a natural distribution within the specific region; but as mentioned have been introduced by farmers. Antelope species that occur as natural (non-introduced) populations within the area are Steenbok (*Raphicerus campestris*), Common duiker (*Sylvicapra grimmia*) and to a lesser extent Kudu (*Tragelaphus strepsiceros*).

Species observed within the project site as well as the surrounding environment include:

» Rocky Outcrops: No observations
» Woodland- and Tree Savanna: Aardvark (*Orycteropus afer*), Damaraland mole rat (*Cryptomys damarensis*), Cape porcupine (*Hystrix africaeaustralis*), Slender mongoose (*Galerella sanguinea*), Steenbok (*Rhapicerus campestris*), Savanna Hare (*Lepus microtis*), Gerbil species (likely from the genus *Gerbilliscus*), Warthog (*Phacochoerus africanus*) Kudu (*Tragelaphus strepsiceros*), Ground Squirrel (Xerus inauris)
» Shrubland Savannah: Ground Squirrel (Xerus inauris), Springhare (*Pedetes capensis*), Yellow mongoose (*Cynictis penicillata*), Cape short-tailed gerbil (*Desmodillus auricularis*), Savanna Hare (*Lepus microtis*)
» Dwarf-Shrubland Savanna: Al species recorded within this habitat have been introduced - Plains zebra (*Equus quagga*), Giraffe (*Giraffa camelopardalis*) Blue wildebeest (*Connochaetes taurinus*), Red hartebeest (*Alcelaphus caama*), Blesbok (*Damaliscus pygargus phillipsi*)
» Depression Wetlands: Cape fox (*Vulpes chama*), Warthog (*Phacochoerus africanus*)
» Ga-Mogara River: Aardvark (*Orycteropus afer*)

Four listed terrestrial mammals have a potential of occurring within the project site, the Honey Badger *Mellivora capensis* (Endangered), Brown Hyaena *Hyaena brunnea* (Near Threatened), Southern African Hedgehog *Atelerix frontalis* (Near Threatened) and the African Pangolin *Smutsia temminckii* (Vulnerable). Although, the area is used for livestock production and game farming, human activity in the area is low and it is likely that all four listed species occur in the general area. As these species have a wide national distribution, the power line would generate an insignificant extent of habitat loss for these species. These species can be expected to occur in very low numbers, or be largely transient (e.g. Brown Hyaena) within the broader area. Due to the minimal extent of habitat transformation associated with power line construction (aside from the removal of trees), the proposed line is not likely to significantly impact any mammal species occurring within the area, including the red-listed species. As the African Pangolin has recently been upgraded to CITES Appendix 1, due to the high rates of illegal trading in this species, there should be strict measures to prohibit poaching of wild animals at the site during all phases of development.

8. ASSESSMENT OF PROPOSED IMPACTS

Assumptions

The following is assumed and/or known:

- » A thorough botanical walkthrough of all footprint areas will be conducted to detect and relocate, where possible, all plant species of conservation concern by a suitably qualified botanist before the commencement of activities.
- » Throughout the duration of the project life cycle the footprint will be routinely cleared of all alien invasive plants if detected.
- » The site establishment itself will be associated with clearing of vegetation within the footprint of the power line only.
- » After the decommissioning of the power line, a continuous vegetation layer will be the most important aspect of ecosystem functionality within and beyond the project site.

- A weakened or absent vegetation layer not only exposes the soil surface but also lacks the binding and absorption capacity that creates the buffering functionality of vegetation to prevent or lessen erosion as a result of floods.

Localised vs. cumulative impacts: some explanatory notes

Ecosystems consist of a mosaic of many different patches. The size of natural patches affects the number, type, and abundance of species they contain. At the periphery of patches, influences of neighbouring patches become apparent, known as the 'edge effect'. Patch edges may be subjected to increased levels of heat, dust, desiccation, disturbance, invasion of exotic species, and other factors. Edges seldom contain rare species, habitat specialists, or species that require larger tracts of undisturbed core habitat. Fragmentation due to development reduces core habitat and greatly extends edge habitat, which causes a shift in the species composition, which in turn puts great pressure on the dynamics and functionality of ecosystems (Perlman & Milder, 2005).

Cumulative impacts of developments on population viability of species can be reduced significantly if new developments are kept as close as possible to existing developed and/or transformed areas or, where such is not possible, different sections of development be kept as close together as possible.

Due to the extent of this grid connection corridor, as well as the location the grid connection corridor within an area largely transformed and disturbed, the development of the Olifantshoek 132kV Power Line will have a **very limited contribution** to the cumulative impacts of the area and will **not:**

- » compromise the ecological functioning of the larger "natural" environment; and
- » disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.

Excessive clearing of vegetation can and will influence runoff and stormwater flow patterns and dynamics, which could cause excessive accelerated erosion of plains and intermittent drainage lines, and this could also have detrimental effects on the lower-lying areas.

- Rehabilitation and revegetation of all surfaces disturbed or altered during the operational phase are desirable.

Disturbance of indigenous vegetation creates a major opportunity for the establishment of invasive species and the uncontrolled spread of alien invasives into adjacent rangelands.

- » A regular monitoring and eradication protocol must be part of all the developments' long-term management plans.

After decommissioning, a continuous vegetation layer will be the most important aspect of ecosystem functionality within and beyond the project site.

- A weakened or absent vegetation layer not only exposes the soil surface; but, lacks the binding and absorption capacity that creates the buffering functionality of vegetation to prevent or lessen erosion as a result of floods.

Identification of Potential Impacts and Associated Activities

Potential botanical impacts resulting from the proposed project would stem from a variety of different activities and risk factors associated with the site-establishment and operation phases of the project including the following:

Construction and Operation Phase

- Human presence and uncontrolled access to the site may result in negative impacts on fauna and flora through poaching of fauna and uncontrolled collection of plants for traditional medicine or other purposes.
- Site clearing for site establishment of the construction camp and for the construction of the foundations for the pylons required for the power line.
- Vegetation clearing could impact locally listed plant species. Vegetation clearing would also lead to the loss of vegetation communities and habitats for fauna and potentially the loss of faunal species, habitats, and ecosystems. On a larger and cumulative scale (if numerous and uncontrolled power line developments are allowed to occur in the future) the loss of these vegetation communities and habitats may potentially lead to a change in the conservation status of the affected vegetation type, as well as the ability of this vegetation type and associated features to fulfil its ecological responsibilities (functions).
- Soil compaction and increased erosion risk would occur due to the loss of plant cover and soil disturbance created during the construction phase. This may potentially impact the downstream watercourses and aquatic habitats. These potential impacts may result in a reduction in the buffering capacities of the landscape during extreme weather events.
- Invasion by alien plants may be attributed to excessive disturbance to vegetation, creating a window of opportunity for the establishment of these alien invasive species. Also, regenerative material of alien invasive species may be introduced to the project site by machinery traversing through areas with such plants or materials that may contain regenerative materials of such species.
- The power line will require management and if this is not done effectively, it could impact adjacent intact areas through impacts such as erosion and the invasion of alien plant species.

Cumulative Impacts

- The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the country’s ability to meet its conservation targets.
- Transformation of intact habitat would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna, avifauna, and flora and impair their ability to respond to environmental fluctuations.

Assessment of Impacts

Planning and Construction Phase

Impact 1: *Potential Impacts on vegetation and listed and protected plant species*

Impact Nature: Vegetation clearing will lead to the loss of current habitat within the grid connection corridor and is an inevitable consequence of this type of activity. The extent of this grid connection corridor , is however, relatively small and the vegetation types within the affected area have a relatively wide distribution and are regarded as Least Concern. Furthermore, there are protected trees present along the route, especially *Vachellia erioloba*.

The loss of local vegetation within the footprint is expected to be of relatively minor significance when considered on a broad scale.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Minor (1)
Probability	Certain (5)	Highly Probable (4)
Significance	**Medium (55)**	**Low (24)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Unlikely	Unlikely
Can impacts be mitigated?	Impacts on protected plant species can to some extent be mitigated through avoidance, but some impact on vegetation and protected species is inevitable and cannot be avoided.	
Mitigation	» Pre-construction walk-through of the power line route/corridor to locate species of conservation concern that can be translocated or avoided. » Vegetation clearing to commence only after walkthrough has been conducted and necessary permits obtained. » Pre-construction environmental induction for all construction staff on-site to ensure that basic environmental principles are adhered to. This includes awareness as to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, remaining within demarcated construction areas, etc. » EO to provide supervision and oversight of vegetation clearing activities near sensitive areas. » Vegetation clearing to be kept to a minimum. No unnecessary vegetation to be cleared. Preferably *Acacia erioloba* trees under the line should be trimmed and not cut down. » All construction vehicles should adhere to defined and demarcated roads. No off-road driving to be allowed. » Temporary lay-down areas should be located within the development footprint or within areas that have been identified as being of low sensitivity. These areas should be rehabilitated after use. » Existing tracks should be used for access wherever possible.	

	» The morphology and hydrology of the riverbeds should not be altered by unnecessary excavations, dumping of soil or other waste.
Cumulative Impacts	The potential for cumulative impacts is low given the small footprint of the power line and the level of existing developments (i.e. power lines & mining areas) in the area. Although some *Vachellia erioloba* trees may be affected, this is the dominant tree in the area and the loss of some individuals is not considered highly significant.
Residual Impacts	Some residual vegetation loss will result from the development, equivalent to the operational footprint of the power line.

***Impact 2:** Potential Impacts on fauna*

Impact Nature: Disturbance, transformation, and loss of habitat will have a negative effect on resident fauna during construction.

There are fauna residents within the site, and these will be impacted during the construction of the power line. However, faunal diversity and density within the site are low, and post-mitigation impacts are likely to be Low and of Local significance only.

Increased levels of noise, pollution, disturbance, and human presence during the construction phase may affect the local fauna. Sensitive and shy fauna would move away from the area during the construction phase and may move back into the area upon completion of the construction phase. Some slow-moving species (i.e. tortoise & snakes) would not be able to avoid the activities and might be killed.

Faunal diversity and density within the site are low and post-mitigation impacts are likely to be Low and of Local significance only.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (5)	Low (4)
Probability	Probable (4)	Probable (3)
Significance	**Medium (32)**	**Low (21)**
Status	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	Unlikely	Unlikely
Can impacts be mitigated?	Large amounts of noise and disturbance at the site during construction are largely unavoidable.	
Mitigation	» All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises which are often persecuted out of superstition, or pangolin which is traded illegally.	

	» Any fauna threatened by the construction activities should be removed to safety by the EO or appropriately qualified personnel. » No construction activity should be allowed at the site between sunset and sunrise. » All construction vehicles should adhere to a low-speed limit to avoid collisions with susceptible species such as snakes and tortoises. » All hazardous materials should be stored appropriately to prevent contamination of the site. Any accidental chemical, fuel, and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
Cumulative Impacts	During the construction phase, the activity would contribute to cumulative fauna disturbance and disruption in the area, but the impact would be of a local extent and not of high significance with mitigation.
Residual Impacts	There will be minimal residual impact as the facility will have low operational impacts on fauna, after the construction phase.

Impact 3: *Loss of riparian systems and alluvial watercourses*

Impact Nature: The physical removal of the narrow strips of riparian zones and disturbance of any alluvial watercourses by pylon construction and road crossings, being replaced by hard engineered surfaces during construction. This biological impact would however be localised, as a large portion of the remaining catchment would remain intact.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (2)	Small (0)
Probability	Probable (3)	Probable (3)
Significance	**Low (21)**	**Low (15)**
Status	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	Unlikely	Unlikely
Can impacts be mitigated?	Impacts on riparian vegetation can be avoided by excluding these areas from the development footprint and crossing the Ga-Mogara where there are no woody riparian habitats present. Significant impacts on the water resource can be significantly reduced by spanning the river without the placement of any pylon structures within the watercourse itself.	
Mitigation	» No pylons must be placed within the delineated watercourses and the riparian habitat; however, the pylon may span these features. » Use as far as possible the existing roads.	

	» Where watercourse crossings are required, the engineering team must provide an effective means to minimise the potential upstream and downstream effects of sedimentation and erosion (erosion protection) as well minimise the loss of riparian vegetation (small footprint). » No vehicles must refuel within watercourses/ riparian vegetation. » With micro adjustments of the pylon positions, it is possible to place pylons outside of any riparian zones. » All depression wetlands should be excluded from the development footprint and should be regarded as no-go areas
Cumulative Impacts	Increase in surface run-off velocities, reduction in the potential for groundwater infiltration, and the spread of erosion into downstream wetlands.
Residual Impacts	Possible impact on the remaining catchment due to changes in run-off characteristics in the development site.

Impact 4: *Impact on localized surface water quality*

Impact Nature: During pre-construction, construction, and to a **limited degree** the operational phase, chemical pollutants (hydrocarbons from equipment and vehicles, cleaning fluids, cement powder, wet concrete, shutter-oil, etc.) associated with site-clearing machinery and construction activities could be washed downslope via the ephemeral systems.

Appropriate ablution facilities should be provided for construction workers during construction of the power line.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (30)**	**Low (10)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	Medium	Low
Can impacts be mitigated?	Yes, to a large extent.	
Mitigation	» Implement appropriate measures to ensure strict use and management of all hazardous materials used on site » Implement appropriate measures to ensure strict management of potential sources of pollutants (e.g. litter hydrocarbons from vehicles and machinery, cement during construction, etc.) » Implement appropriate measures to ensure the containment of all contaminated water through careful run-off management on the development site.	

	» Implement appropriate measures to ensure strict control over the behaviour of construction workers. » Working protocols incorporating pollution control measures (including approved method statements by the Contractor) should be clearly set out in the Construction Environmental Management Plan (CEMP) for the project and strictly enforced.
Cumulative Impacts	None
Residual Impacts	Residual impacts will be negligible after appropriate mitigation.

Impact 5: *Increase in sedimentation and erosion within the development footprint*

Impact Nature: This may alter the local watercourse morphology and influence water quality downstream		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Very Short (1)
Magnitude	Low (2)	Small (0)
Probability	Probable (3)	Improbable (2)
Significance	**Low (21)**	**Low (4)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent.	
Mitigation	» Use only the existing service roads when crossing any watercourses. » Any erosion observed to be associated with the project infrastructure should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur. » All bare areas, as a result of the development, should be revegetated with locally occurring species, to bind the soil and limit erosion potential. » Silt traps should be used where there is a danger of topsoil or material stockpiles eroding and entering streams and other sensitive areas. » Topsoil should be removed and stored separately and should be re-applied where appropriate as soon as possible, to encourage and facilitate the rapid regeneration of the natural vegetation on cleared areas. » Where practical, phased development and vegetation clearing should be applied so that cleared areas are not left un-vegetated and vulnerable to erosion for extended periods. » Construction of gabions and other stabilisation features to prevent erosion if deemed necessary. » There should be reduced activity at the site after large rainfall events when the soils are wet. No driving off of hardened	

	roads should occur immediately following large rainfall events until soils have dried out and the risk of bogging down has decreased.
Cumulative Impacts	Downstream erosion and sedimentation of the downstream systems. During flood events, any unstable banks (eroded areas) and sediment bars (sedimentation downstream) may be vulnerable to erosion. However, due to low mean annual runoff within the region, this is not anticipated due to the nature of the development together with the proposed layout.
Residual Impacts	Due to the extent and nature of the development, residual impacts are unlikely to occur, however, where infrastructure is to be directly placed within the watercourses, an altered streambed morphology is likely to occur,this residual impact is unlikely to occur.

Operation Phase

Impact 1: *Increase in sedimentation and erosion within the development footprint during the undertaking of maintenance activities of the power line*

Impact Nature: This may alter the local watercourse morphology and influence water quality downstream		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (2)	Low (2)
Probability	Probable (3)	Improbable (2)
Significance	**Low (21)**	**Low (14)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Use only the existing service roads (of the 275kV power line) when crossing any watercourses. » Any erosion observed to be associated with the project infrastructure should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur. » Silt traps should be used where there is a danger of topsoil or material stockpiles eroding and entering streams and other sensitive areas. » Construction of gabions and other stabilisation features to prevent erosion if deemed necessary.	

Cumulative Impacts	Downstream erosion and sedimentation of the downstream systems. During flood events, any unstable banks (eroded areas) and sediment bars (sedimentation downstream) may be vulnerable to erosion. However, due to low mean annual runoff within the region, this is not anticipated due to the nature of the development together with the proposed layout.
Residual Impacts	Due to the extent and nature of the development, residual impact is unlikely to occur.

Impact 2: *Impact on riparian systems during operation as a result of hard engineered surfaces and the removal of vegetation during construction*

Impact Nature: This could increase the surface water runoff on riparian form and function.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Low (27)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Ensure the vegetation removal is minimised to an absolute minimum, restricted only to the footprint area.	
Cumulative Impacts	Downstream erosion and sedimentation of the downstream systems. During flood events, any unstable banks (eroded areas) and sediment bars (sedimentation downstream) may be vulnerable to erosion. However, due to low mean annual runoff within the region, this is not anticipated due to the nature of the development together with the proposed layout.	
Residual Impacts	Due to the extent and nature of the development, residual impact is unlikely to occur.	

Assessment of Cumulative Impacts

Cumulative Impact 1: *Reduced ability to meet conservation obligations and targets*

Impact Nature: The loss of unprotected vegetation types on a cumulative basis from the broader area impacts the Province's ability to meet its conservation targets.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Regional (2)
Duration	Long Term (4)	Long-Term (4)
Magnitude	Small (0)	Minor (2)
Probability	Very Improbable (1)	Highly Improbable (2)
Significance	**Low (5)**	**Low (16)**
Status	Neutral	Slightly Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Highly unlikely	Unlikely
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. » Mitigation measures of the current site should align with neighbouring sites and other developments in the area.	

***Cumulative Impact 2:** Impacts on Broad-Scale Ecological Processes*

Impact Nature: Transformation of intact habitat could potentially compromise ecological processes as well as ecological functioning of important habitats and would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Regional (2)
Duration	Long Term (4)	Long-Term (4)
Magnitude	Small (0)	Minor (2)
Probability	Very Improbable (1)	Highly Improbable (2)
Significance	**Low (5)**	**Low (16)**
Status	Neutral	Slightly Negative
Reversibility	Low	Low

Irreplaceable loss of resources	Highly unlikely	Unlikely
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. » Mitigation measures of the current site should align with neighbouring sites and other developments in the area.	

Cumulative Impact 2: *Compromise ecological processes as well as ecological functioning of important habitats*

Impact Nature: Transformation of intact habitat could potentially compromise ecological processes as well as ecological functioning of important habitats and would contribute to habitat fragmentation and potential disruption of habitat connectivity and impair their ability to respond to environmental fluctuations. This is especially of relevance for larger watercourses and wetlands serving as important groundwater recharge and floodwater attenuation zones, important microhabitats for various organisms, and important corridor zones for faunal movement (mostly located downstream, outside of study area and associated mainly with Kuruman River).		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Local (1)
Duration	Long Term (4)	Long Term (4)
Magnitude	Small (1)	Small (1)
Probability	Highly Improbable (1)	Highly Improbable (1)
Significance	**Low (6)**	**Low (6)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes	
Mitigation	» The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. » Use existing service roads when crossing the watercourses. » Avoid placing pylons within the boundaries of the watercourses. » Avoid any activities within the depression wetlands. » Avoid clearing the fringing shrubby vegetation associated with the depression wetlands.	

9. CONCLUSION

The proposed power line route is situated in the Savanna biome (Eastern Kalahari Bushveld Bioregion) and will traverse three vegetation types namely, Kuruman Thornveld, Kathu Bushveld, and Olifantshoek Plains Thornveld.

The number of species at broad geographical levels (gamma diversity) has been given as 5788 for the Savanna Biome in southern Africa, which in turn gives a relatively low species-area ration of 9.2 $10^3/10^6$ km^2. For the southern Kalahari part of this biome, the ration drops even lower to 4.4 $10^3/10^6$ km^2. Furthermore, there is a clear gradient of sharply decreasing diversity of trees and larger shrub species from east to west within the southern African Savanna Biome. Be it as it may, regular variations within this species composition and vegetation structure (woody plant – grass, tree – shrub and tree-tree interactions) allow for habitat, niche, and resource variation and in turn allow for the persistence of a relatively high diversity of faunal biota to persist in this arid Savanna.

Within the project site itself, a high turnover of habitat types was present. The main ecological drivers within the area are underlying geology, edaphic factors, and moisture availability. Tree-shrub interactions, grazing, and anthropogenic activities are responsible for the more subtle variations within the different habitat types.

The current power line route will have a limited impact on these habitat types due to the narrow linear "nature" of the development (spreading the impact over various habitat rather than restricting the impact to a large area within a singular habitat type), along with the fact that the power line route, will for large portions, run close to already impacted servitudes of existing linear infrastructure. Subsequently, existing access and service routes can be utilized.

During the study, it was found that the majority of the grid connection corridor can be regarded as Low and Medium Sensitive with High Sensitive areas associated with the depression wetlands and habitats associated with the Ga-Mogara River. These depression wetlands are regarded as No-Go areas and should be excluded from the development. The location where the planned power line will cross the Ga-Mogara River is regarded as acceptable as impacts on the woody riparian habitats are avoided, whilst the point of crossing is located near an existing access road. No construction activities may be allowed within the Ga-Mogara River apart from the spanning of the power line across the river (no pylons allowed within the delineated river area).

The major impacts of the development of the power line are associated with the construction phase, due to the disturbance that would take place at this time. Construction phase disturbance would however be transient and while impacts on flora are likely to persist for some time, impacts on fauna during operation would be very low. Although there are some sensitive features present in the area especially patches of *Vachellia erioloba*, with proper planning of the pylon footprints, impacts to these areas can be minimised. Due to the low overall footprint of the power line and its relatively low length, impacts associated with the construction and operation of the power line would be local in nature and of low overall significance after mitigation.

Thus from an ecological perspective, no objective or motives (identification of impacts of high ecological significance, etc.) were identified which would hinder the establishment of this development. Activities and impacts are regarded as acceptable from an ecological perspective and will not cause detrimental impacts to the ecological features located within the affected area and surrounding properties. Therefore, it is the opinion of the specialist that the development may be authorised, subject to the implementation of the recommended mitigation measures.

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11. APPENDICES

Appendix 1: List of Abbreviations

CARA:	Conservation of Agricultural Resources Act 43 of 1983
CBA:	Critical Biodiversity Area
CITES:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CR:	Critically Endangered (threat status)
DAFF:	Department of Agriculture, Forestry and Fisheries
DEA:	Department of Environmental Affairs
DENC:NC:	Department of Environment and Nature Conservation: Northern Cape Province
DWS:	Department of Water and Sanitation
NCNCA:	Northern Cape Nature Conservation Act (Act No. 9 of 2009)
DDD:	Data Deficient – Insufficient Information (threat status)
DDT:	Data Deficient – Taxonomically Problematic (threat status)
NFA:	Nation Forest Act 1998; No 84 of 1998
DEA:	Department of Environmental Affairs
EA:	Environmental Authorisation
ECO:	Environmental Control Officer
EIA:	Environmental Impact Assessment: EIA regulations promulgated under section 24(5) of NEMA and published in Government Notice R. 543 in Government Gazette 33306 of 18 June 2010
EIS	Ecological Importance and Sensitivity
EMPr:	Environmental Management Programme
EN:	Endangered (threat status)
ESA:	Ecological Support Areas
EX:	Extinct (threat status)
EW:	Extinct in the Wild
FEPA:	Freshwater Ecosystem Priority Area
FW:	Facultative wetland species – usually grow in wetlands (67 – 99% occurrence) but occasionally found in non-wetland areas
CIS:	Conservation Important Species (species listed within IUCN and South African Red Data Lists or that are protected within relevant international, national and provincial legislation
IAPs:	Invasive Alien Plants
IP:	Invasive Plant (indigenous or alien)
LC:	Least Concern
LT:	Least threatened
NFA:	National Forest Act 84 of 1998
NE:	Not Evaluated (threat status)

NEMA: National Environmental Management Act 107 of 1998

NEM:BA National Environmental: Biodiversity Act (Act No. 10 of 2004)

NFEPA: National Freshwater Ecosystem Priority Areas, identified to meet national freshwater conservation targets (CSIR, 2011)

NT: Near Threatened (treat status)

NWA: National Water Act No.36 of 1998

OW: Obligate wetland species

PES: Present Ecological State, referring to the current state or condition of an environmental resource in terms of its characteristics and reflecting a change from its reference condition

RE: Regionally Extinct

SANBI: South African National Biodiversity Institute

SST: Shrub-sometimes-small-tree

TOPS: Threatened and Protected Species in terms of section 56 of the National Environment: Biodiversity Act (NEM:BA) of 2004 (Species list as published within Gazette No. 30568, 14 December 2007)

VU: Vulnerable (treat status)

Appendix 2: List of Definitions

Alien: originating from another country or continent and originally different environment, commonly used to describe plants that are not indigenous to South Africa and have become problematic (spreading rapidly, threatening existing biodiversity)

Alluvium soils: Sedimentary material found in regions fringing river courses and composed of detrital matter transported and deposited by the river.

Bare soil: Un-vegetated soil surface, unaltered by humans

Bush encroachment: means stands of plants of the kinds specified in CARA Table 4, where individual plants are closer to each other than three times the mean crown diameter.

Catchment: A catchment is an area where water is collected by the natural landscape. In a catchment, all rain and run-off water eventually flow to a river, wetland, lake or ocean, or into the groundwater system.

Calcareous: Pertaining to a soil or rock containing calcium carbonate, or related minerals, so that it effervesces (bubbles of CO_2) when treated with acid. Usually formed from shells or chemical precipitation, these soils and rocks tend to have a coastal distribution (modified after Low & Rebelo, 1998)

Calcrete: A rock formed in the soil profile at the water table when calcium carbonate accumulates and cements particles together to form a hard rock band (Low & Rebelo, 1998)

Chert: Cryptocrystalline quartz of organic or inorganic origin. Also, the rock formed by the precipitation of this material, which can form bands or layers of nodules in sedimentary rocks

Climax: That vegetation type or plant community structure that occurs at the end of the seral cycle. The climax communities may not be the final endpoint of the succession: frequent or even rare events, such as fire, frost, harvesting, or hurricanes, may hold the communities in a stable subclimax indefinitely (Low & Rebelo, 1998)

Compacted soil surface: A soil surface that has been hardened by an outside source, causing the soil to be more compacted than the surrounding area.

Conservation Important Plant: Any plant species that are protected within relevant international, national and/or provincial legislation and any species that is listed within the Red List of South African plants (version 2017.1).

Dwarf Shrub Savanna: This savannah type is dominated by dwarf karroid shrubs, that have likely replaced graminoids, and contain scattered woody species, predominantly shrubs and SST.

Ecotone: A zone in which two or more vegetation types or ecosystems merge. These areas may be rich in species from both systems or may occur as species-poor fringes.

Ecosystem Goods and Services: The goods and benefits people obtain from natural ecosystems. Various types of ecosystems provide a range of ecosystem goods and services. Aquatic ecosystems such as rivers and wetlands provide goods such as forage for livestock grazing or sedges for craft production and services such as pollutant trapping and flood attenuation. They also provide habitat for a range of aquatic biota.

Endemic: Refers to a plant, animal species, or a specific vegetation type that is naturally restricted to a particular defined region (not to be confused with indigenous). A species of animal may, for example, be endemic to South Africa in which case it occurs naturally anywhere in the country, or endemic only to a specific geographical area within the country, which means it is restricted to this area and grows naturally nowhere else in the country.

Forb: A plant without secondary thickening (i.e. non-woody), usually living for only one or two seasons

Function/functioning/functional: Used here to describe natural systems working or operating in a healthy way, as opposed to dysfunctional, which means working poorly or in an unhealthy way.

Geophytic: resprouting during the growing season from an underground storage organ such as bulbs, corms, tubers or rhizomes, and dying back completely during unfavourable seasons

Geoxylic Suffrutex: A plant with annual or short-lived woody above-ground shoots sprouting from a massive or extensive, perennial, underground stem

Graminoid: Pertaining to an herbaceous growth form characterised by a 'grass-like' appearance (tufted growth, usually long and narrow leaves, secondary root system) and including plants such as grasses, restios, sedges, and rushes.

Grassland: Vegetation dominated by grasses (or graminoids) usually with a single-layered structure and sometimes with an open, woody plant cover.

Habitat: The general features of an area inhabited by animal or plant which are essential to its survival (i.e. the natural "home" of a plant or animal species).

Indigenous: refers to a plant or animal that occurs naturally in the place in which it is currently found

Invasive plant: a kind of plant which has under section 2 (3) of CARA been declared an invader plant, and includes the seed of such plant and any vegetative part of such plant which reproduces itself asexually

Intact: Used here to describe a natural environment that is not badly damaged, and is still operating healthily.

Landscape: Consists of a mosaic of two or more ecosystems that exchange organisms, energy, water, and nutrients.

Land Type: Map unit denoting land, mappable at 1:250 000 scale, over which there is a marked uniformity of climate, terrain form, and soil pattern.

Mitigate/Mitigation: Mitigating impacts refers to reactive practical actions that minimize or reduce in situ impacts. Examples of mitigation include "changes to the scale, design, location, siting, process, sequencing, phasing, and management and/or monitoring of the proposed activity, as well as restoration or rehabilitation of sites". Mitigation actions can take place anywhere, as long as their effect is to reduce the effect on the site where a change in ecological character is likely, or the values of the site are affected by those changes (Ramsar Convention, 2012).

Regic Soils: Pertaining to a blanket of soil, usually sand, which has been deposited over another soil or rock, and which has not yet had time to develop profiles or layers

Plagioclimax community: An area/habitat/plant community in which anthropogenic (human) influences have prevented the ecosystem from developing further. The ecosystem may have been stopped from reaching its full climax or deflected towards a different climax by activities such as long-term ploughing, deforestation, burning, grazing and trampling by domestic animals, etc.

Risk: A prediction of the likelihood and impact of an outcome; usually referring to the likelihood of a variation from the intended outcome.

Savanna: Typically, vegetation with a grass-dominated herbaceous layer and scattered low to tall trees. It includes the closed woodland and open woodlands of Edwards (1983) with a tree cover less than 75% and generally greater than 1%

Savannoid / Savanna grasslands: Pertaining to open wooded grassland structurally similar to savanna, but from climatic reasons not belonging to the Savanna Biome. Savannoid vegetation is encountered within temperate zones.

Savanna Woodland: Trees, shrubs, and SST forming a light canopy.

Shrub-Sometimes-Small-Tree: Medium-sized woody plants (>3 – 6m), with variable architecture from multi-stemmed to pole-like. Key attributes are reproduction at small height and relatively low resprouting vigour after a topkill by fire.

Shrub: Small woody plants (up to 3m tall) with many stems, a dense relatively wide crown, and a relatively slow increase in height with stem diameter. Key attributes of shrubs are reproduction at small height and vigorous resprouting after a topkill by fire.

Shrub Savanna: Savanna type where shrubs and shrub-sometimes-small-tree (SST) form the prominent woody component (still open structure), influencing the productivity and functionality of the landscape.

Soil Erosion: is a natural process whereby the ground level is lowered by wind or water action and may occur as a result of inter alia chemical processes and or physical transport on the land surface**.**

Succession: A series of stages in which different plants and animals colonise an area following some kind of disturbance. The final stage of the succession is called the 'climax', but various disturbances may prevent the vegetation from attaining its potential climax

Tree: Potentially large woody plants (≥6m), either single-stemmed or with a few stems and a distinct, sparse crown that is held well above-ground level. Key attributes of trees are delayed reproduction, focused investment in height growth, and focused allocation of resources to on big stem when resprouting.

Thornveld: A woodland savanna dominated by trees with thorns, mainly Acacia species.

Threatened Ecosystem: In the context of this document, it refers to Critically Endangered, Endangered, and Vulnerable ecosystems.

Threat Status: Threat status (of a species or community type) is a simple but highly integrated indicator of vulnerability. It contains information about past loss (of numbers and/or habitat), the number and intensity of threats, and current prospects as indicated by recent population growth or decline. Anyone of these metrics could be used to measure vulnerability. One much-used example of a threat status classification system is the IUCN Red List of Threatened Species (BBOP, 2009).

Tree Savanna: Savanna type with a well developed but still open woody component comprising of both shrubs and trees, with three species being the prominent feature and most important ecological factor. Savanna trees along the broad-scale Kalahari transect may be multistemmed.

Vegetation structure: The horizontal, vertical, and temporal arrangement of vegetation, i.e. spatially explicit, e.g. layers, patches, etc.

Vegetation texture: The composition of the vegetation in terms of species, growth forms, life forms, leaf morphological types, etc.

Watercourse: Means a river or spring; a natural channel in which water flows regularly or intermittently: a wetland, lake or dam into which, or from which, water flows: und any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks (National Water Act, 1998).

Wetland: Refers to 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 land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil (National Water Act, 1998).

WGS84: Abbreviation of 'World Geodetic System of 1984'. A geocentric datum and geographical coordinate system created by the United States military and in world-wide use (ESRI 2006).

Transformation: The conversion of an ecosystem to a different ecosystem or land use type.

Topsoil: uppermost layer of soil, in natural vegetation maximally 30 cm, in cultivated landscapes the total depth of cultivation, containing the layer with humus, seeds, and nutrients. Topsoils that are applied to landscapes to be rehabilitated must be free of refuse, large roots and branches, stones, alien weeds and/or any other agents that would adversely affect the topsoils suitability for re-vegetation.

White grass: Veld management term for (usually) tussock grasses (Stipagrostis, Aristida) turning veld into white plains through their conspicuous plumage of hairs on the seeds at the state of ripening and dispersal.

Weed: a plant that grows where it is not wanted, and can, therefore, be an indigenous or alien species. An unwanted plant growing in a garden is just called a weed, but the 198 listed IPs are called "declared weeds and invaders".

(Coetzee 2005, Clewell et al. 2005, SER 2004)

Appendix 3: Methodology: Ecology (Biodiversity)

Methods to be followed during Field Sampling and Assessment

As part of the BA process, a detailed field survey of the vegetation of the development footprint was undertaken (from the 4th to 7th of March 2020) with the main purpose of:

» Inspecting the various habitat, vegetation, and landscape units that are present the mining site and to correlate such observations with the results of the desktop study.
» Identifying all observed species that were recorded within the development footprint.
» Providing a list of protected and red list species.
» Noting the presence of sensitive habitats such quartz patches, drainage lines, and unique edaphic environments,

These features were mapped onto satellite imagery of the site.

Aspects of biodiversity that were used to guide the interpretation and assessment of the study area are summarized below (Table 7).

Table 7: Summary of the different aspects of biodiversity considered in the assessment of the study site.

Intrinsic / Ecological Values
Species-level aspects of biodiversity
» Protected species of flora; » Threatened Species (Red Data List); » Keystone species performing a key ecological role; » Large or congregatory species population; » Endemic species or species with restricted ranges; » Previously unknown species.
Community & ecosystem-level aspects of biodiversity
» Distinct or diverse communities or ecosystems; » Unique ecosystems; » Locally adapted communities or assemblages; » Species-rich or diverse ecosystems; » Communities with a high proportion of endemic species or species with restricted ranges; » Communities with a high proportion of threatened and/or declining species; » The main uses and users of the area and its ecosystem goods and services: important ecosystem services, valued ecosystem goods, valued cultural areas.
Community & ecosystem-level aspects of biodiversity
» Key ecological processes (e.g. seed dispersal, pollination, primary production, carbon sequestration); » Areas with large congregations or species and/or breeding grounds; » Migration routes/corridors; » Importance as a link or corridor to other fragments of the same habitat, to protected or threatened or valued biodiversity areas; » Importance and role in the landscape with regard to a range of 'spatial components of ecological processes', comprising processes tied to fixed physical features (e.g. soil or vegetation interfaces, river or sand movement corridors, upland-lowland interfaces) and flexible processes (e.g. upland-lowland

gradients and macro-climatic gradients), as well as important movement or migration corridor for species.

The following methods were used to assess mapped terrestrial habitat:

Vegetation Species Composition:

The vegetation species composition was documented during field surveys to estimate the relative abundance of indigenous species vs alien/exotic species. The level of naturalness was subjectively rated per habitat unit assessed using the table below:

% Indigenous Cover	Level of Naturalness	Score
> 90	Natural	5
75 – 90	High	4
31 – 74	Moderate	3
6 – 30	Low	2
1 – 5	Very Low	1
0	Non (transformed)	0

Grass composition:

The ecological status of grasses refers to the grouping of grasses based on their reaction to different levels of grazing and disturbance (Van Oudtshoorn, 2006). It can either become more dominant (increaser type) or less dominant (decreaser type). The status of species indicates the ecological or veld condition, as per the table below which was used to guide the condition rating of grasslands:

Abundant Grass Status	Description
Decreaser	Abundant in good veld, palatable climax species, that decrease when veld is overgrazed
Increaser I	Grasses that are abundant in the underutilised veld, unpalatable, and robust climax species.
Increaser II	Abundant in overgrazed veld, mostly pioneer and subclimax species that quickly establish on new ground.
Increaser III	Commonly found in overgrazed veld, usually unpalatable, dense climax grasses that are strong competitors
Invaders	Invader species

Structural intactness of habitat:

The structural intactness of habitat is rated based on visual assessments in the field and rated according to the matrix below which compares the present structure of habitat with the estimated reference structure (natural state):

Structural Intactness Matrix	Present State				
Reference State	Continuous	Clumped	Scattered	Sparse	Very Sparse
Continuous	5	4	3	2	1
Clumped	4	5	4	3	2
Scattered	3	4	5	4	3
Sparse	2	3	4	5	4
Very Sparse	1	2	3	4	5

The existing level of disturbance:

The existing level of disturbance was documented based on the presence of on-site and adjacent anthropogenic impacts such litter/pollution, soil erosion, vegetation removal/clearing, grazing/harvesting, cultivation, housing development, etc. which were documented in the field and used to provide a qualitative rating of the level of habitat disturbance according to the ratings in the table below:

Level of disturbance	Score
None	5
Low	4
Medium	3
High	2
Very High	1
Extreme (no natural vegetation remains)	0

Present Ecological Status:

The scores assigned to each habitat unit based on the rating tables (shown above) were then used to provide an overall PES (Present Ecological State) rating that describes the condition or integrity for each habitat unit based on the following calculation:

» **PES = (Level of disturbance + Structural Intactness + % indigenous) / 3**

<u>Assessing species of conservation concern:</u>

Species of conservation concern are species that have high conservation importance in terms of preserving South Africa's biodiversity. A description of the different SANBI categories of species of conservation concern is provided in Table 8, below.

Table 8: South African Red List Categories for species of conservation significance (adapted from SANBI, on-line at http://redlist.sanbi.org/redcat.php).

Present State			
Species of Conservation Concern		Extinct (EX)	A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
		Extinct in the Wild (EW)	A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
		Regionally Extinct (RE)	A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
	Threatened Species	Critically Endangered, Possibly Extinct (CR PE)	Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered.
		Critically Endangered (CR)	A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
		Endangered (EN)	A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.
		Vulnerable (VU)	A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
		Near Threatened (NT)	A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is, therefore, likely to become at risk of extinction in the near future.
		Critically Rare	A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
		Rare	A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria.
		Declining	A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.
		Data Deficient – Insufficient Information (DDD)	A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that threatened classification is appropriate.
Other		Data Deficient – Taxonomically Problematic (DDT)	A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined so that an assessment of the risk of extinction is not possible.
		Least Concern (LC)	A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
		Not Evaluated (NE)	species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given a national Red List status. However, some species included in Plants of southern

			Africa: an online checklist are species that do not qualify for national listing because they are naturalized exotics, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

As mentioned, flora of conservation significance (including threatened, protected and rare species) likely to occur in the various habitats of the study area were assessed at a desktop level using the outputs of SANBI's PRECIS (National Herbarium Pretoria Computerized Information System) electronic database. This information was used to identify potential habitat in the project area that could support these species based on information on each species' particular habitat preferences which were obtained from SANBI online species database. Special attention was given to the identification of any of these Red Data species as well as the identification of suitable habitat for Red Data species observed during field investigations.

Ecological Mapping

Mapping has been done by comparing georeferenced ground survey data to the visual inspection of available Google-Earth Imagery (which is a generalised colour composite image without any actual reflectance data attached to it) and in that way extrapolating survey reference points to the entire study area. Delineations are therefore approximate, and due to the intricate mosaics and often gradual mergers of vegetation units, generalisations had to be made. Mapped units will thus show where a certain vegetation unit is predominant, but smaller inclusions of another vegetation type in this area do exist but have not been mapped separately. The latter would require a supervised classification of georeferenced raw SPOT or similar satellite imagery (with all reflectance data), which has not been available to this project due to the high cost of such imagery.

Sensitivity Analysis and Criteria

The determination of specific ecosystem services and the sensitivity of ecosystem components, both biotic and abiotic, is rather complex and no single overarching criterion will apply to all habitats studied. The main aspects of an ecosystem that need to be incorporated in a sensitivity analysis, however, include the following:

» Describing the nature and number of species present, taking into consideration their conservation value as well as the probability of such species to survive or re-establish itself following disturbances, and alterations to their specific habitats, of various magnitudes
» Identifying the species or habitat features that are 'key ecosystem providers' and characterising their functional relationships (Kremen 2005)

» Determining the aspects of community structure that influence function, especially aspects influencing stability or rapid decline of communities (Kremen 2005)
» Assessing key environmental factors that influence the provision of services (Kremen 2005)
» Gaining knowledge about the spatial-temporal scales over which these aspects operate (Kremen 2005).

This implies that in the sensitivity analysis not only aspects that currently prevail on the area should be taken into consideration, but also if there is a possibility of a full restoration of the original environment and its biota, or at least the rehabilitation of ecosystem services resembling the original state after an area has been significantly disturbed.
According to the above, sensitivity classes have been summarised as follows:

» **Vert High Sensitivity:** Areas that contain critical and/or unique habitats have a very high sensitivity; such areas usually serve as habitats for rare/endangered species or perform critical and irreplaceable ecological roles. Very high sensitivity areas are no-go areas and developments in such areas should be avoided at all costs.
» **High Sensitivity:** High sensitivity areas are those that usually have a high biodiversity value or important ecological roles, and it is expected that impacts on such areas will likely be high; these areas include natural or transformed land. It might be difficult to mitigate all impacts appropriately in high sensitivity areas, and thus development within these areas is undesirable and should proceed with caution.
» **Medium Sensitivity:** The impacts on medium sensitivity areas are likely to be mostly local with the risk of secondary impacts (such as erosion) being low; these areas include natural or previously transformed land. On the condition that appropriate mitigation measures are implemented, development within medium sensitivity areas will have a relatively little ecological impact.
» **Low Sensitivity:** The impact on ecological processes and plant diversity in a low sensitivity area is likely to be negligible. Areas of low sensitivity are those areas where natural vegetation has already been transformed, for example as a result of intensive agricultural practices such as crop production. The majority of developments would have a little ecological impact in low sensitivity areas. The majority of the site is a Low Sensitivity area since it has already been heavily transformed due to past mining activities.

Appendix 4: Methodology: Freshwater Resource

Survey methods

The assessment was initiated with a survey of the pertinent literature, past reports, and the various conservation plans that exist for the study region. Maps and Geographical

Information Systems (GIS) were then employed to ascertain, which portions of the proposed development, could have the greatest impact on the wetlands and associated habitats.

The desktop delineation of all surface water resources (i.e. rivers, streams, and wetlands) within 500m of the proposed development (i.e. the DWS regulated area for Water Use in terms of Section 21 of the National Water Act) was undertaken by analysing available contour data and colour aerial photography, supplemented by Google EarthTM imagery where applicable. Digitization and mapping were undertaken using ArcMap GIS software. All of the mapped watercourses were then broadly subdivided into distinct resource units (i.e. classified as either riverine or wetland systems/habitat) based on professional experience, topographical setting, and drainage patterns. Following the mapping of water resource units within 500m of the proposed development, the risk posed by the development to freshwater ecosystems was screened at a desktop level and ascribed a qualitative risk rating. The potential risks were also identified based on the nature of the proposed development and professional experience with similar developments, as well as based on ground-truthing of mapped watercourses in the field.

A two-day site visit was then conducted (6^{th} and 7^{th} of March, 2020) to ground-truth the above findings, thus allowing critical comments of the development when assessing the possible impacts and delineating the freshwater resource areas.

» The following equipment was utilized during fieldwork.
  - Canon EOS 450D Camera
  - Garmin Etrex Legend GPS Receiver
  - Soil Auger
  - Munsell Soil Colour Chart (2000)
  - Braun-Blanquet Data Form (for vegetation recording and general environmental recordings).

Freshwater resource areas were then assessed on the following basis:

» Identification and delineation of wetlands and riparian areas according to the procedures specified by DWAF (2005a).
» Vegetation type – verification of type and its state or condition-based, supported by species identification using Germishuizen and Meyer (2003), Vegmap (Mucina and Rutherford, 2006 as amended), and the South African Biodiversity Information Facility (SABIF) database.
» Plant species were further categorised as follows:
  - Terrestrial/Upland: species are rarely found within the riparian zone (<25% probability) and characterize the terrestrial landscape that borders the riparian zones. Upland species usually occur naturally in the upper parts of the riparian zone, but with low relative abundance (DWAF, 2008).

- Facultative riparian: species may occur in either riparian zones or the upland (25>% probability of occurrence in the riparian zone). They can habituate to more mesic conditions with a high probability of survival, or can tolerate higher levels of flooding disturbance or soil moisture. They are not good national indicators, but rather circumstantial indicators good for particular regions (DWAF, 2008).
- Preferential riparian: these area species that are preferentially, but not exclusively, found in the riparian zone (>75% probability). They may be found in non-riparian areas as indicators of wetness. Where they do occur in the upland, they show progressive reductions in abundance, statue, and vigour farther from the riparian zone. Preferential riparian species may harden to drought conditions, but will always indicate sites with increased moisture availability, and are therefore consistent indicators across geographic boundaries (DWAF, 2008).
- Obligate: these species occur almost exclusively in the riparian zone (>90% probability). They are seldom found in non-riparian areas, but where they are outside of riparian areas, they still indicate wetness. They are not likely to occur in the upland. Obligate riparian species are conservative as such i.e. an obligate will remain obligate throughout all geographic regions (DWAF, 2008).

» Assessment of the freshwater resources based on the method discussed below and the required buffers.
» Mitigation or recommendations required.

Classification System for Wetlands and other Aquatic Ecosystems in South Africa System (SANBI, 2013)

Since the late 1960's, wetland (including other freshwater ecosystems) classification systems have undergone a series of international and national revisions. These revisions allowed for the inclusion of additional wetland types, ecological and conservation rating metrics, together with a need for a system that would allude to the functional requirements of any given wetland (Ewart-Smith et al., 2006). Wetland function is a consequence of biotic and abiotic factors, and wetland classification should strive to capture these aspects.

The South African National Biodiversity Institute (SANBI) in collaboration with several specialists and stakeholders developed in 2010 the newly revised accepted National Wetland Classification Systems (NWCS, 2010). In 2013 however, this classification system (National Wetland Classification System) underwent a name change to now be known as the 'Classification System for Wetlands and other Aquatic Ecosystems in South Africa'. This was done to avoid confusion around the term 'wetland' which is defined differently by the RAMSAR Convention and the South Africa National Water Act (Act No. 36 of 1998). The scope of the Classification System has not been changed, however, in that it still includes all ecosystems that the RAMSAR Convention is concerned with.

This classification system includes and distinguishes between three broad types of inland aquatic/freshwater systems namely:

» Rivers, which are 'lotic' aquatic ecosystems with flowing water concentrated within a distinct channel, either permanently or periodically.
» Open water bodies, which are permanently inundated 'lentic' aquatic ecosystems where standing water is the principal medium within which the dominant biota live. In this system, open water bodies with a maximum depth of greater than 2m are called limnetic (lake-like) systems.
» Wetlands are transitional between aquatic and terrestrial systems and are generally characterised by (permanently to temporarily) saturated soils and hydrophytic vegetation. These areas are, in some cases, periodically covered by shallow water and/or may lack vegetation.

The basis upon which this classification system is based on is the principles of the Hydrogeomorphic (HGM) approach at higher levels, including structural features at the finer or lower levels of classification (SANBI, 2013) (Table 9).

Table 9: Hydrogeomorphic (HGM) Units for Inland Systems, showing the primary HGM Types at Level 4A and sub-categories at Levels 4B to 4C.

Level 4: Hydrogeomorphic (HGM) Units		
HGM Type	**Longitudinal zonation/Landform/Outflow drainage**	**Landform/Inflow drainage**
River	Mountain headwater stream	Active channel
		Riparian Zone
	Mountain Stream	Active channel
		Riparian Zone
	Transitional	Active channel
		Riparian Zone
	Upper foothills	Active channel
		Riparian Zone
	Lower foothills	Active channel
		Riparian Zone
	Lowland river	Active channel
		Riparian Zone
	Rejuvenated bedrock fall	Active channel
		Riparian Zone
	Rejuvenated foothills	Active channel
		Riparian Zone
	Upland floodplain	Active channel
		Riparian Zone
Channeled valley-bottom wetland	N/A	N/A
Unchanneled valley-bottom wetland	N/A	N/A
Floodplain	Floodplain depression	N/A
	Floodplain flat	N/A
Depression	Exorheic	With channeled inflow
		Without channeled inflow

	Endorheic	With channeled inflow
		Without channeled inflow
	Dammed	With channeled inflow
		Without channeled inflow
Seep	With channeled outflow	N/A
	Without channeled outflow	N/A
Wetland Flat	N/A	N/A

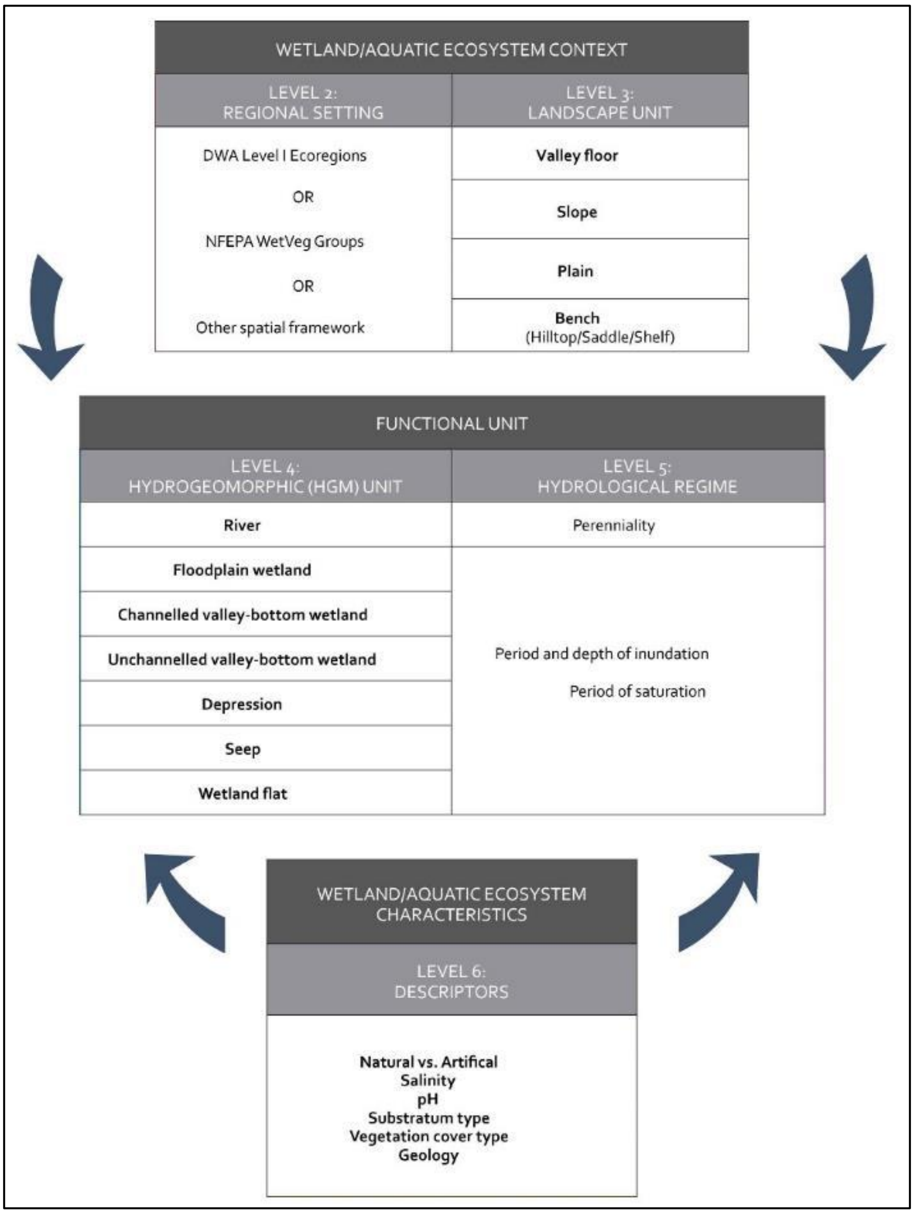

Figure 16: Basic structure of the National Wetland Classification System, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the hydrological regime, and 'descriptors' applied at Level 6 to categorise the characteristics of wetlands classified up to Level 5 (From SANBI, 2009).

It is widely accepted that hydrology (i.e. the presence or movement of water) and geomorphology (i.e. landform characteristics and processes) are the two fundamental features that determine the way in which an inland aquatic ecosystem functions, regardless of climate, soils, vegetation or origin. Subsequently, it is significant that the HGM approach has now been included in wetland classification as the HGM approach has been adopted throughout the water resources management realm with regard the determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) and WET-Health assessments for aquatic environments. All of these systems are then easily integrated using the HGM approach in line with the Eco-classification process of river and wetland reserve determinations used by the Department of Water Affairs.

In summary, the overall structure of this classification system comprises six tiers. This tiered structure is summarised in Figure 16 with Level 4 tier (HGM Units), as mentioned, forming the focal point of this system together with Level 5 tier (hydrological regime).

Some of the terms and definitions used in this document are present below:

Wetland definition

Although the National Wetland Classification System (SANBI, 2009) is used to classify wetland types it is still necessary to understand the definition of a wetland. Wetland definitions as with classification systems have changed over the years. Terminology currently strives to characterise a wetland not only on its structure (visible form) but also to relate this to the function and value of any given wetland.

The Ramsar Convention definition of a wetland is widely accepted as "**areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres**" (Davis 1994). South Africa is a signatory to the Ramsar Convention and therefore its extremely broad definition of wetlands has been adopted for the proposed NWCS, with a few modifications.

Whereas the Ramsar Convention included marine water to a depth of six metres, the definition used for the NWCS extends to a depth of ten metres at low tide, as this is recognised seaward boundary of the shallow photic zone (Lombard et al., 2005). An additional minor adaptation of the definition is the removal of the term 'fen' as fens are considered a type of peatland. The adapted definition for the NWCS is, therefore, as follows (SANBI, 2009):

WETLAND: an area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres.

This definition encompasses all ecosystems characterised by the permanent or periodic presence of water other than marine waters deeper than ten meters. The only legislated definition of wetlands in South Africa, however, is contained within the National Water Act (Act No. 36 of 1998) (NWA), where wetlands are defined as "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 land in normal circumstances supports, or would support, vegetation adapted to life in saturated soil." This definition is consistent with more precise working definitions of wetlands and therefore includes only a subset of ecosystems encapsulated in the Ramsar definition. It should be noted that the NWA definition is not concerned with marine systems and clearly distinguishes wetlands from estuaries, classifying the later as a watercourse (SANBI, 2009). The DWA is however reconsidering this position concerning the management of estuaries due to the ecological needs of these systems concerning water allocation. Table 14 provides a comparison of the various wetlands included within the main sources of wetland definition used in South Africa.

Although a subset of Ramsar-defined wetlands was used as a starting point for the compilation of the first version of the National Wetland Inventory (i.e. "wetlands", as defined by the National Water Act, together with open water bodies), it is understood that subsequent versions of the Inventory include the full suite of Ramsar-defined wetlands to ensure that South Africa meets its wetland inventory obligations as a signatory to the Convention (SANBI, 2009).

Wetlands must, therefore, have one or more of the following attributes to meet the above definition (DWAF, 2005):

» A high-water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.
» Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils
» The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water-loving plants).

It should be noted that riparian systems that are not permanently or periodically inundated are not considered true wetlands, i.e. those associated with the drainage lines.

Table 10: Comparison of ecosystems considered to be 'wetlands' as defined by the proposed NWCS, the National Water Act (Act No. 36 of 1998), and ecosystems are included in DWAF's (2005) delineation manual.

Ecosystem	NWCS "wetland"	National Water Act wetland	DWAF (2005) delineation manual
Marine	YES	NO	NO
Estuarine	YES	NO	NO

Waterbodies deeper than 2 m (i.e. limnetic habitats often describe as lakes or dams)	YES	NO	NO
Rivers, channels and canals	YES	NO[1]	NO
Inland aquatic ecosystems that are not river channels and are less than 2 m deep	YES	YES	YES
Riparian[2] areas that are permanently / periodically inundated or saturated with water within 50 cm of the surface	YES	YES	YES3
Riparian areas that are not permanently / periodically inundated or saturated with water within 50 cm of the surface	NO	NO	YES[3]

Rivers: a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow (unidirectional) of water. A river is taken to include both the active channel and the riparian zone as a unit (SANBI, 2013).

Dominant water sources for rivers include concentrated surface flow from upstream channels and tributaries. Other inputs can include diffuse surface or subsurface flow (e.g. from an upstream seepage wetland), interflow (e.g. from an upstream seepage wetland), interflow (e.g. from valley side-slopes), and/or groundwater inflow (e.g. from springs). Water moves through the system, at least periodically, as concentrated flow and usually exits as such, except where there is a sudden decrease in gradient causing the outflow to become diffuse (in which case the river would grade into one of the wetland types). Other water outputs from a river include evapotranspiration and infiltration (SANBI, 2013) (refer to Figure 17).

[1] Although river channels and canals would generally not be regarded as wetlands in terms of the National Water Act, they are included as a 'watercourse' in terms of the Act.
[2] According to the National Water Act and Ramsar, riparian areas are those areas that are saturated or flooded for prolonged periods would be considered riparian wetlands, opposed to non –wetland riparian areas that are only periodically inundated and the riparian vegetation persists due to having deep root systems drawing on water many meters below the surface.
[3] The delineation of 'riparian areas' (including both wetland and non-wetland components) is treated separately to the delineation of wetlands in DWAF's (2005) delineation manual.

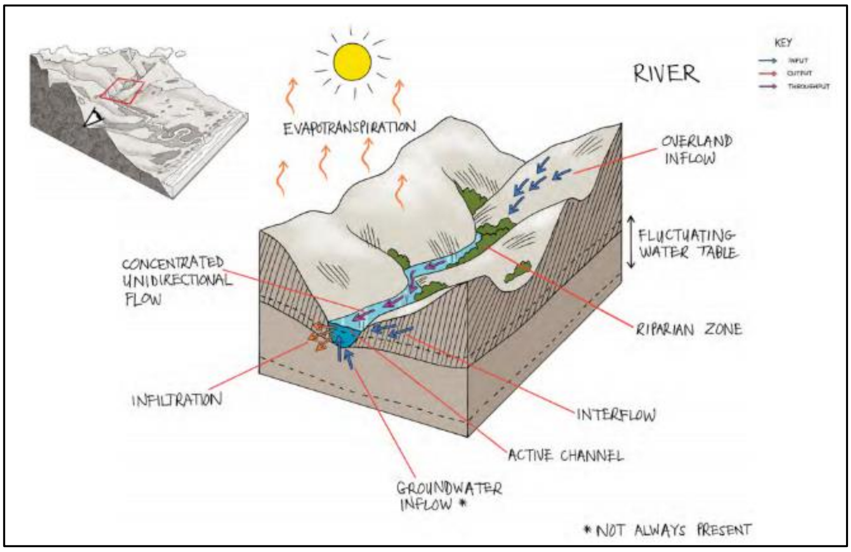

Figure 17: A conceptual illustration of a river as provided by SANBI, 2013.

Riparian zone: According to the definition provided by DWAF (2008), a riparian zone can be described as:

"*the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas*"

Furthermore, DWAF (2008) states that:

"*unlike wetland areas, riparian zones are usually not saturated for a long enough duration for redoxymorphic features to develop. Riparian zones instead develop in response to (and are adapted to) the physical disturbances caused by frequent overbank flooding from the associated river or stream channel*."

Riparian vegetation may be associated with both perennial and non-perennial watercourses/rivers. Riparian areas furthermore represent the transitional area between aquatic and terrestrial habitats. The vegetation associated with riparian zones typically require ample water and are adapted to shallow water table conditions as well as periodical flooding. Due to water availability and rich alluvial soils, riparian areas are usually very productive. Tree growth rate is high and the vegetation under the trees is usually lush in comparison to the upland terrestrial vegetation (refer to Figure 18).

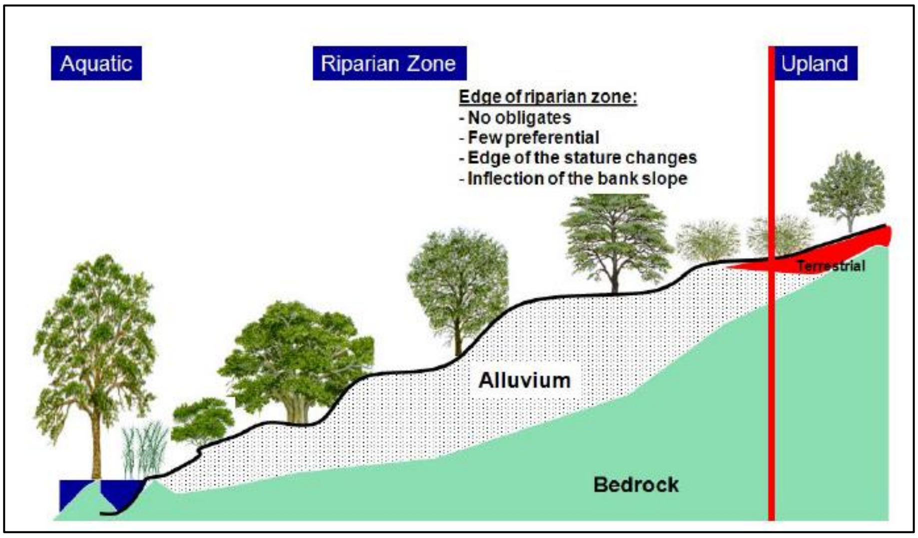

Figure 18: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river (DWAF, 2008).

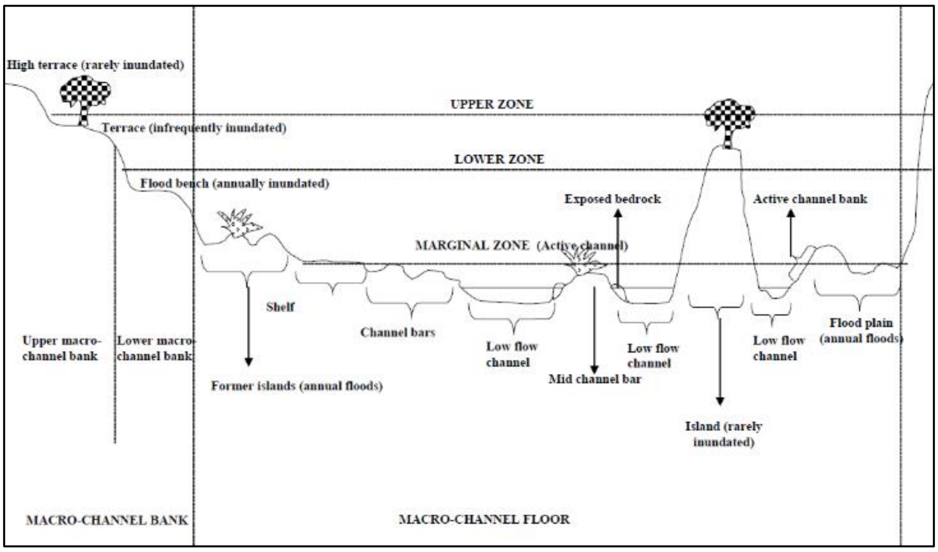

Figure 19: A schematic diagram illustrating (example) the different riparian zones relative to the different geomorphic zones typically associated with a river (Kleynhans *et al*., 2008).

The structure and dynamics of riparian zones are highly variable and are mostly an expression of the hydrological and geomorphological nature of watercourse (Figure 18 and Table 19). As such DWAF (2008) has recommended that the type of river or stream channel with which the riparian zone is associated be considered (Table 11).

Indicators of riparian areas include:

» Landscape position:
  - Riparian areas are associated with valley bottom landscape units (i.e. adjacent to the river/stream channel and floodplains).

» Alluvial soils and recently deposited material:
  - Alluvial soils are soils derived from material deposited by flowing water.

- Alluvial soils cannot always be used as a primary indicator to accurately delineate riparian areas but it can be used to confirm the topographical and vegetative indicators.

» Topography:
- The National Water Act definition of riparian zones refers to the structure of the banks and likely the presence of alluvium.
- A good indicator of the presence of riparian zones is the presence of alluvial deposited material adjacent to the active channel (such as benches and terraces), as well as the wider incised "macro-channels" which are typical of many of southern Africa's eastern seaboard rivers.
- Recently deposited alluvial material outside of the main active channel banks can indicate a currently active flooding area; and thus, the likely presence of wetlands.

» Vegetation:
- The identification of riparian areas relies heavily on vegetative indicators (Unlike wetland delineation which relies on redoximorphic features in soil).
- Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs:
  - in species composition relative to the adjacent terrestrial area; and
  - in the physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, compactness, crowding, size, structure, and/or numbers of individual plants.
- In addition to indicators of structural differences in vegetation, indicator species themselves can be used to denote riparian areas (e.g. Obligate-, Preferential- and Facultative riparian species).

Table 11: Geomorphological longitudinal river zones for South African rivers as characterized by Rowtree & Wadeson (2000) (SANBI, 2013).

Longitudinal Zone (and zone class)	Characteristic gradient	Diagnostic channel characteristics
Zonation associated with a normal profile		
Source zone	Not specified	Low-gradient, upland plateau or upland basin able to store water. Spongy or peaty hydromorphic soils.
Mountain headwater stream	>0.1	A very steep-gradient stream dominated by vertical flow over bedrock with waterfalls and plunge pools. Normally first or second order. Reach types include bedrock fall and cascades.
Mountain stream	0.040-0.099	Steep-gradient steam dominated by bedrock and boulders, locally cobble or coarse gravels in pools. Reach types include cascades, bedrock fall, step-pool, plane bed. Approximate equal distribution of 'vertical' and 'horizontal' flow components.
Transitional	0.020-0.039	Moderately steep stream dominated by bedrock or boulders. Reach types include plane bed, pool-rapid, or pool-riffle. Confident or semi-confined valley floor with limited floodplain development.
Upper foothills	0.005-0.019	Moderately steep cobble-bed or mixed bedrock-cobble bed channel, with plane bed, pool-riffle reach types. Length of

		pools and riffles/rapids similar. Narrow floodplain of sand, gravel, or cobble often present.
Lower foothills	0.001-0.005	Lower gradient, mixed-bed alluvial channel with sand and gravel dominating the bed, locally may be bedrock-controlled. Reach types typically include pool-riffle or pool-rapid, sand bars common in pools. Pools of a significantly greater extent than rapids or riffles. Floodplain often present.
Lowland River	0.0001-0.0010	Low-gradient, alluvial sand-bed channel, typically regime reach type. Often confined, but fully developed meandering pattern within a distinct floodplain develops in unconfined reaches where there is an increase in silt content in bed or banks.
B. Additional zones associated with a rejuvenated profile		
Rejuvenated bedrock fall/cascades	>0.02	Moderate to steep gradient, often confined channel (gorge) resulting from uplift in the middle to lower reaches of the long profile, limited lateral development of alluvial features, reach types include bedrock fall, cascades and pool-rapid.
Rejuvenated foothills	0.001-0.020	Steepened section within middle reaches of the river caused by uplift, often within or downstream of gorge; characteristic similar to foothills (gravel/cobble-bed rivers with pool-riffle/pool-rapid morphology) but of a higher order. A compound channel is often present with an active channel contained within a micro-channel activated only during infrequent flood events. A floodplain may be present between the active and macro-channel.
Upland floodplain	<0.005	An upland low-gradient channel, often associated with uplifted plateau areas as occurring beneath the eastern escarpment.

Table 12: A description of the different riparian vegetation zones typically associated with a river/stream system (Kleynhans *et al*., 2008).

	Marginal	Lower	Upper
Alternative Description	Active features (Wet bank)	Seasonal features (Wet bank)	Ephemeral features (Dry bank)
Extends from	Water level at low flow	Marginal Zone	Lower Zone
Extends to	Geomorphic features/substrates that are hydrologically activated (inundated or moistened) for the greater part of the year	Usually a marked increase in lateral elevation.	Usually a marked decrease in lateral elevation
Characterized by	See above; Moist substrates next to water's edge; water loving-species usually vigorous due to near-permanent access to soil moisture	Geomorphic features that are hydrologically activated (inundated or moistened) on a seasonal basis. May have different species than marginal zone	Geomorphic features that are hydrological activated (inundated or moistened) on an ephemeral basis. Presence of riparian and terrestrial species with increased stature.

Importance and functions of riparian areas

Riparian areas perform a variety of functions that are of value to society, especially the protection and enhancement of water resources, and the provision of habitat for plant and animal species.

Riparian areas can variously:
- » store water and help reduce flood peaks;
- » stabilize stream banks;
- » improve water quality by trapping sediment and nutrients;
- » maintain natural water temperature through shading for aquatic species;
- » provide shelter, food and migration corridors for the movement of both aquatic and terrestrial species;
- » act as a buffer between aquatic ecosystems and adjacent upslope land uses;
- » can be used as recreational sites; and
- » provide material for building, muti, crafts, and curios.

However, as mentioned, the structure and dynamics of riparian zones are highly variable and as such not all riparian areas are capable of fulfilling all of these functions or to the same extent.

Habitat Integrity and Condition of the Affected Freshwater Resources:

To assess the Present Ecological State (PES) or condition of the observed wetlands, a modified Wetland Index of Habitat Integrity (DWAF, 2007) was used. The Wetland Index of Habitat Integrity (WETLAND-IHI) is a tool developed for use in the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP), formerly known as the River Health Programme (RHP). The output scores from the WETLAND-IHI model are presented in the standard DWAF A-F ecological categories (Table 13), and provide a score of the Present Ecological State of the habitat integrity of the wetland system being examined. The author has included additional criteria into the model-based system to include additional wetland types. This system is preferred when compared to systems such as WET-Health – wetland management series (WRC 2009), as WET-Health (Level 1) was developed with wetland rehabilitation in mind, and is not always suitable for impact assessments. This coupled to the degraded state of the wetlands in the study area, a complex study approach was not warranted, i.e. conduct a Wet-Health Level 2 and WET-Ecosystems Services study required for an impact assessment.

Table 13: Description of A – F ecological categories based on Kleynhans et al., (2005).

ECOLOGICAL CATEGORY	ECOLOGICAL DESCRIPTION	MANAGEMENT PERSPECTIVE
A	Unmodified, natural.	Protected systems; relatively untouched by human hands; no discharges or impoundments allowed
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	Some human-related disturbance, but mostly of low impact potential
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	

The WETLAND-IHI model is composed of four modules. The "Hydrology", "Geomorphology" and "Water Quality" modules all assess the contemporary driving processes behind wetland formation and maintenance. The last module, "Vegetation Alteration", provides an indication of the intensity of human land use activities on the wetland surface itself and how these may have modified the condition of the wetland. The integration of the scores from these 4 modules provides an overall Present Ecological State (PES) score for the wetland system being examined. The WETLAND-IHI model is an MS Excel-based model, and the data required for the assessment are generated during a rapid site visit.

Additional data may be obtained from remotely sensed imagery (aerial photos; maps and/or satellite imagery) to assist with the assessment. The interface of the WETLAND-IHI has been developed in a format that is similar to DWAF's River EcoStatus models which are currently used for the assessment of PES in riverine environments.

Conservation importance of the individual wetlands was based on the following criteria:
Habitat uniqueness
Species of conservation concern
Habitat fragmentation concerning ecological corridors
Ecosystem service (social and ecological)

The presence of any or a combination of the above criteria would result in a HIGH conservation rating if the wetland was found in a near-natural state (high PES). Should any of the habitats be found modified the conservation importance would rate as MEDIUM, unless a species of conservation concern were observed (HIGH). Any systems that were highly modified (low PES) or had none of the above criteria, received a LOW conservation importance rating.

Wetland Ecological Importance and Sensitivity (EIS)

The outcomes of the wetland functional assessment were used to inform an assessment of the importance and sensitivity of wetland systems using the Wetland EIS (Ecological Importance and Sensitivity) assessment tool. The Wetland EIS tool includes an assessment of three components:

- Biodiversity support;
- Landscape-scale importance;
- Sensitivity of the wetland to floods and water quality changes.

The maximum score for these components was taken as the importance rating for the wetland which is rated using Table 14.

Table 14: Rating table used to rate level of ecosystem supply.

RATING	IMPORTANCE OR LEVEL OF SUPPLY OF ECOSYSTEM SERVICES
None, Rating=0	Rarely sensitive to changes in water quality/hydrological regime.
Low, Rating=1	One or a few elements sensitive to changes in water quality/hydrological regime.
Moderate, Rating=2	Some elements sensitive to changes in water quality/hydrological regime.
High, Rating=3	Many elements sensitive to changes in water, quality/hydrological regime.
Very High, Rating=4	Vary many elements sensitive to changes in water quality/hydrological regime.

Appendix 5: Methodology: Assessment of Impacts

The Environmental Impact Assessment methodology assists in the evaluation of the overall effect of a proposed activity on the environment. This includes an assessment of the significant direct, indirect, and cumulative impacts. The significance of environmental impacts is to be assessed by means of the criteria of extent (scale), duration, magnitude (severity), probability (certainty) and direction (negative, neutral or positive).

- The **nature**, which includes a description of what causes the effect, what will be affected and how it will be affected.

- The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional,

Immediate area	1
Whole site (entire surface right)	2
Neighboring areas	3
Regional	4
Global (Impact beyond provincial boundary and even beyond SA boundary)	5

» The **duration**, wherein it was indicated whether:

Lifetime of the impact will be of a very short duration (0 – 1 year)	1
The lifetime of the impact will be of a short duration (2 – 5 years)	2
Medium-term (5 -15 years)	3
Long term (> 15 years)	4
Permanent	5

» The **magnitude**, quantified on a scale from 0 – 10,

small and will have no effect on the environment	2
minor and will not result in an impact on processes	4
moderate and will result in processes continuing but in a modified way	6
high (processes are altered to the extent that they temporarily cease)	8
very high and results in complete destruction of patterns and permanent cessation of processes	10

» The **probability** of occurrence, which describes the likelihood of the impact actually occurring. Probability was estimated on a scale of 1 -5,

very improbable (probably will not happen)	1
improbable (some possibility, but low likelihood)	2
probable (distinct possibility)	3
highly probable (most likely)	4
definite (impact will occur regardless of any prevention measures)	5

» The **significance**, was determined through a synthesis of the characteristics described above and can be assessed as;

- **LOW**,
- **MEDIUM** or
- **HIGH**;

» the **status**, which was described as either positive, negative or neutral.
» the degree of which the impact can be reversed,
» the degree to which the impact may cause irreplaceable loss of resources,
» the degree to which the impact can be mitigated.

The significance was calculated by combining the criteria in the following formula:

S=(E+D+M)P where;

» S = Significance weighting
» E = Extent
» D = Duration

» M = Magnitude
» P = Probability

The significance weightings for each potential impact are as follows;

Table 15: Rating table used to rate level of significance.

RATING	CLASS	MANAGEMENT DESCRIPTION
< 30	**Low (L)**	Where the impact would not have a direct influence on the decision to develop the area.
30 - 60	**Medium (M)**	Where the impact could influence the decision to develop in the area unless it is effectively mitigated.
> High	**High (H)**	Where the impact must have an influence on the decision process to develop in the area.

Appendix 6: Description of the Biophysical Environment

Climate and Rainfall

The Olifantshoek/Kathu area is characterized by an arid summer rainfall climate with an average annual temperature of 18.6°C and an average rainfall of 395mm falling predominantly in late summer (highest in March: 74mm). The driest month is July with only 3mm of precipitation. With an average temperature of 25.3°C, January is the warmest month, whilst July is the coldest month with an average of 10.8°C (https://en.climate-data.org/location/27075/).

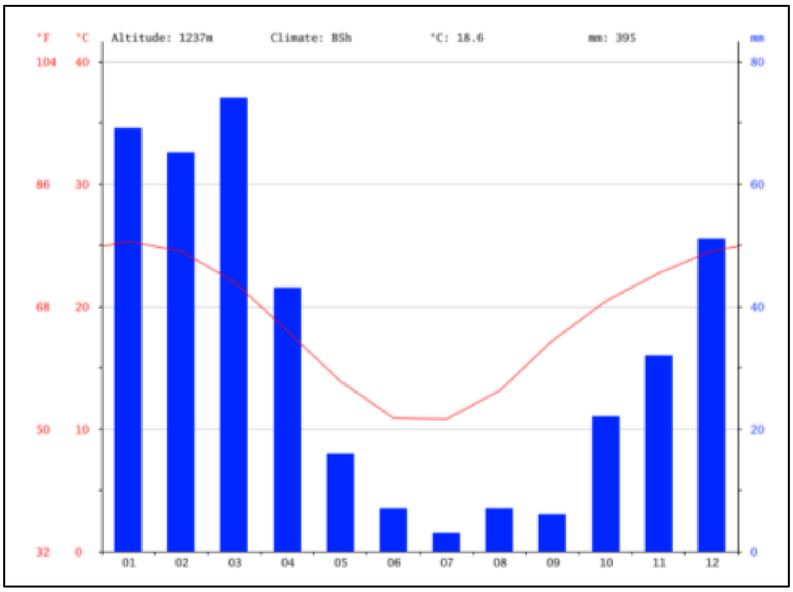

Figure 20: Climate graph of Olifantshoek/Kathu region (https://en.climate-data.org/location/27075/).

month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Okt	Nov	Dec
mm	69	65	74	43	16	7	3	7	6	22	32	51
°C	25.3	24.5	22.0	18.0	13.9	10.9	10.8	13.1	17.2	20.4	22.7	24.5
°C (min)	18.0	17.4	15.2	10.5	5.8	2.4	2.1	4.2	8.4	12.1	14.8	16.9
°C (max)	32.6	31.6	28.9	25.6	22.1	19.5	19.5	22.0	26.0	28.7	30.7	32.2
°F	77.5	76.1	71.6	64.4	57.0	51.6	51.4	55.6	63.0	68.7	72.9	76.1
°F (min)	64.4	63.3	59.4	50.9	42.4	36.3	35.8	39.6	47.1	53.8	58.6	62.4
°F (max)	90.7	88.9	84.0	78.1	71.8	67.1	67.1	71.6	78.8	83.7	87.3	90.0

Figure 21: Climate table of Olifantshoek/Kathu region (https://en.climate-data.org/location/27075/).

Physiography and soils

Landscape Features

According to Mucina and Rutherford (2006), the region can be described as a largely flat (to very slightly undulating) sandy plain covered usually with open tree and shrub layers with, for example, *Acacia luederitzii, Boscia albitrunca,* and *Rhus tenuinervis* and with a usually sparse grass layer.

According to AGIS, 2007 the bulk of the affected landscape is classified as A2 terrain type (>80% has a slope less than 8% with a local relief of 30 – 90m) and is situated within a footlsope/valley bottom landscape setting with a straight slope shape (Z). Percentage slope is generally between 0 and 2%.

At a finer scale using a Google elevation profile for the study area and immediate surrounding landscape can be described as a gently undulating plain interrupted by rocky outcrops and low hills in the south and exposed calcrete and chert plains to the north-east (Figure 22). The landscape has a general south-west to a north-east slope, from the Langeberg Mountains to the west, towards the Ga-Mogara River valley. The Langeberg Mountain Range and the Ga-Mogara River are the most important and prominent geographical features.

The southern portion (6km), south of the N14, is located within an undulating landscape comprising of moderate to deep sandy valleys and foot slopes intersected by low hills and rocky outcrops. The southern portion is situated between elevations of 1226 m and 1287 m (average elevation of 1257 m) with the highest portion being the section crossing the andesitic lava outcroppings of Harley Hill. The average slope of this stretch is 1.9%, -2.2% with a maximum slope of 7.8%.

The section of the power line route between the N14 Road and the Ga-Mogara River can be described as a gently undulating plain with slight typographical variations within the landscape as a result of the varying depth of the aeolian regic sands. Lower lying areas are associated with areas where the deposited sands have been thinned out, exposing chert, volcanic rock, and calcrete surfaces, as well as with the lower-lying ephemeral Ga-Mogara River which can be characterised as a relative shallow alluvial valley with moderate sloping banks. This section is located between elevations 1231 m and 1165 m above sea level (lowest point associated with the Ga-Mogara River) with an average slope of 1%, -1%.

North of the Ga-Mogara River the landscape becomes much flatter with less typographical variation and is dominated by a relatively deep regic sand cover. This section of the route is located between elevations 1177 m and 1159 m above sea level with an average slope of 0.9%, -1.2%.

Figure 22: Elevation profile (Google) of the power line route from Emil substation to the Olifantshoek substation). Important typographical features: A = andesitic lava outcropping; B = chert hill; C = low lying calcrete plain; D & F = elevated deep regic sand; E = exposed chert area; G = Ga-Mogara River, H = Ga-Mogara River

Geology

Regional Geology

The basement consists of porphyritic granite. The Ventersdorp Super Group overlies the porphyritic granite and consists of green andesitic lava with amygdaloids in places, occurs in the northeast, and attains a geologically estimated thickness of 60m. Griqualand West Super Group: At its base is the Vryburg Formation consisting of arkose (occasionally mica rich) and quartzite, lies unconformably on either the granite or the Ventersdorp Super Group rocks.

The Schmidsdrift Formation overlies the Vryburg Formation and forms the lowest unit of the Campbell Group. It is divided into 3 members each being approximately 10m thick. The lowest member consists of alternating layers of oolitic and stromatolitic dolomite with thin interbedded layers of shale and quartzite. The shale becomes more prominent higher up in the succession with the result that the middle member consists mainly of ferruginous shale with siltstone and interbedded thin dolomite. The upper member consists mainly of calcitic dolomite with few stromatolites and thin interbedded shale and siltstone.

The Ghaap Plateau Formation: Very similar to the Schmidsdrift Formation and there is a gradational contact between the Ghaap Plateau Formation and the underlying Schmidsdrift Formation and can only be distinguished where the quartzite is present on the latter. A brown ferruginous jasper layer, up to 12m thick, separates the lowest part of the formation from the overlying grey coarse-grained dolomite. The upper part contains lenses and breccia of chert and a prominent layer of chert which tops the succession.

The Asbestos Hills Formation forms part of the Griquatown Group and lies conformably on the Ghaap Plateau Formation. The formation is subdivided into the Kuruman and Danielskuil Members. The uppermost chert of the Ghaap Plateau Formation grades into banded ironstone of the Kuruman Member which varies in thickness from 180 to 240m. It consists of a succession of thin alternating layers of light coloured chert and jasper and dark-coloured ferruginous jaspilite. The jaspilite contains mainly magnetite, haematite, and limonite. The rock also contains several crocidolite-bearing zones. The "blinkklip breccia", a basal layer of banded iron stone, lies on the Ghaap Plateau Formation in the Maremane Anticline. The Danielskuil Member has an undulating structure and consists of brown jaspilite with thin magnetite layers and lenticular breccia and chert nodules. The overlying jaspilite attains a thickness of 150m and several marker layers.

The Gamagara Formation was deposited on the Maremane Anticline and rests unconformable on dolomite and banded iron stone of the underlying formations. It consists of a basal conglomerate with pebbles of jasper, ironstone, shale with lenses of conglomerate, iron-rich flagstone and quartzite. The formation has a thickness of 300m and when resting on banded ironstone are ferruginised and manganised where they lie on dolomite.

The Makganyane Formation lies unconformable on the Gamagara Formation, where the latter is developed and elsewhere it overlies the Asbestos Hills Formation conformably. The maximum thickness is less than 470m. A tillite occurs at the base of the formation and contains fragments of chert and jasper. Higher up in the succession alternating layers of grit, tillite, silicified mudstone and felspathic quartzite occur. Dolomite or limestone occurs interbedded in the mudstone.

The Ongeluk Formation forms the lower part of the Olifantshoek Group. Andesitic lava belonging to this formation crops out in the Dimoten Syncline and west of the Maremane Anticline and disappears under the sand cover further north. The formation consists of grey-green lava with jasper amygdales and lenses of red
jasper.

The Voëlwater Formation overlies the Ongeluk Formation and has a thickness of 450m. The lower beds are banded ironstone and banded red jasper with chert, dolomite and lava. In the north, there is a manganiferous jaspilite near the base of the formation. The upper portion of the succession consists predominantly of dolomite with chert, banded jasper and lava.

The Lucknow Formation occurs east of Olifantshoek and also in the Koranaberg where the strata are disturbed by several faults. It lies unconformably on the Voëlwater Formation. The formation has a maximum thickness of 1500 m. The lower portion consists of mainly shale with subordinate layers of quartzite and lava and the upper portion of whitish quartzite with lenses of flagstone and dolomitic limestone.

The bedrock geology is mainly covered by Tertiary and younger deposits known as Kalahari Group sediments. The pre-tertiary topography of the area controlled deposition of these sediments. The total thickness of the Kalahari Beds was reported by Smit (1977) to exceed 100m.

Several sub-outcropping dykes (mainly magnetic with some low to non-magnetic) occur in the area. These dyke structures are mainly visible on aerial photos and remote sensing images where the soil or sediment cover is less than 15 meters. These linear structures mostly represent intrusive dykes, which are generally near vertical (85 to 90degrees) and have strike lengths in excess of 100 km. The general strike directions are WSW – ENE, SSW –NNE, and ESE – WNW.

Local Geology and Hydrogeology

The local geology consists of mainly Banded Iron Formation of the Asbestos Hills Formation and Andesitic Lava of the Ongeluks Formation. The bulk of the basement geology is concealed beneath the partially consolidated sediments of the Kalahari Group. To the south, the Kalahari cover becomes thin and patchy and large areas of bedrock are exposed. Within the southern portion of the proposed power line rocks of the Olifantshoek Supergroup becomes exposed as this Kalahari blanket thins out. Between the N14 and the Ga-Mogara this blanket of Kalahari sand thins out several times exposing calcrete surface to the south and north and chert, lava, and ironstone surfaces within the midsection. (refer to Figures 23, 24, 25 and 26).

Outcroppings and hills (e.g. Hartley Hill) comprise of this supergroup and can be divided into two unconformity-bounded sequences. The oldest of these sequences is named the Elim Group and consists of the Mapedi and Lucknow formations, an upward coarsening shale to quartzite succession with interbedded carbonate rocks. The second sequence is taken from the regional unconformity at the base of the overlying Harley Formation, which is composed of basal conglomerate and quartzite, followed by dominantly volcanic rocks. The Hartley Formation is overlain conformably by light grey to white sandstone, forming the top of the Volop Group.

The Kalahari Group Sediments is subdivided into 4 formations, i.e. Wessels Gravel Formation, overlain by the Budin Clay Formation, and the Eden Sandstone Formation and followed by the Mokalanen Limestone Formation at the top.

- **Wessels Gravel Formation**
  The Wessels Formation consists of brown clayey gravel with gravel beds, which as a rule contains a large percentage of clay (30%). It occupies some of the deeper troughs and channels of the pre-Kalahari surface and reaches a maximum thickness of 100m.

- **Budin Clay Formation**
  The Budin Formation reaches a maximum thickness of 100m and consists predominantly of red and brown clay, marl, and micaceous shale. The clay often contains fine-grained (<2mm) gravel material. Cross-bedded gravels occur near the base, where they apparently grade into the Wessels Formation. The environment of deposition is probably lacustrine or low-energy fluvial.

- **Eden Sandstone Formation**
  The Eden Formation consists of greenish generally rather loosely consolidated sandstones, grits, and minor intra-formational conglomerates. The sediments show a gradation downwards into the Budin Formation, and upwards into sandy limestone. The maximum thickness is about 80m.

- **Mokalanen Calcrete Formation**
  The calcrete of the Mokalanen Formation forms the boundary between the Tertiary and Quaternary rocks. It occurs extensively on the Dwyka Formation. The formation consists of hardpan calcrete (generally thick and of Quaternary Age) with underlying white diatomaceous limestone (fossiliferous), loosely consolidated with a very low density. The maximum thickness of the formation is 50m. The depositional environment is probably one of a sluggish flowing river or a still freshwater lake.

- **Intrusive diabase and dolerite dykes** (mainly magnetic with some low magnetic to non-magnetic) represent the youngest rocks in the study area. The dykes generally intruded along major faults, are mostly impervious (with low to impervious hydraulic conductivity) and compartmentalize the dolomite aquifer into sub-units. These dykes are only present in the bedrock below the Kalahari sediments.

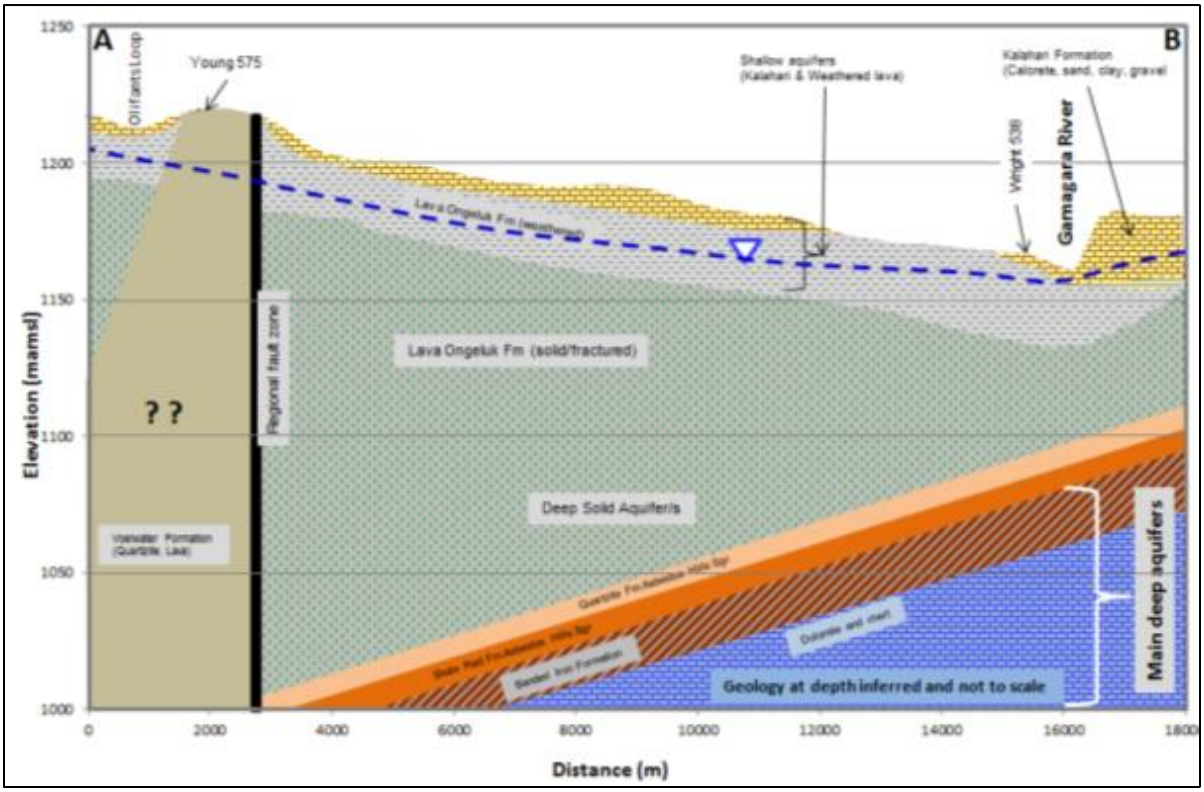

Figure 23: Conceptual west-east hydrological cross-section of the study area north of the N14 as provided by Vivier (2016).

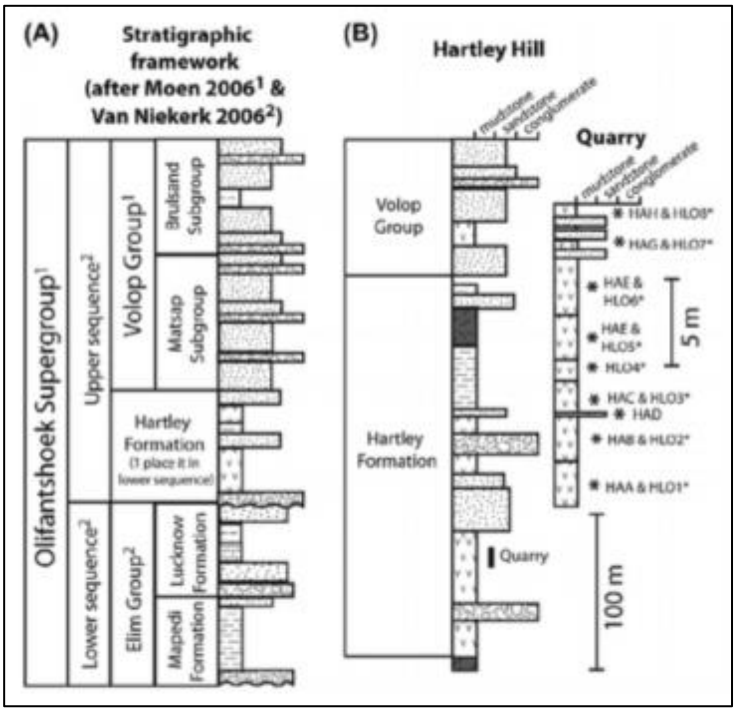

Figure 24: Lithostratigraphy of the Olifantshoek Supergroup. A. Stratigraphic framework of the Olifantshoek Supergroup after Moen (2006) and Van Niekerk (2006). B. Lithostratigraphy at Hartley Hill (modified after Cornell, 1987).

Groundwater is the only reliable resource of water supply in the area. According to Vivier (2016) there are a number of important hydrogeological zones with the affected landscape namely:

» The Gamagara River Alluvial Aquifer that consists of sediments containing gravel, calcrete and clay. The riverbed is underlain by clay in some sections.
» The surficial Kalahari beds that consists of clacrete, sand and clay as well as gravel. The Kalahari beds are underlain by a thick clay layer towards the west where Sishen Mine is located.
» The weathered/fractured and solid/fractured lava underlies the Kalahari Beds and forms weathered basins where groundwater was historically developed.
» The lava formations are underlain by quartzite, shale, banded iron formation and dolomite. The banded iron formation forms the major regional aquifer in the area.
» The lava contains geological structures that are inferred as dolerite dykes and/or fault zones that strike mainly north-east to south-west.

The water levels according to the study conducted by Viviers (2016) indicated that water levels in the Ga-mogara River Alluvial Aquifer were historically much shallower at 1m to 2m as it was recharged by flooding from the river every 5 – 8 years. These water levels are now around 6m to 8m deep. The cause of the deeper water levels in the Ga-mogara River Alluvial Aquifer has been confirmed to be due to leakage of the river into the Sishen Compartment that is partially dewatered by mining. Concerns were also raised within the study that the Olifantsloop drainage could also be affected by the impact on the Gamagara.

The same situation was recorded for water levels in the lava formation which declined from 10m to 15m deep in the hand-dug wells in the 1960's to around 20m to 40m since around 2005.

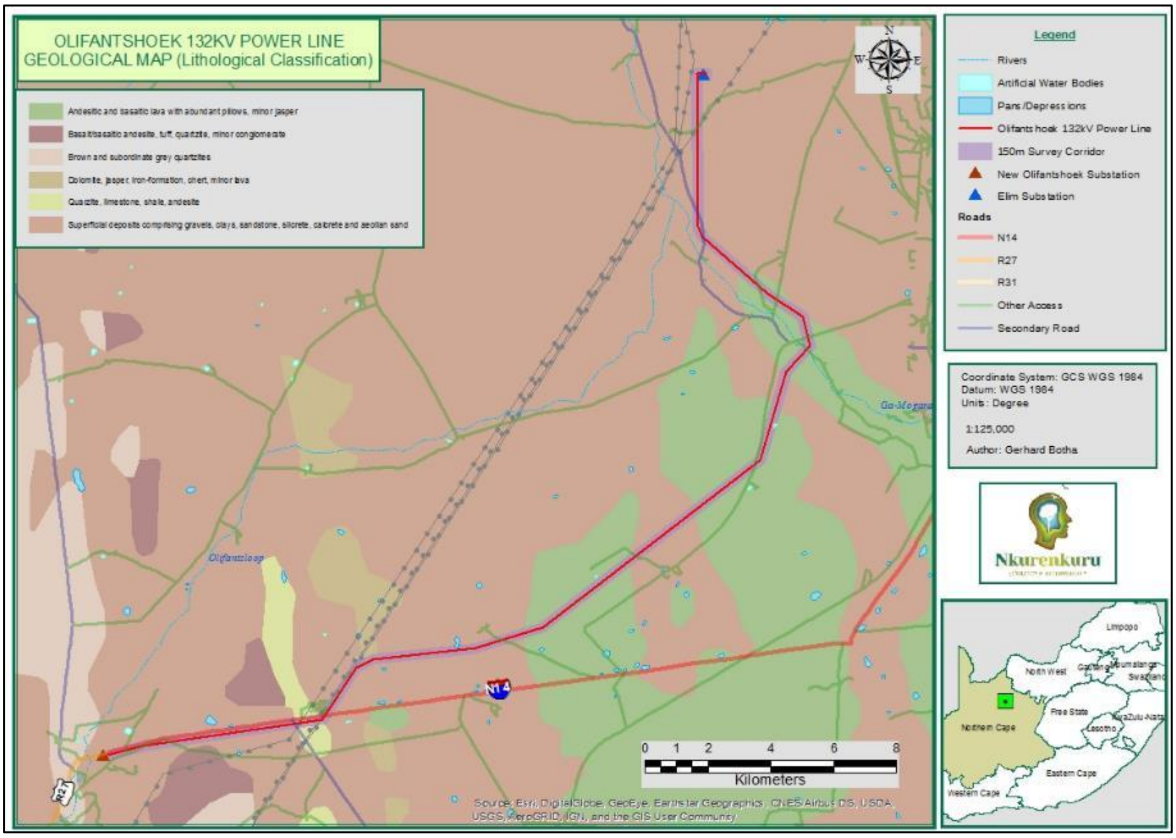

Figure 25: Map indicating the main lithological groups of the impacted area as well as surroundings.

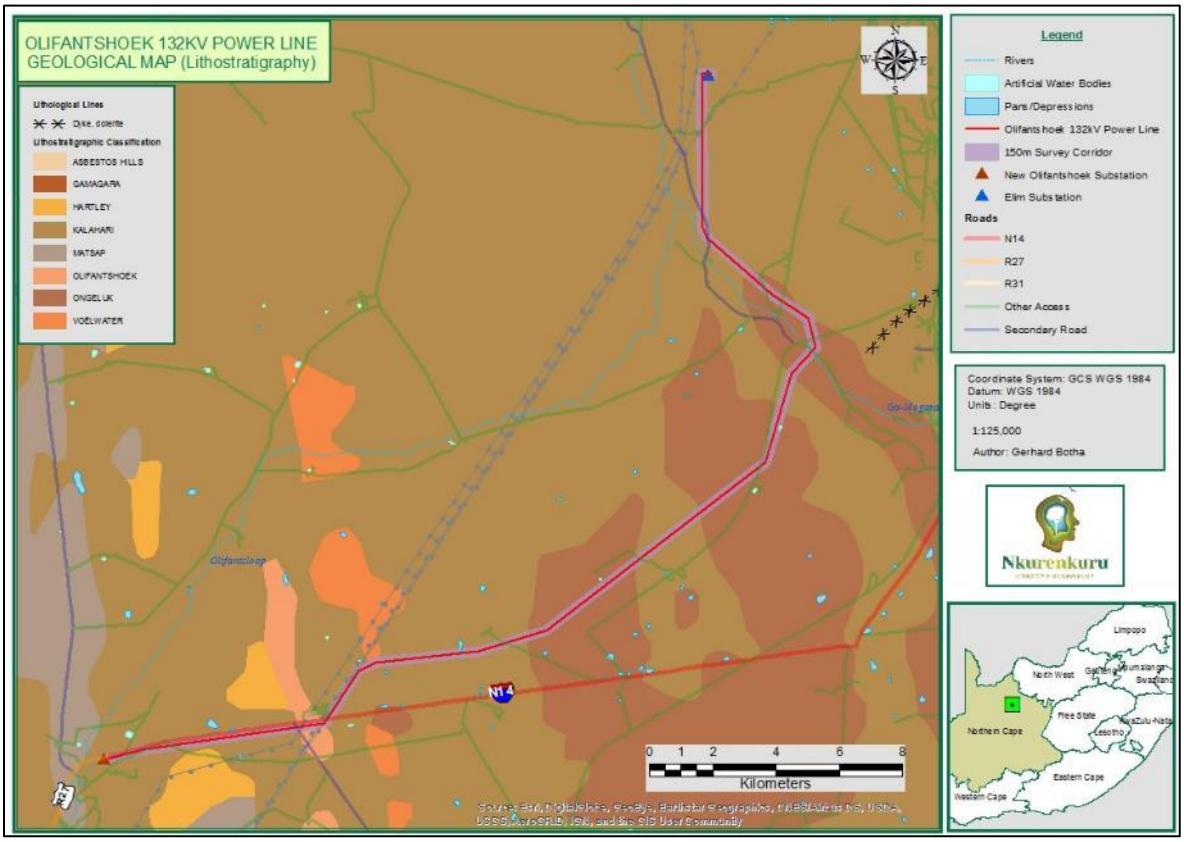

Figure 26: Map indicating the dominant rock forms found within the project site as well as surroundings.

Soil and Land Types

Detailed soil information is not available for broad areas of the country. A surrogate land type data was used to provide a general description of soil in the study area (land types are areas with largely uniform soils, topography, and climate). The study area is situated within the Ae6, Ae7, and Ag110 land types (Figure 26).

» Ae land type refers to areas characterised by red-yellow apedal, freely drained soils (Red, high base status soils, deeper than 300mm without dunes). This moderately deep red, freely drained apedal soils occur in areas associated with low to moderate rainfall (300-700mm per annum) in the interior of South Africa and have a high fertility status. A wide range of texture occurs (usually sandy loam to sandy clay loam). Dominant soil forms include Hutton and Oakleaf. Isolated areas with shallow soils are characterised by the Mispah soil form.

» The Ag land type is characterised by red to yellow apdeal freely drained soils (red, high baste status soils, normally shallower than 300mm). These shallow red, freely drained, apedal soils occur in arid to semi-arid areas associated with low rainfall (less than 500mm per annum) and are underlain by hard to weathered rock. Stones or rocks are often present on the soil surface (Land Type Survey Staff, 1987). Areas with deeper soils are characterised by the Hutton soil form, whilst the areas containing shallow soil are usually characterised by the Mispah soil form.

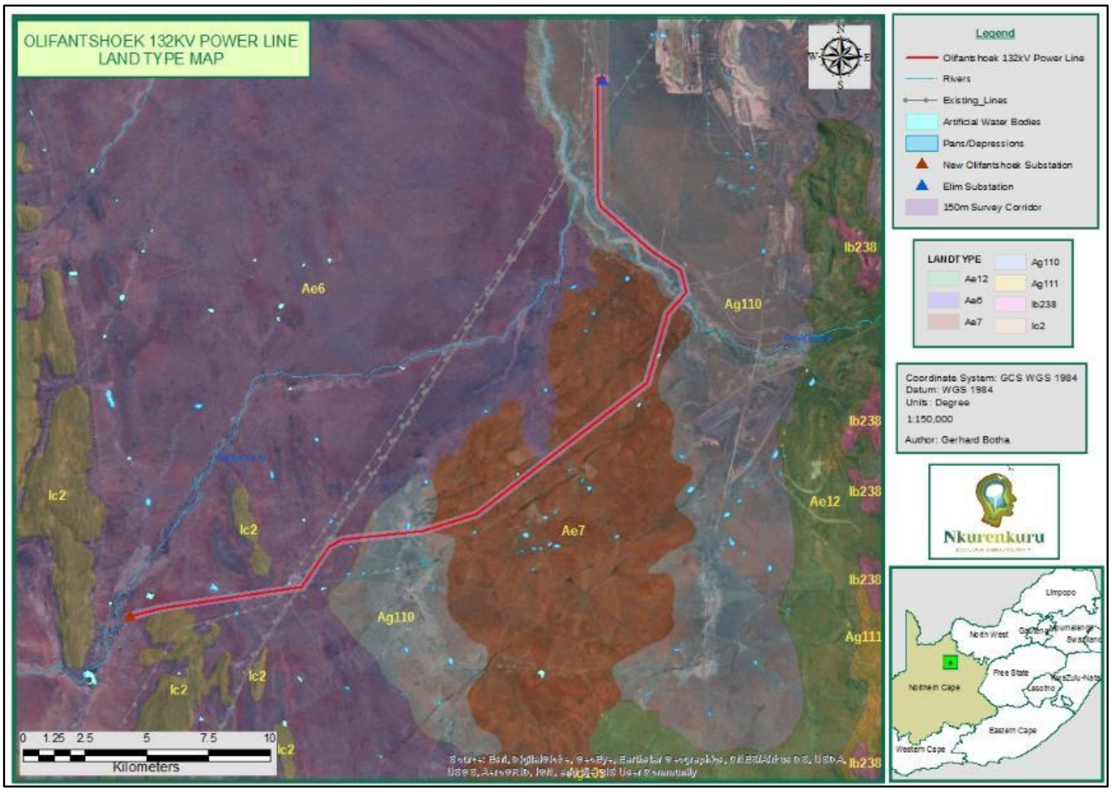

Figure 27: Land types found within the power line corridor as well as the surrounding landscape.

Surface Hydrology

The project site is situated within the Lower Vaal Water Management Area (WMA), Quaternary Catchment D41J (Molopo River primary catchment), and Ecoregion 31.02 (Southern Kalahari Ecoregion) (Figures 28, 29).

The Lower Vaal WMA is located downstream of the Bloemhof Dam and upstream of the Douglas Weir and covers a catchment area of 51,543 km^2. WMA 10 is largely dependant on water releases from the Middle Vall WMA for meeting the bulk of the water requirements by the urban, mining and industrial sectors within its area of jurisdiction, with local resources mainly used for irrigation and smaller towns. Water quality in the Lower Vaal WMA is strongly influenced by usage and management practices in the Upper- and Middle Vaal WMA. WMA 10 consists of five large drainage basins (Primary Catchment Areas), however, WMA 10 is typically divided into three main-areas or Sub-Water Management Areas, namely the Molopo, Harts and Vaal River downstream of Bloemhof Dam. Land use within the Lower Vaal WMA is dominated by stock farming. The proposed development is located within the Molopo Sub-Water Management Area. Apart from livestock farming, mining also plays an important role within this Sub-Water Management Area with the Sishen Mine, the major supplier of iron ore in the country, located within the area.

According to the Lower Vaal WMA Overview of Water Resources Availability Report, DWAF (2003a), "As a result of the low rainfall, flat topography and sandy soils over much of the water management area, little usable surface runoff is generated in the water management area. The runoff which does occur is highly variable and intermittent. Although occasional runoff occurs in the upper reaches of the Molopo River, no record exists of flow having reached the Orange River. Previous recordings of flow in the lower reaches of the Molopo and/or Kuruman Rivers were in 1933 and again in the 1974/5 and 1975/76 seasons." It must be noted that the 197 million m^3 per annum, mentioned within the above-mentioned overview, is the natural mean runoff for the entire Molopo catchment, including the upper portion of the catchment, which falls outside this WMA, in the neighbouring state of Botswana. The contribution of runoff from the South African portion of the Molopo catchment is negligible as the remaining runoff is lost through evaporation. There are no storage dams within the Molopo SWMA.

The proposed development footprint is located within the Olifants River and Ga-Mogara Catchment (Quaternary Catchment D41J).

The entire study area is drained by these main, non-perennial watercourses namely the Olifantsloop River (42.492 km) and the Ga-mogara River (88.037 km). The Olifantsloop River originates within Langeberg Mountain range, west of the town of Olifantshoek. The watercourse flows in an eastern direction until reaching Olifantshoek, after which it flows in a north-eastern direction to terminate into the Ga-mogara River (~1.1 km south-east of the point where the proposed powerline will cross the Ga-mogara River). The Ga-mogara

River originates as smaller tributaries within the Asbestos Mountains north-east of the town of Danielskuil and flows in a north-western direction past smaller settlements as well as the southern portion of the Sishen mining area (Dingelton). The entire system is endorheic with the Ga-mogara River flowing into the Kuruman River close to Hotazel, after which the Kuruman River flows into the Molopo River at Andriesvale south of the Kgalagadi Transfontier Park. From there, the Molopo flows into the Abiekswasputs pans north of the town of Noenieput. There is hence no outflow into the sea.

The only natural wetlands in the project area are small, endorheic, closed depressions) pans. *A depression is 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, groundwater discharge, interflow, and (diffuse or concentrated) overland flow. Dominant hydrodynamics are (primarily seasonal) vertical fluctuations. Pans such as in the study area are flat-bottomed lack in and outlets. For this 'endorheic depression', water exits by means of evaporation and infiltration*

These depressions form due to micro-topography variations of the underlying substrates (shallower soils over calcrete), giving rise to low grasslands on pan bottoms (may even be devoid of vegetation). The outer belt of these pans comprises of a mixture of tall shrubs and trees. The pan-like alluvium consists of sandy loam with a fairly high content of Calcium and Phosphate. The pan soils consist of white (washed) sand and is exposed for most of the year and carry shallow pools for a short period of time following sufficient rains.

The natural topography of the site has been significantly altered (especially to the east) as a result of historic and on-going mining activities. Currently, the existing mine infrastructure and activities dominate the landscape at Sishen, and the natural, relatively flat topography has been replaced by man-made topographical features.

Numerous of these depression wetlands have been listed within the NFEPA spatial data is indicated in Figure 29.

According to the Present Ecological State (DWS PES, 1999) the condition of the Ga-mogara River is classified as Class B, which indicates that the river is still largely in a natural state. The same PES classification (Class B) was provided for the Olifantsloop River, a non-perennial tributary of the Ga-mogara River.

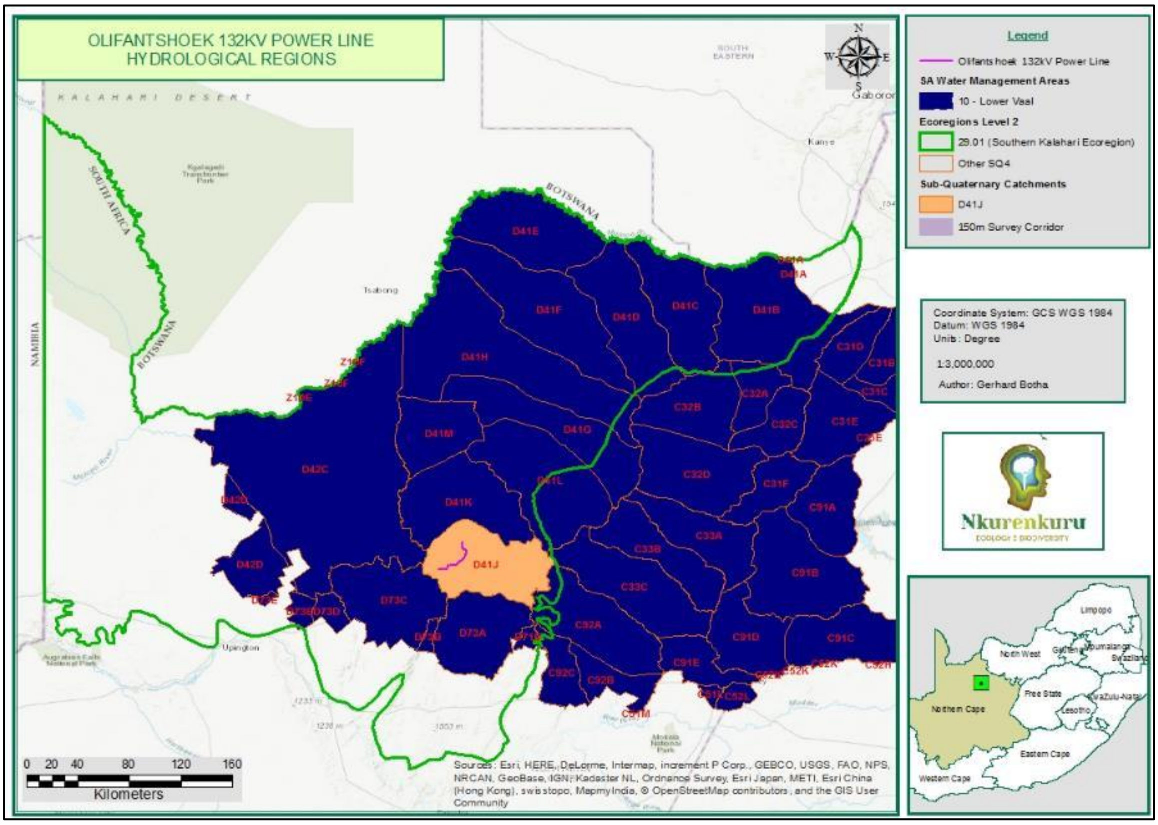

Figure 28: Map indicating the major hydrological regions of the area.

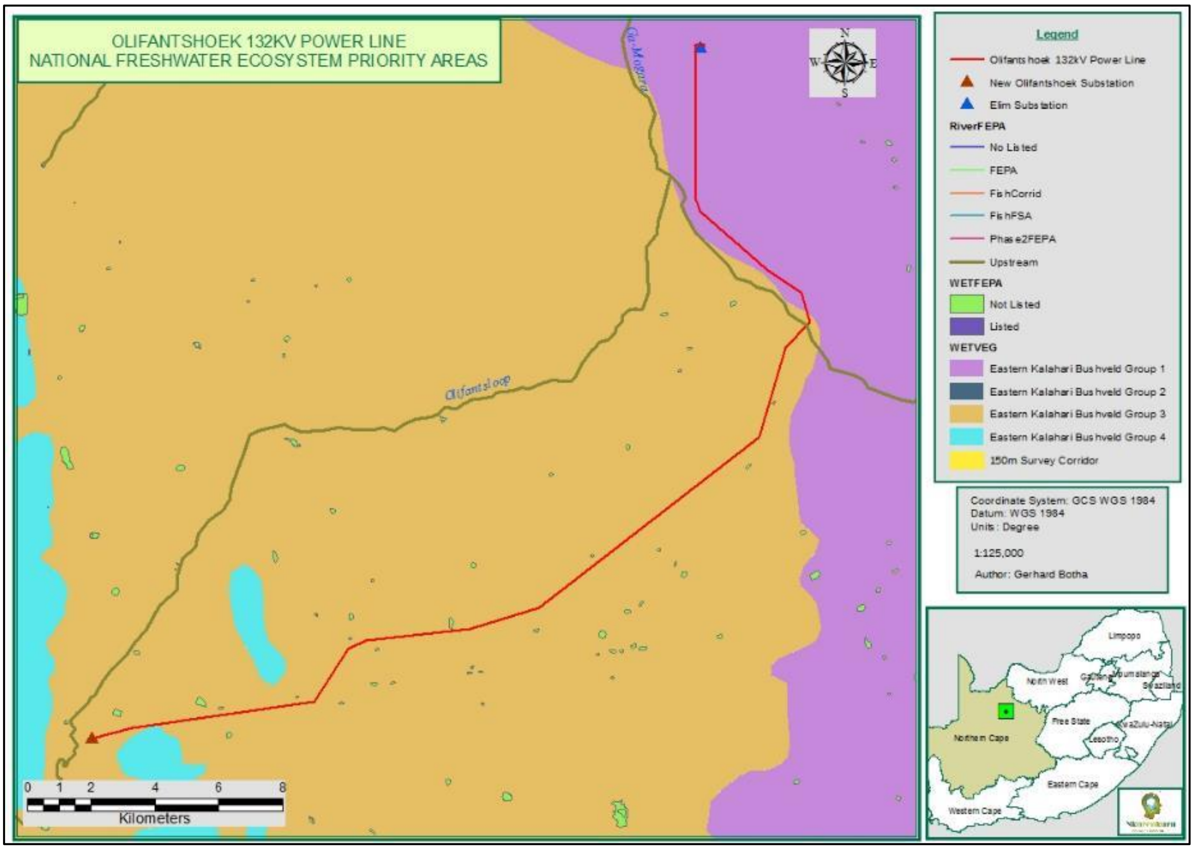

Figure 29: NFEPA Map illustrating the numerous small depression wetlands as well as the two most important freshwater resource features of the area namely the Olifantsloop River and the Ga-Mogara River.

Existing Land Use

Land use within the study area is mostly for farming. Farming practices consist mainly of cattle and game farming and to a lesser extent farming with sheep and goats. North of the N14 the power line will traverse, for approximately 4km, degraded land, mainly due to grazing pressure from cattle and game and the gravel pit located just north of the N14. Historically some areas have been ploughed and irrigated, mainly for the cultivation of lucern, ranging in size between 2ha to 16ha on some farms that had high yielding boreholes. The northern portion of the proposed power line will traverse such a historically cultivated area. Apart from agricultural practices, mining forms the largest industrial land use activity within the larger landscape (e.g. Sishen to the west of the study area).

The proposed power line will be, for a short distance, located parallel to the existing servitude of the 275kV power line and new 400kV power line. The servitudes of the 275kV & 400kV power lines have been cleared of all tall trees and shrub species. The power line will cross the gravel road to Dingleton in the north after which it will connect to the existing Emil Eskom switching station.

Major land transformation within the survey corridor is due to numerous roads, railway, cleared servitudes for power lines as well as some small scale mining and borrow pits.

Vegetation Overview

Broad-Scale Vegetation Patterns

According to the national vegetation map (Mucina & Rutherford 2006), there are several vegetation types in the wider area around the site but only three within the footprint of the power line corridor (Figure 4). The route falls predominantly within the Olifantshoek Plains Thornveld vegetation type, with the northernmost section within the Kathu Bushveld vegetation type and a small section of the line traversing Kuruman Thronveld.

Olifantshoek Plains Thornveld has a relatively limited extent of 8496 km^2 and occurs on most of the pediment areas of the Korannaberg, Langeberg and Asbestos Mountains as well as those of some ridges to the west of the Langeberg. It stretches from the vicinity of Sonstraal in the north, past Olifantshoek to areas north of Niekerkshoop between Volop and Griekwastad in the south as well as from Griekwastad northwards to the flats west of Lime Acres. It is described as a very wide and diverse unit on plains with usually open tree and shrub layers which vary in composition from place to place across the unit. Key species of this vegetation type are; *Vachellia luediritzii*, *Boscia albitrunca* and *Searsia tenuinervis*. It is classified as Least Threatened and has not been significantly impacted by transformation and about 99% of the original extent remains. It is however very poorly conserved and less than 1% is statutorily conserved in the Witsand Nature Reserve. No endemic species are known from this vegetation unit, which can be ascribed to its relatively limited extent and association with a relatively homogenous and unspecialised habitat.

Table 16: Key species associated with the Olifantshoek Plains Thornveld according to Mucina and Rutherford (2006).

Growth Form	Key Species
Tall Tree	*Vachellia erioloba*
Small Tree	*Senegalia mellifera subsp. detinens, Boscia albitrunca, Terminalia sericea*
Tall Shrubs	*Lessertia frutescens, Lycium hirsutum, Rhigozum obovatum, Searsia tridactyla, Tarchonanthus camphoratus*
Low Shrubs	*Aptosimum procumbens, Grewia retinervis, Hoffmannseggia burchellii, Lycium pilifolium, Solanum tomentosum, Solanum tomentosum*
Geoxylic Suffrutex	*Elephantorrhiza elepantina*
Graminoids	*Schmidtia pappophoroides, Stipagrostis uniplumis, Aristida congesta, Brachiaria serrata, Digitaria eriantha, Melinis repens*
Herbs	*Acanthosicyos naudinianus, Gisekia pharnacioides, Hermannia tomentosa, Ipomoea magnusiana, Oxygonum delagoense, Pollichia campestris, Tephrosia purpurea subsp. leptostachya*
Succulent Shrubs	*Lycium cinereum, Talinum caffrum*
Succulent Herb	*Piaranthus decipiens*
Biogeographically Important Taxa	
Growth Form	**Species**
Small Tree	*Vachellia luederitzii var. luederitzii, Terminalia sericea*
Tall Shrubs	*Lebeckia macrantha*
Low Shrubs	*Hermannia burchellii, Justicia puberula, Putterlickia saxatilis, Tarchonanthus obovatus*
Graminoid	*Anthephora argentea*
Herb	*Sutera griquensis*
Endemic Taxa	
Growth Form	**Species**
Low Shrub	*Amphiglossa tecta*

The Kathu Bushveld vegetation unit occupies an area of 7443 km^2 and extends from around Kathu and Dibeng in the south through Hotazel and to the Botswana border between van Zylsrus and McCarthysrus. In terms of soils, the vegetation type is associated with aeolian red sand and surface calcrete and deep sandy soils of the Hutton and Clovelly soil forms. The main land types are Ah and Ae with some Ag. This vegetation type is characterised by a medium-tall tree layer with *Vachellia erioloba* in places, but mostly open and including *Boscia albitrunca* as the prominent trees. The shrub layer is generally the most important with, for example, *Senegalia mellifera*, *Diospyros lycioides* and *Lycium hirsutum*. Grass layer is variable in cover. The Kathu Bushveld vegetation type is still largely intact and less than 2% has been transformed by mining activity and it is classified as Least Threatened. It is, however, poorly conserved and does not currently fall within any formal conservation areas. Although no endemic species are restricted to this vegetation type a number of Kalahari endemics are known to occur in this vegetation type such as *Vachellia luederitzii* var *luederitzii*, *Anthephora argentea*, *Megaloprotachne albescens*, *Panicum kalaharense* and *Neuradopsis bechuanensis*.

Table 17: Key species associated with the Kathu Bushveld according to Mucina and Rutherford (2006).

Growth Form	Key Species
Tall Tree	*Vachellia erioloba*
Small Tree	*Acacia mellifera subsp. detinens, Boscia albitrunca, Terminalia sericea*
Tall Shrubs	*Diospyros lycioides subsp. lycioides, Dichrostachys cinerea, Dichrostachys cinerea, Grewia flava, Gymnosporia buxifolia, Rhigozum brevispinosum*
Low Shrubs	*Aptosimum decumbens, Grewia retinervis, Nolletia arenosa, Sida cordifolia, Sida cordifolia, Tragia dioica*
Graminoids	*Aristida meridionalis, Brachiaria nigropedata, Centropodia glauca, Eragrostis lehmanniana, Schmidtia pappophoroides, Stipagrostis ciliata, Stipagrostis ciliata, Aristida congesta, Eragrostis biflora, Eragrostis chloromelas, Eragrostis heteromera, Eragrostis pallens, Melinis repens, Melinis repens, Schmidtia kalahariensis, Stipagrostis uniplumis, Tragus berteronianus*
Herbs	*Acrotome inflate, Erlangea misera, Gisekia Africana, Heliotropium ciliatum, Hermbstaedtia fleckii, Hermbstaedtia odorata, Limeum fenestratum, Limeum fenestratum, Limeum viscosum, Lotononis platycarpa, Senna italica subsp. arachoides, Tribulus terrestris*
Biogeographically Important Taxa	
Growth Form	**Species**
Small Tree	*Vachellia luederitzii var. luederitzii, Terminalia sericea*
Graminoid	*Anthephora argentea, Megaloprotachne albescens, Panicum kalaharense*

The **Kuruman Thornveld** vegetation unit occupies an area of about 5794 km^2 and extends from around Postmasburg and Danielskuil (flats, west of the Kuruman Hills) in the south via Kuruman to Tsineng and Dewar in the North. This vegetation type is found between altitudes of 1100 m and 1500 m. This vegetation type occupies flat rocky plains and some sloping hills characterised by dolomites and chert of the Campbell Group as well as younger, superficial Kalahari Group sediments with red wind-blown (0.3-1.2 m deep) sand. Most important land types are Ae, Ai, Ag and Ah, with Hutton soil form. The Kuruman Thornveld typically contains a well-developed, closed shrub layer and well-developed open tree stratum consisting of *Vachellia erioloba*. This vegetation type is still largely intact and less than 2% has been transformed. It is, however poorly conserved and does not currently fall within any formal conservation areas. This vegetation type is regarded as Least Threatened. Only one endemic taxon is restricted to this vegetation type namely; Gnaphalium englerianum. A few Griqualand West- and Kalarhari Endemics are known to occur within this vegetation types such as *Vachellia luederitzii* var *luederitzii, Vachellia haematoxylon, Blepharis marginata, Digitaria polyphylla* and *Corchorus pinnatipartitus*.

Table 18: Key species associated with the Kuruman Thornveld according to Mucina and Rutherford (2006).

Growth Form	Key Species
Tall Tree	*Vachellia erioloba*
Small Tree	*Senegalia mellifera subsp. detinens, Boscia albitrunca*
Tall Shrubs	*Grewia flava, Lycium hirsutum, Tarchonanthus camphoratus, Gymnosporia buxifolia*
Low Shrubs	*Acacia hebeclada subsp. hebeclada, Monechma divaricatum, Gnidia polycephala, Helichrysum zeyheri, Hermannia comosa, Pentzia calcarea, Plinthus sericeus*
Geoxylic Suffrutex	*Elephantorrhiza elepantina*
Graminoids	*Aristida meridionalis, Aristida stipitata subsp. stipitata, Eragrostis lehmanniana, Eragrostis echinochloidea, Melinis repens, Melinis repens*
Herbs	*Dicoma schinzii, Gisekia Africana, Gisekia Africana, Gisekia Africana, Harpagophytum procumbens subsp. procumbens, Indigofera daleoides, Limeum fenestratum, Limeum fenestratum, Nolletia ciliaris, Seddera capensis, Tripteris aghillana, Tripteris aghillana, Vahlia capensis subsp. vulgaris, Vahlia capensis subsp. vulgaris*
Biogeographically Important Taxa	
Growth Form	**Species**
Small Tree	*Vachellia luederitzii var. luederitzii, Terminalia sericea*
Tall Shrubs	*Vachellia haematoxylon*
Low Shrubs	*Blepharis marginata*
Graminoid	*Digitaria polyphylla*
Endemic Taxa	
Growth Form	**Species**
Herb	*Gnaphalium englerianum*

A species list from the SANBI database (POSA) containing the species that have been recorded to date within the surroundings of the study area has been compiled. POSA generated species lists also contain updated Red Data species status according to the Red List of South African Plants published by SANBI in Strelitzia 25 (Raimondo *et al*. 2009, updated 2013). Only protected and red data species that may potentially occur in the study area have been listed within the baseline study section of this report. The actual field survey confirmed which of the species already recorded actually occurs in the study area, and indicates the presence of additional species that may not have been recorded in official databases to date.

A total of 770 species have been recorded within the broader area, with a high diversity of forbs, shrubs and graminoids. Of the 695 indigenous species previously recorded, 68 species are South African Endemics. Alien Plant diversity within the affected region is regarded as moderate with a total of 34 species recorded and listed within the POSA species list. Of these 34 species16 have been listed as Invasive Alien plants with the most notable/significant plants listed being; *Oxalis corniculata, Salvia verbenaca, Lamarckia aurea, Argemone ochroleuca, Cirsium vulgare, Melilotus albus, Atriplex semibaccata, Dysphania carinata, Verbena brasiliensis, Rumex crispus, Persicaria lapathifolia, Argemone Mexicana, Paspalum dilatatum, Brassica tournefortii, Cichorium intybus, Sonchus oleraceus*

Species of Conservation Concern

A total of 3 red data plant species is known to occur in the broad area surrounding the site, as obtained from the SANBI SIBIS database and Threatened Species Programme, Red List of South African Plants (2011). These species of conservation concern are; Barleria media (Vulnerable), Hereroa wimaniae (Data Defficient) and Cleome conrathii (Near Threatened)

Furthermore, apart from the previously observed red data species, a total of 59 species have been recorded which are protected within the Northern Cape Nature Conservation Act (Act No. 9 of 2009). Of these 59 species, only one species is Specially Protected namely; *Hoodia gordonii*.

At a national level, three species have been recorded which are protected with the National Forest Act, namely *Vachellia erioloba*, *V. haematoxylon*, *Boscia foetida,* and *B. albitrunca*.

As mentioned a total of 68 South-Africa endemic species have been recorded within the greater area.

Conservation Plannig/Context

National Protected Areas Expansion Strategy

Focus areas for land-based protected area expansion are large, intact, and unfragmented areas of high importance for biodiversity representation and ecological persistence, suitable for the creation or expansion of large protected areas. The focus areas were identified through a systematic biodiversity planning process undertaken as part of the development of the National Protected Area Expansion Strategy 2008 (NPAES). They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES and were designed with a strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES. They are also not a replacement for fine-scale planning which may identify a range of different priority sites based on local requirements, constraints, and opportunities.

According to the NPAES spatial data (Holness, 2010), the proposed power line route is located outside of any Focus Area and Protected Area (Formal and Informal).

National Level of Conservation Priorities (Threatened Ecosystems)

The vegetation types of South Africa have been categorized according to their conservation status which is, in turn, assessed according to the degree of transformation and rates of conservation. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. On a national scale, these thresholds are as depicted in the table below, as determined by the best available scientific approaches (Driver et al. 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

Table 19: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement.

Habitat remaining (%)			
	80–100	least threatened	LT
	60–80	vulnerable	VU
	*BT–60	endangered	EN
	0–*BT	critically endangered	CR

A national process has been undertaken to identify and list threatened ecosystems that are currently under threat of being transformed by other land uses. The first national list of threatened terrestrial ecosystems for South Africa was gazetted on 9 December 2011 (National Environmental Management: Biodiversity Act or NEMBA: National list of ecosystems that are threatened and in need of protection, G 34809, GoN 1002, 9 December 2011). The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function, and composition of threatened ecosystems (SANBI, 2011). The NEMBA provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. There are four main types of implications of listing ecosystems:

» Planning related implications which are linked to the requirement in the Biodiversity Act (Act 10 of 2004) for listed ecosystems to be taken into account in municipal IDPs and SDFs;
» Environmental authorisation implications in terms of NEMA and the EIA regulations;
» Proactive management implications in terms of the National Biodiversity Act;
» Monitoring and reporting implications in terms of the Biodiversity Act.

According to Mucina and Rutherford (2006), all three vegetation types are classified as Least Threatened, all having a conservation target of 16%. Currently, none of the vegetation types are conserved in statutory conservation areas (Table 20).

Furthermore, this area is **Not** listed within the Threatened Ecosystem List (NEMA:BA).

It is highly unlikely that this development will have an impact on the status of the Vegetation Type due to the extent of the development as well as the presence of already disturbed areas within the footprint (existing mine) and the fact that only existing access roads will be used.

Table 20: Conservation status of the vegetation type occurring in and around the study area.

Vegetation Type	Target (%)	Transformed (%)	Conserved (Statutorily & other reserves)	Conservation Status	
				Driver *et al.*, 2005; Mucina & Rutherford, 2006	National Ecosystem List (NEMA:BA)
Olifantshoek Plains Thornveld	16%	0.9%	0%	Least Threatened	Not Listed
Kathu Bushveld	16%	1.2%	0%	Least Threatened	Not Listed
Kuruman Thornveld	16%	1.9%	0%	Least Threatened	Not Listed

Critical Biodiversity Areas and Broad Scale Ecological Processes

Critical Biodiversity Areas have been identified for all municipal areas of the Northern Cape Province (Oosthuysen & Holness, 2016) and are published on the SANBI website (bgis.sanbi.org). This biodiversity assessment identifies CBAs which represent biodiversity priority areas that should be maintained in a natural to near-natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to maintain ecosystem functioning and meet national biodiversity objectives (refer to Table 5 for the different land management objectives set out for each CBA category). According to these maps, most of the power line route is located within Other Natural Areas (ONA) with some sections traversing Ecological Support Areas. No Critical Biodiversity Areas will be impacted. These Ecological Support Areas (ESA) are mostly associated with the Ga-Mogara River as well as rocky outcrops, ridges and exposed rocky areas.

The presence of the line would not compromise the the functioning of the ESA in any way, especially as it would run mostly along with existing line infrastructure. As the footprint of the power line is relatively low, the impact of the development of the Olifantshoek power line is not likely to result in significant disruption of any broad-scale ecological processes.

Table 21: Relationship between Critical Biodiversity Areas categories (CBAs) and land management objectives

CBA category	Land Management Objective
Protected Areas (PA) & CBA 1	***Natural landscapes:*** » Ecosystems and species are fully intact and undisturbed. » These are areas with high irreplaceability or low flexibility in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost, then targets will not be met. » These are landscapes that are at or past their limits of acceptable change.
CBA 2	***Near-natural landscapes:*** » Ecosystems and species are largely intact and undisturbed. » Areas with intermediate irreplaceability or some flexibility in terms of the area required to meet biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising the ability to achieve targets. » These are landscapes that are approaching but have not passed their limits of acceptable change.
ESA	***Functional landscapes:*** » Ecosystem moderately to significantly disturbed but still able to maintain basic functionality. » Individual species or other biodiversity indicators may be severely disturbed or reduced. » These are areas with low irreplaceability with respect to biodiversity pattern targets only.
ONA (Other Natural Areas) and Transformed	Production landscapes: Manage land to optimise sustainable utilisation of natural resources.

Appendix 4. Specialist CV.

CURRICULUM VITAE:

Gerhard Botha

Name:	:	Gerhardus Alfred Botha
Date of Birth	:	11 April 1986
Identity Number	:	860411 5136 088
Postal Address	:	PO Box 12500 Brandhof 9324
Residential Address	:	3 Jock Meiring Street Park West Bloemfontein 9301
Cell Phone Number	:	084 207 3454
Email Address	:	gabotha11@gmail.com
Profession/Specialisation	:	Ecological and Biodiversity Consultant
Nationality:	:	South African
Years Experience:	:	8
Bilingualism	:	Very good – English and Afrikaans

Professional Profile:

Gerhard is a Managing Director of Nkurenkuru Ecology and Biodiversity (Pty) Ltd. He has a BSc Honours degree in Botany from the University of the Free State Province and is currently completing a MSc Degree in Botany. He began working as an environmental specialist in 2010 and has since gained extensive experience in conducting ecological and biodiversity assessments in various development field, especially in the fields of conventional as well as renewable energy generation, mining and infrastructure development. Gerhard is a registered Professional Natural Scientist (Pr. Sci. Nat.)

Key Responsibilities:

Specific responsibilities as an Ecological and Biodiversity Specialist include, inter alia, professional execution of specialist consulting services (including flora, wetland and fauna studies, where required), impact assessment reporting, walk through surveys/ground-truthing to inform final design, compilation of management plans, compliance monitoring and audit reporting, in-house ecological awareness training to on-site personnel, and the development of project proposals for procuring new work/projects.

Skills Base and Core Competencies

- Research Project Management
- Botanical researcher in projects involving the description of terrestrial and coastal ecosystems.
- Broad expertise in the ecology and conservation of grasslands, savannahs, karroid wetland, and aquatic ecosystems.
- Ecological and Biodiversity assessments for developmental purposes (BAR, EIA), with extensive knowledge and experience in the renewable energy field (Refer to Work Experiences and References)
- Over 3 years of avifaunal monitoring and assessment experience.
- Mapping and Infield delineation of wetlands, riparian zones and aquatic habitats (according to methods stipulated by DWA, 2008) within various South African provinces of KwaZulu-Natal, Mpumalanga, Free State, Gauteng and Northern Cape Province for inventory and management purposes.
- Wetland and aquatic buffer allocations according to industry best practice guidelines.
- Working knowledge of environmental planning policies, regulatory frameworks, and legislation
- Identification and assessment of potential environmental impacts and benefits.
- Assessment of various wetland ecosystems to highlight potential impacts, within current and proposed landscape settings, and recommend appropriate mitigation and offsets based on assessing wetland ecosystem service delivery (functions) and ecological health/integrity.
- Development of practical and achievable mitigation measures and management plans and evaluation of risk to execution
- Qualitative and Quantitative Research
- Experienced in field research and monitoring
- Working knowledge of GIS applications and analysis of satellite imagery data
- Completed projects in several Provinces of South Africa and include a number of projects located in sensitive and ecological unique regions.

Education and Professional Status

Degrees:

- *2015:* Currently completing a M.Sc. degree in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- *2009:* B.Sc. Hons in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- *2008:* B.Sc. in Zoology and Botany, University of the Free State, University of the Free State, Bloemfontein, RSA.

Courses:

- *2013*: Wetland Management (ecology, hydrology, biodiversity, and delineation) – University of the Free State accredited course.
- *2014*: Introduction to GIS and GPS (Code: GISA 1500S) – University of the Free State accredited course.

Professional Society Affiliations:

- The South African Council of Natural Scientific Professions: Pr. Sci. Nat. Reg. No. 400502/14 (Botany and Ecology).

Employment History

- December 2017 – Current: Nkurenkuru Ecology and Biodiversity (Pty) Ltd
- 2016 – November 2017: ECO-CARE Consultancy

- *2015 - 2016*: Ecologist, Savannah Environmental (Pty) Ltd
- *2013 – 2014*: Working as ecologist on a freelance basis, involved in part-time and contractual positions for the following companies
    - Enviroworks (Pty) Ltd
    - GreenMined (Pty) Ltd
    - Eco-Care Consultancy (Pty) Ltd
    - Enviro-Niche Consulting (Pty) Ltd
    - Savannah Environmental (Pty) Ltd
    - Esicongweni Environmental Services (EES) cc
- *2010 - 2012*: Enviroworks (Pty) Ltd

Publications

Publications:

- Botha, G.A. & Du Preez, P.J. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. S. *Afr. J. Bot*., **98**: 172-173.

Congress papers/posters/presentations:

- Botha, G.A. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. 41st Annual Congress of South African Association of Botanists (SAAB). Tshipise, 11-15 Jan. 2015.
- Botha, G.A. 2014. A description of the vegetation of the Nxamasere floodplain, Okavango Delta, Botswana. 10st Annual University of Johannesburg (UJ) Postgraduate Botany Symposium. Johannesburg, 28 Oct. 2014.

Other

- Guest speaker at IAIAsa Free State Branch Event (29 March 2017)
- Guest speaker at the University of the Free State Province: Department of Plant Sciences (3 March 2017):

References:

- Christine Fouché
  Manager: GreenMined (Pty) LTD
  Cell: 084 663 2399
- Professor J du Preez
  Senior lecturer: Department of Plant Sciences
  University of the Free State
  Cell: 082 376 4404

Appendix 5. Specialist's Work Experience and References

WORK EXPERIENCES
&
References

Gerhard Botha

ECOLOGICAL RELATED STUDIES AND SURVEYS

Date Completed	Project Description	Type of Assessment/Study	Client
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Ecological Assessment (Basic Assessment)	Moeding Solar
2019	Expansion of the Raumix Aliwal North Quarry, Eastern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	GreenMined
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Faunal and Flora Rescue and Protection Plan	Zevobuzz
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Zevobuzz
2018	Proposed Kruisvallei Hydroelectric Power Generation Scheme in the Ash River, Free State Province	Ecological Assessment (Basic Assessment)	Zevobuzz
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Ecological Assessment (Basic Assessment)	Eskom
2018	Clayville Thermal Plant within the Clayville Industrial Area, Gauteng Province	Ecological Comments Letter	Savannah Environmental
2018	Iziduli Emoyeni Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Emoyeni Wid Farm Renewable Energy
2018	Msenge Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Amakhala Emoyeni Renewable Energy

2017	H2 Energy Power Station near Kwamhlanga, Mpumalanga Province	Ecological Assessment (Scoping and EIA phase assessments)	Eskom
2017	Karusa Wind Farm (Phase 1 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	Soetwater Wind Farm (Phase 2 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Ecological Assessment	Savannah Environmental
2016 - 2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Ecological Assessment (Scoping and EIA phase assessments)	Cresco
2016	Buffels Solar 2 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	Buffels Solar 1 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	132kV Power Line and On-Site Substation for the Authorised Golden Valley II Wind Energy Facility near Bedford, Eastern Cape Province	Ecological Assessment (Basic Assessment)	Terra Wind Energy
2016	Kalahari CSP Facility: 132kV Ferrum–Kalahari–UNTU & 132kV Kathu IPP–Kathu 1 Overhead Power Lines, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Kalahari CSP Facility: Access Roads, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Karoshoek Solar Valley Development – Additional CSP Facility including tower infrastructure associated with authorised CSP Site 2 near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshoek Solar Valley Development –Ilanga CSP 7 and 8 Facilities near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshoek Solar Valley Development –Ilanga CSP 9 Facility near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Lehae Training Academy and Fire Station, Gauteng Province	Ecological Assessment	Savannah Environmental
2016	Metal Industrial Cluster and Associated Infrastructure near Kuruman, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Northern Cape Department of Economic Development and Tourism
2016	Semonkong Wind Energy Facility near Semonkong, Maseru District, Lesotho	Ecological Pre-Feasibility Study	Savannah Environmental
2015 - 2016	Orkney Solar PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015 - 2016	Woodhouse 1 and Woodhouse 2 PV Facilities near Vryburg, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy

2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Expansion of the existing Komsberg Main Transmission Substation near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Proposed Karusa Facility Substation and Ancillaries near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Eskom Karusa Switching Station and 132kV Double Circuit Overhead Power Line near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Karusa Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Facility Substation, 132kV Overhead Power Line and Ancillaries, near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Soetwater Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Expansion of the existing Scottburgh quarry near Amandawe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental
2015	Expansion of the existing AFRIMAT quarry near Hluhluwe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental
2014	Tshepong 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Transalloys circulating fluidised bed power station near Emalahleni, Mpumalanga Province	Ecological Assessment (for EIA)	Trans-Alloys
2014	Umbani circulating fluidised bed power station near Kriel, Mpumalanga Province	Ecological Assessment (Scoping and EIA)	Eskom
2014	Gihon 75MW Solar Farm: Bela-Bela, Limpopo Province	Ecological Assessment (for EIA)	NETWORX Renewables

2014	Steelpoort Integration Project & Steelpoort to Wolwekraal 400kV Power Line	Fauna and Flora Pre-Construction Walk-Through Assessment	Eskom
2014	Audit of protected *Acacia erioloba* trees within the Assmang Wrenchville housing development footprint area	Botanical Audit	Eco-Care Consultancy
2014	Rehabilitation of the N1 National Road between Sydenham and Glen Lyon	Peer review of the ecological report	EKO Environmental
2014	Rehabilitation of the N6 National Road between Onze Rust and Bloemfontein	Peer review of the ecological report	EKO Environmental
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks
2011	Rocks Farm chicken broiler houses	Botanical Assessment (for EIA)	EnviroWorks
2011	Botshabelo 132 kV line	Ecological Assessment (for EIA)	CENTLEC
2011	De Aar Freight Transport Hub	Ecological Scoping and Feasibility Study	EnviroWorks
2011	The proposed establishment of the Tugela Ridge Eco Estate on the farm Kruisfontein, Bergville	Ecological Assessment (for EIA)	EnviroWorks
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Vegetation Rehabilitation Plan for illegally cleared areas	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Invasive Plant Management Plan	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Protected and Endangered Species Walk-Through Survey	NEOTEL
2011	Optic Fibre Infrastructure Network, Swartland Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2011	Optic Fibre Infrastructure Network, City of Cape Town Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2010	Construction of an icon at the southernmost tip of Africa, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	New boardwalk from Suiderstrand Gravel Road to Rasperpunt, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	Farm development for academic purposes (Maluti FET College) on the Farm Rosedale 107, Harrismith	Ecological Assessment (Screening and Feasibility Study)	Agri Development Solutions
2010	Basic Assessment: Barcelona 88/11kV substation and 88kV loop-in lines	Botanical Assessment (for EIA)	Eskom Distribution
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks

WETLAND DELINEATION AND HYDROLOGICAL ASSESSMENTS

Date Completed	Project Description	Type of Assessment/Study	Client
In progress	Steynsrus PV 1 & 2 Solar Energy Facilities near Steynsrus, Free State Province	Wetland Assessment	Cronimet Mining Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Wetland Assessment (Basic Assessment)	Moeding Solar
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Wetland Assessment (Basic Assessment	Zevobuzz
2017	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy

2017	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Surface Hydrological Assessment (Basic Assessment)	Eskom
2017	Expansion of the Elandspruit Quarry near Ladysmith, KwaZulu-Natal Province	Wetland Assessment	Raumix
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Aquatic Assessment & Flood Plain Delineation	Savannah Environmental
2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Surface Hydrological Assessment (EIA phase)	Cresco
2016	Wolmaransstad Municipality 75MW PV Solar Energy Facility in the North West Province	Wetland Assessment (Basic Assessment)	BlueWave Capital
2016	BlueWave 75MW PV Plant near Welkom Free State Province	Wetland Delineation	BlueWave Capital
2016	Harmony Solar Energy Facilities: Amendment of Pipeline and Overhead Power Line Route	Wetland Assessment (Basic Assessment)	BBEnergy

AVIFAUNAL ASSESSMENTS

Date Completed	Project Description	Type of Assessment/Study	Client
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Avifauna Assessment (Basic Assessment)	Moeding Solar
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Avifauna Assessment (Basic Assessment)	Eskom
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Avifauna Assessment (Basic Assessment)	Eskom
2016	TEWA Solar 1 Facility, east of Upington, Northern Cape Province	Wetland Assessment (Basic Assessment	Tewa Isitha Solar 1
2016	TEWA Solar 2 Facility, east of Upington, Northern Cape Province	Wetland Assessment	Tewa Isitha Solar 2

ENVIRONMENTAL IMPACT ASSESSMENT

- Barcelona 88/11kV substation and 88kV loop-in lines – BA (for Eskom).
- Thabong Bulk 132kV sub-transmission inter-connector line – EIA (for Eskom).
- Groenwater 45 000 unit chicken broiler farm – BA (for Areemeng Mmogo Cooperative).
- Optic Fibre Infrastructure Network, City of Cape Town Municipality – BA (for Dark Fibre Africa (Pty) Ltd).
- Optic Fibre Infrastructure Network, Swartland Municipality – BA (for Dark Fibre Africa).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – EMP (for Eskom).
- Lower Kruisvallei Hydroelectric Power Scheme (Ash river) – EIA (for Kruisvallei Hydro (Pty) Ltd).
- Construction of egg hatchery and associated infrastructure – BA (For Supreme Poultry).

- Construction of the Klipplaatdrif flow gauging (Vaal river) – EMP (DWAF).

ENVIRONMENTAL COMPLIANCE AUDITING AND ECO

- National long haul optic fibre infrastructure network project, Bloemfontein to Laingsburg – ECO (for Enviroworks (Pty) Ltd.).
- National long haul optic fibre infrastructure network project, Wolmaransstad to Klerksdorp – ECO (for Enviroworks (Pty) Ltd.).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – ECO (for Enviroworks (Pty) Ltd.).
- Construction and refurbishment of the Vredefort/Nooitgedacht 11kV power line – ECO (for Enviroworks (Pty) Ltd.).
- Mining of Dolerite (Stone Aggregate) by Raumix (Pty) Ltd. on a portion of Portion 0 of the farm Hillside 2830, Bloemfontein – ECO (for GreenMined Environmental (Pty) Ltd.).
- Construction of an Egg Production Facility by Bainsvlei Poultry (Pty) Ltd on Portions 9 & 10 of the farm, Mooivlakte, Bloemfontein – ECO (for Enviro-Niche Consulting (Pty) Ltd.).
- Environmental compliance audit and botanical account of Afrisam's premises in Bloemfontein – Environmental Compliance Auditing (for Enviroworks (Pty) Ltd.).

OTHER PROJECTS:

- Keeping and breeding of lions (*Panthera leo*) on the farm Maxico 135, Ficksburg – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Keeping and breeding of lions (*Panthera leo*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Keeping and breeding of wild dogs (*Lycaon pictus*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Existing underground and aboveground fuel storage tanks, TWK AGRI: Pongola – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Erf 171, TWK AGRI: Amsterdam – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 14 000 L of fuel (diesel) aboveground on Erf 32, TWK AGRI: Carolina – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 23 000 L of fuel (diesel) above ground on Portion 10 of the Farm Oude Bosch, Humansdorp – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 16 000 L of fuel (diesel) aboveground at Panbult Depot – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks, TWK AGRI: Mechanisation and Engineering, Piet Retief – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Portion 38 of the Farm Lothair, TWK AGRI: Lothair – Environmental Management Plan (for TWK Agricultural Ltd).