

Appendix D1
Terrestrial Biodiversity Assessment Associated with Kareerand
Tailings Storage Facility Expansion Project
- Iggdrasil Scientific Services, 2019



**FINAL DRAFT: Terrestrial Biodiversity
Assessment Associated with Kareerand
Tailings Storage Facility Expansion Project,
North West, South Africa**



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Report Status

Report Title: **FINAL DRAFT: Biodiversity Assessment Associated with Kareerand Tailings Storage Facility Expansion Project, North West, South Africa.**

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Report Status: **Final Draft Report**

Date of Report: **22nd July 2019**

Declaration

I, Lorainmari den Boogert, declare that -

- I act as the independent specialist;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998), regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 8;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.



Signature of specialist

Iggdrasil Scientific Services (Pty) Ltd.

Name of company

2019/07/22

Date

Executive Summary

Iggdrasil Scientific Services (ISS) was appointed by GCS Water and Environmental Consultants to conduct the biodiversity assessment associated with the Application for Environmental Authorisation of the Kareerand TSF Expansion Project by Mine Waste Solutions in the North West Province. The proposed development, or study area, is situated approximately 6 km South East of Stilfontein and approximately 25 km South West of Potchefstroom. The project area is classified as a Critical Biodiversity Area 2, as well as Ecological Support Areas 1 and 2, based on the North West Biodiversity Sector Plan. This report should be interpreted along with the botanical report compiled by De Castro & Brits (2017) as well as the terrestrial fauna report by Deacon (2017) as the study area of this report did not cover the entire footprint area.

Due to the fact that animals are mobile, they may only be transient through the Survey Area and may not reside on site. The results presented in this report focus on animals that are confirmed endemic and Threatened or Protected (TOP) fauna highly likely to reside on site. As animals are not always observed in field, close attention is given to micro-habitats of TOPS.

The site visit was undertaken during summer on 20th to the 23rd of November 2018 with a follow up survey over 5th to the 8th of February 2019. The area seemed to have received rainfall, as vegetation was sparse during November and denser in February. Weather was hot and sunny, with some windy periods which slightly hampered fauna surveying. Overall conditions were good for fauna and flora surveying.

Many fauna habitat types were noted within the area. Such features, which include various rocky habitats and wetland habitats, increase the habitat heterogeneity of the site. Biogeographically, more habitat diversity will result in greater faunal richness and diversity. In terms of habitat for terrestrial fauna, with focus on ecologically significant species the following can be concluded:

- Although it is unreasonable to survey the entire area, the survey indicated no true deep sandy soils, and any species with specific preferences for sandy soils are unlikely to reside in the area.
- No caves, mine adits/shafts or caverns were noted within the area, but may occur in the surrounds. Species with preference for such sites, such as some bats and birds, are unlikely to reside in the area, but may forage over the area.
- Other than the Vaal River, no large bodies of surface water exist on site. Fauna with a preference for water bodies would therefore only periodically occur on site when high rainfall fills the existing pans and dams on site or if foraging over the area.

From past and current surveys, the following can be stated in terms of TOP species:

- Three TOP mammals have been included as confirmed on site. The Aardvark, Black Wildebeest and Black-footed Cat. Scat for the latter was noted and assumed to belong to this species as a cautionary

approach (rather than the African Wild Cat). Eleven additional TOP mammals are highly likely to occur on site based on the recent EWT Fact Sheets for the Red-listed mammals (Child, *et al.* 2016).

- Two TOP birds are confirmed (Secretarybird and Lanner Falcon) for the area and an additional four are highly likely to occur in the area.
- No TOP reptiles were recorded from the area and none are likely to occur in the area.
- The only Red-listed frog that may occur in the greater area is the Near Threatened Giant Bull Frog, also Protected under GN151, 2007.
- Burrowing scorpions have been confirmed for the Quatre Degree Grid Square (QDGS) and are highly likely to occur on site.
- The Wildebeest Pan and surrounds supported a variety of ground beetles. Of those observed, none are protected, but several ground beetles are protected under GN151 and could also occur in the area.
- Areas is not seen as an area of endemism in terms of the terrestrial fauna assessed on site.

In terms of TOP species confirmed on site and with a high likelihood of occurring on site, all are largely grassland and wetland specialists. Most have large and unrestricted ranges and can escape the development along existing ecological corridors associated with the Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) as long as these are maintained and not disconnected by the development.

In terms of vegetation, eleven different vegetation communities were identified during the site visits. Three of these vegetation communities were assigned a high sensitivity due to their floristic composition, habitat for red listed and TOP species as well as provincially protected and other Species of Conservation Concern (SCC). Two Near Threatened plant species were observed during the site visits. Species richness was affected by a fire event prior to the November 2018 survey and lack of significant rains prior to the February 2019 surveys.

A sensitivity plan was compiled based on prior biodiversity reports and then updated based on the current findings and overall on-site ecological connectivity and ecological connectivity to the greater area. In general, the current survey's findings are in agreement with conserving the area associated with CBMA 1, where the area supports diverse habitat, high faunal assemblages and is well connected in terms of aquatic and terrestrial environments and existing ecological corridors.

The impacts of high significance that have been addressed within the report include:

- Destruction and fragmentation of fauna habitats in CBMAs 1 and 3 and isolation between terrestrial and aquatic habitats leading to the loss of fauna and decrease in faunal biodiversity.
- Any potential destruction of TOPS which could lead to local to provincial / national declines and extinctions.

- Introduction of Alien Invasive Species (AIS) / exacerbation of existing AIS which is highly likely to lead to the loss of natural fauna habitat and potential hybridisation of fauna.
- Contamination and complete degradation of fauna habitat which, without remedy, would lead to complete loss of fauna biodiversity.

The type and extent of the proposed activities coupled with the overall status of the sites to be affected are not expected to have extremely detrimental effects on the overall ecological character as long as mitigation measures are implemented. Due to the high faunal assemblages in the area (albeit a game farm), and the variety of habitats and micro-habitats on site, the area is largely designated as highly sensitive in terms of terrestrial fauna. In terms of flora the largest sections of the study area are considered to be of moderate sensitivity, however three highly sensitive communities were identified. Two Near Threatened plant species were observed during the site visit, however the proposed footprint area does currently not affect the two species apart from the expected increase in dust as a result of construction activities as well as the larger surface area of the TSF during the operational phase. The management plan proposes recommendations to maintain a sample of sensitive habitats and connectivity between these habitats to retain and manage biodiversity on site.

The management and monitoring plan outlined in this report must be implemented to ensure overall impact significance to terrestrial fauna stays low to moderate. All measures must be applied, but of particular importance are the following:

- The proposed fence (Figure 13) should be moved to exclude the southern highly sensitive area as this will disconnect the sensitive site which is utilised by wild cats (as a cautionary approach, *F. nigripes*) (See section 4.2).
- Approximate locations of ecological corridors that must be maintained in at least the current natural state are indicated in Figure 14. These corridors were mapped with connectivity between existing sensitive areas, rocky habitats, grassland habitats and wetland/riverine habitats in mind. Flexibility is allowed in determining the actual final areas to be established as ecological corridors, but the following should be adhered to:
 - Consider the flora and wetland sensitivity plans and incorporate these areas as far as possible.
 - Corridors should have at least 700m width.
 - The core (500m central width) should encompass highly sensitive areas depicted in Figure 14 with the outer 200m (100m x2 on either side of the core area) encompassing highly sensitive and then moderately sensitive areas.
- Many of the more severe impacts to fauna habitat can be mitigated through properly planned construction, good design, frequent monitoring/auditing, good house-keeping practices during operations and decommissioning and proper rehabilitation and revegetation of the affected site.
- Some impacts identified are related to contractor and staff activity on site. Human behaviour is not easy to manage, but providing the relevant information and motivation as stipulated in the mitigation

measures through environmental awareness and re-iterating the information frequently should inform people active on site of the importance of conserving fauna on site.

- The specific mitigation measures within the accompanying excel spreadsheet should be incorporated into the final EMPr.
- No activities are to commence within riverine and wetland areas (+100m buffer / 1:100 year flood-line) until the necessary authorisations are obtained under the NWA and NEMA. This is of particular relevance to the RWDs.

All conditions in the Water Use License and Environmental Authorisations must be complied with and audited as required.

Abbreviations

ADU	Animal Demography Unit
AI	Alien Invasive
AIS	Alien Invasive Species
BGIS	Biodiversity Geographic Information System
BMU	Biodiversity Management Unit
BODATSA	Botanical Database of Southern Africa
CARA	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)
CBA	Critical Biodiversity Areas
CBMA	Core Biodiversity Management Area
CR	Critically Endangered
DD	Data Deficient
DDT	Data Deficient - Taxonomically Problematic
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECA	Environmental Conservation Act, 1989 (Act No. 73 of 1989)
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EMPr	Environmental Management Plan Report
EN	Endangered
EO	Environmental Officer
ESAs	Ecological Support Areas
EWT	Endangered Wildlife Trust
FEPA	Freshwater Ecosystem Priority Area
GCS	GCS Water and Environmental Consultants (Pty) Ltd
GPS	Global Positioning System
IBA	Important Bird Areas
ISS	Iggdrasil Scientific Services
IUCN	International Union for Conservation of Nature
LC	Least Concern
LT	Least Threatened
mamsl	Metres above mean sea level
Mtpm	million tonnes per month
MWS	Mine Waste Solutions
NBA	National Biodiversity Assessment

NEMA	National Environmental Management Act
NEM:BA	National Environmental Management: Biodiversity Act
NT	Near Threatened
NWA	National Water Act
NWBSP	North West Biodiversity Sector Plan
PA	Protected Area
QDGS	Quarter Degree Grid Square
RWD	Return Water Dam
SABAP	South African Bird Atlas Project
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
TOP (S)	Threatened or Protected (Species)
TSF	Tailings Storage Facility
UP	University of Pretoria
UNESCO	United Nations Educational, Scientific and Cultural Organization
VMUS	Virtual Museum
WMA	Water Management Area
WUL	Water Use License
VU	Vulnerable

Definitions

TERM	DEFINITION
Alien species	Taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity.
Avifauna	The birds of a particular region, habitat, or geological period.
Azonal	Water-logged and salt-laden habitats require specially adapted plants to survive in these habitats. Consequently, the vegetation deviates from the typical surrounding zonal vegetation and are considered to be of azonal character (Mucina and Rutherford, 2006).
Biodiversity	Biodiversity is the variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
Biome	A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.
Buffer zone	A collar of land that filters edge effects.
Conservation	The management of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystems function and integrity.
Conservation concern	Species of conservation concern are those species that are important for South Africa's conservation decision making processes and include all plants that are Threatened (see Threatened), Extinct in the wild, Data deficient, Near threatened, Critically rare, Rare and Declining. These plants are nationally protected by the National Environmental Management: Biodiversity Act. Within the context of these reports, plants that are provincially protected are also discussed under this heading.
Conservation status	An indicator of the likelihood of that species remaining <u>extant</u> either in the present day or the near future. Many factors are taken into account when assessing the conservation status of a species: not simply the number remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on.
Community	Assemblage of populations living in a prescribed area or physical habitat, inhabiting some common environment.
Critically Endangered	A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
Data Deficient	There is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. However, "data deficient" is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.
Declining	A taxon is declining when it does not meet any of the five IUCN criteria and does not qualify for the categories Threatened or Near Threatened, but there are threatening processes causing a continuous decline in the population (Raimondo <i>et al.</i> , 2009).

TERM	DEFINITION
Ecological Corridors	Corridors are roadways of natural habitat providing connectivity of various patches of native habitats along or through which faunal species may travel without any obstructions where other solutions are not feasible.
Ecosystem	Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space.
Edge effect	Inappropriate influences from surrounding activities, which physically degrade habitat, endanger resident biota and reduce the functional size of remnant fragments including, for example, the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution.
Endangered	A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
Endemic	Naturally only found in a particular and usually restricted geographic area or region.
Exotic species	Taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity.
Fauna	The animals of a particular region, habitat, or geological period.
Flora	Flora is the plant life occurring in a particular region or time, generally the naturally occurring or indigenous—native plant life
Forb	A herbaceous plant other than grasses.
Habitat	Type of environment in which plants and animals live.
Herpetofauna	The reptiles and amphibians of a particular region, habitat, or geological period.
Indigenous	Any species which occurs naturally in South Africa.
In situ	“In the place” In Situ conservation refers to on-site conservation of a plant species where it occurs. It is the process of protecting an endangered plant or animal species in its natural habitat. The plant(s) are not removed but conserved as they are. Removal and relocation could kill the plant and therefore in situ conservation is preferred/ enforced.
Invasive species	Naturalised alien species that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas.
Mammals	A warm-blooded vertebrate animal of a class that is distinguished by the possession of hair or fur, females that secrete milk for the nourishment of the young, and (typically) the birth of live young.
Mitigation	The implementation of practical measures to reduce adverse impacts.
Near Threatened	A Taxon is Near Threatened when available evidence indicates that that it nearly meets any of the five IUCN criteria for Vulnerable and is therefore likely to qualify for a threatened category in the near future (Raimondo <i>et al.</i> , 2009).
Plant community	A collection of plant species within a designated geographical unit, which forms a relatively uniform patch, distinguishable from neighboring patches of different vegetation types. The components of each plant community are influenced by soil type, topography, climate and human disturbance. In many cases there are several soil types within a given plant community (Gobbat <i>et al.</i> , 2004).

TERM	DEFINITION
Protected Plant	According to Provincial Nature Conservation Ordinances or Acts, no one is allowed to sell, buy, transport, or remove this plant without a permit from the responsible authority. These plants are protected by provincial legislation.
Threatened	Species that have naturally small populations, and species which have been reduced to small (often unsustainable) population by man's activities.
Red Data	A list of species, fauna and flora that require environmental protection - based on the IUCN definitions. Red data plants <i>now termed Plants of Conservation Concern</i> .
Reptile	A vertebrate animal of a class that includes snakes, lizards, crocodiles, turtles, and tortoises. They are distinguished by having a dry scaly skin and typically laying soft-shelled eggs on land.
Species diversity	A measure of the number and relative abundance of species.
Species richness	The number of species in an area or habitat.
Threatened	Threatened Species are those that are facing a high risk of extinction, indicated by placing in the categories Critically Endangered (CR), Endangered (E) and Vulnerable (VU) (Raimondo <i>et al.</i> , 2009)
Transformation	The removal or radical disturbance of natural vegetation, for example by crop agriculture, plantation forestry, mining or urban development. Transformation mostly results in a serious and permanent loss of biodiversity and fragmentation of ecosystems, which in turn lead to the failure of ecological processes. Remnants of biodiversity may survive in transformed landscapes.
Vegetation Unit	A complex of plant communities ecologically and historically (both in spatial and temporal terms) occupying habitat complexes at the landscape scale. Mucina and Rutherford (2006) state: "Our vegetation units are the obvious vegetation complexes that share some general ecological properties such as position on major ecological gradients and nutrient levels and appear similar in vegetation structure and especially floristic composition".
Vulnerable	A taxon is Vulnerable when it is not Critically Endangered or Endangered but meets any of the five IUCN criteria for Vulnerable and are therefore facing a high risk of extinction in the wild in the future (Raimondo <i>et al.</i> , 2009)

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1. Introduction

1.1. Orientation and Context

Igdrasil Scientific Services (ISS) was appointed by GCS Water and Environmental Consultants (Pty) Ltd. (GCS) to conduct the biodiversity assessment associated with the Mine Waste Solutions Kareerand Tailings Storage Facility (TSF) Expansion Project in the North West Province. The proposed development, or study area, is situated approximately 6 km South East of Stilfontein and approximately 25 km South West of Potchefstroom. In total, the study area is approximately 4 hectares in size.

The report is part of the second and final phase of the biodiversity assessment for the proposed expansion of the TSF as well as associated infrastructure. The site visit was undertaken during summer on 20th to the 23rd of November 2018 with a follow up survey over 5th to the 8th of February 2019. This report, after taking into consideration the findings and recommendation provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

1.2. Project Brief

1.2.1. Background

Mine Waste Solutions (MWS), also known as Chemwes (Pty) Ltd (Chemwes), has been in business since 1964, and conducts its operations over a large area of land to the east of Klerksdorp, within the area of jurisdiction of the City of Matlosana and JB Marks Local Municipalities (LM), which fall within the Dr Kenneth Kaunda District Municipality (DM) in the North-West Province. The MWS/Chemwes Operations are located primarily to the south of the N12, east of the town of Stilfontein. The closest town is Khuma, located about 3km northwest of the facility, and other nearby towns include Stilfontein (10 km from facility) and Klerksdorp (19 km from facility). (GCS pers comm., 2019).

The operations at Mine Waste Solutions entail the collection and reprocessing of mine tailings that were previously deposited on tailings storage facilities (TSFs) in order to extract gold and uranium. High pressure water cannons are used to slurry the tailings on the Source TSFs, then slurry is pumped by a number of pump stations and pipelines to the MWS/Chemwes Processing Plant (indicated in dark green in Figure 1), and the residues from the Processing Plants are pumped to the Kareerand TSF (indicated in yellow in Figure 1). Once an old Source TSF has been completely recovered, it is cleaned-up and rehabilitated. See Figure 1 for an overview of the existing infrastructure used for this process (GCS pers comm., 2019).

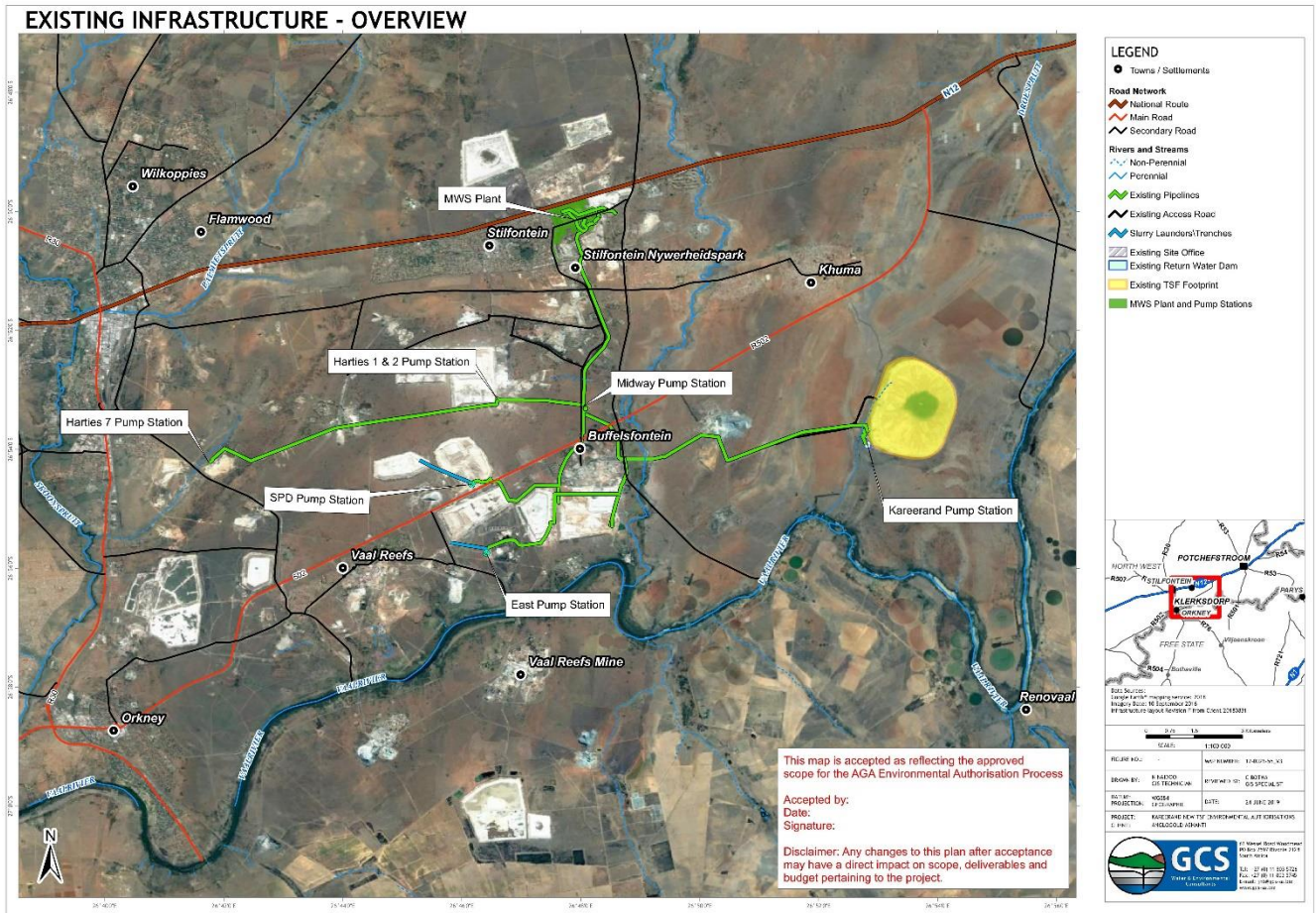


Figure 1: Existing infrastructure

The Kareerand TSF was designed with an operating life of 14 years, taking the facility to 2025, and total design capacity of 352 million tonnes. Subsequent to commissioning of the TSF, MWS was acquired by AngloGold Ashanti and tailings production target has increased by an additional 485 million tonnes, which will require operations to continue until 2042. The additional tailings therefore require extension of the design life of the TSF (GCS pers comm., 2019).

This project entails the expansion of the current Kareerand TSF to accommodate the increased tailings and final design capacity, along with additional pump stations and pipelines. The TSF expansion is proposed on the western edge of the current facility, and the final height of the combined facility (both expansion and current) will be 122m. The expansion footprint will add about 362 hectares to the TSF. Figure 2 depicts the site layout of all additional infrastructure across the operational footprint, while Figure 3 depicts the TSF expansion and its associated infrastructure (GCS pers comm., 2019).

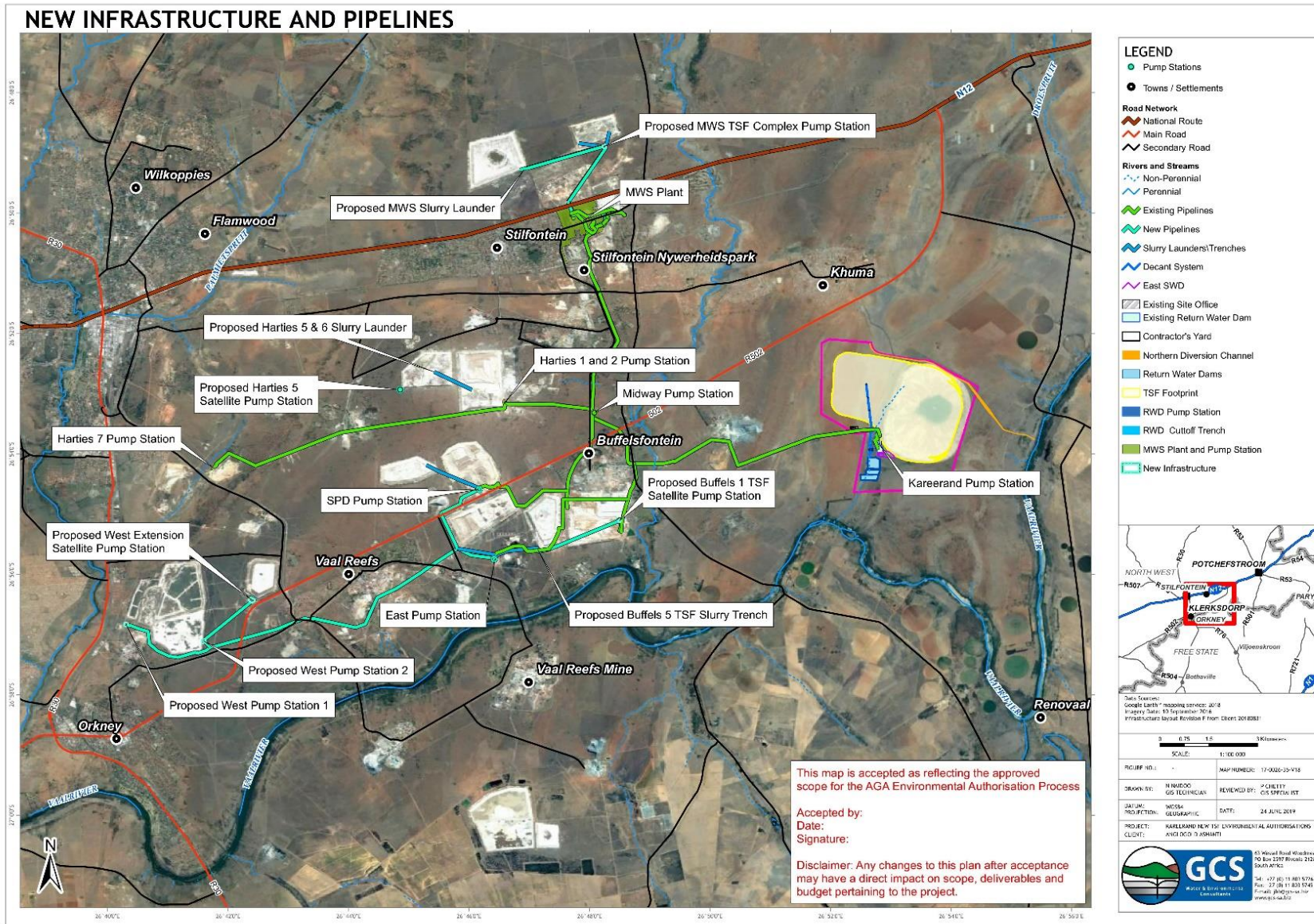


Figure 2: Site layout across operational footprint and TSF expansion footprint. The new infrastructure is noted by the word “proposed”, and the new pipelines are indicated in bright blue (as opposed to existing pipelines indicated in green)

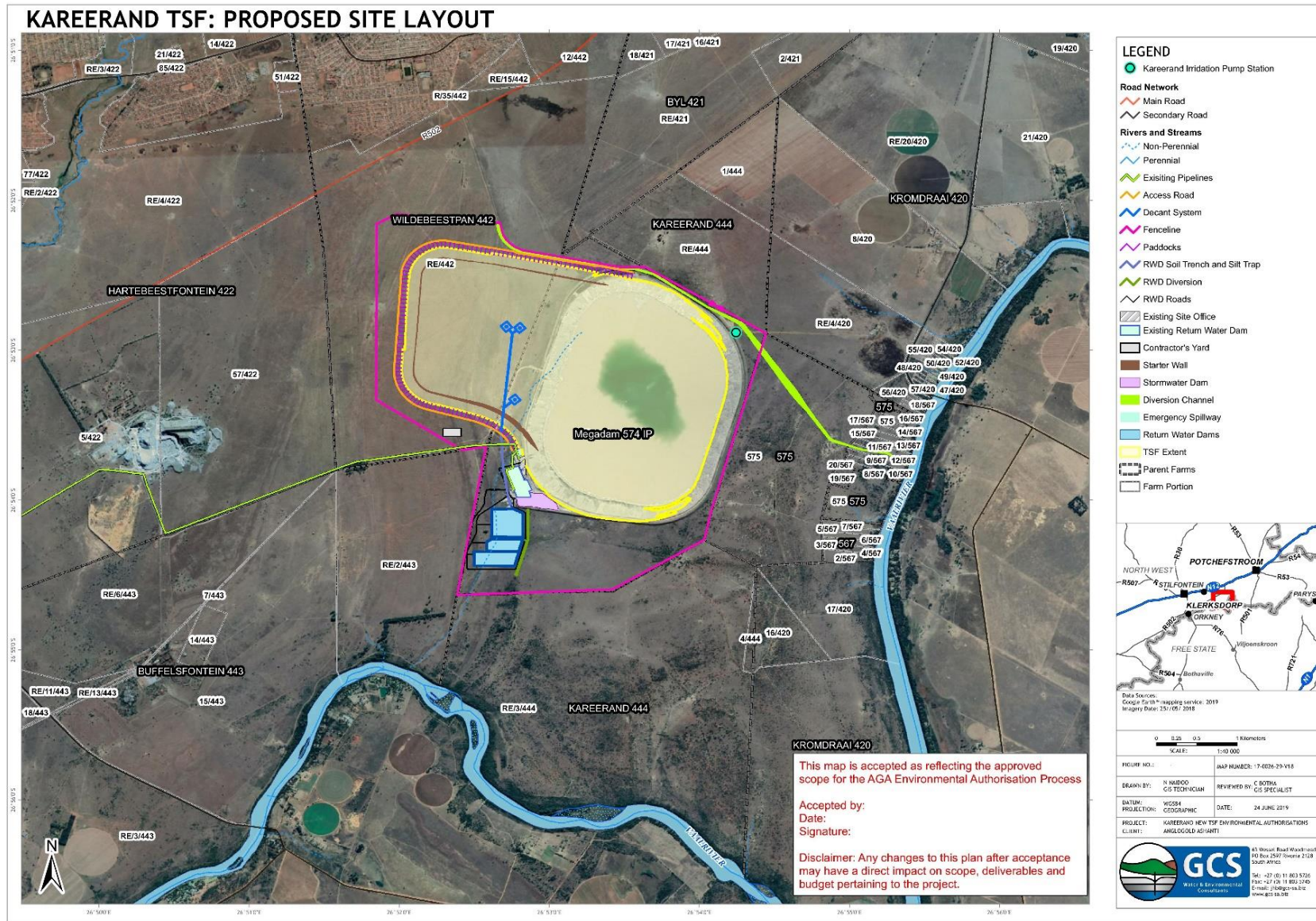









Figure 3: TSF expansion site layout in detail, including associated infrastructure



1.2.2. New infrastructure







The proposed project will make use of the existing facilities as well as additional supporting infrastructure (GCS pers comm., 2019).

The details of the infrastructure which forms part of the expansion of the TSF are as follows:

- TSF expansion  TSF Footprint
 - TSF will be expanded by 362 Ha
- Fences  Fenceline
 - 2.4 m high game fence with appropriate signage will be installed around the perimeter of the new TSF (length of new fence = 7 km)
 - This will tie into the existing fence and is the same type of fence
- New main access road and perimeter access road  Access Road
 - 8 m wide gravel access road around perimeter of TSF, to the RWDs (return water dams), pump stations (western perimeter of TSF extension) and offices
 - Total combined distance of new roads will be 11 km
 - Access ramps provide access onto tailings dam
 - Access ramps are placed near entry of delivery pipelines and valve stations
- Topsoil bund wall
 - A bund wall will be constructed around the TSF, next to the access road
 - The wall will be 6 m at highest point and 2 m at lowest point, crest width is 8 m
 - The bund wall will also be used as access road on northern side of TSF
- Stormwater diversion channels  Diversion Channel  RWD Diversion
 - An unlined trench on the northern side of the TSF, 6 km in length, to divert clean storm water running from the north, towards the east in the direction of the Vaal River
 - Trapezoidal in shape with side slopes of 1v:3h and base width varying from 4 m to 9m.
 - Designed to accommodate the 1:100 year storm event
 - Peak flow velocity will be 158 m³/s during 1:100 year storm events
 - A second unlined trench next to the RWD will divert clean storm water runoff away from the RWD and solution trench and prevent it from mixing with the dirty water
 - Diversion channels will assist to minimise the water quality impact from the TSF
- Delivery pipeline
 - Three steel 500 mm tailings delivery pipes located at the toe of the facility (western edge); 13.5 km in total length
 - Will deliver slurry to the northern, western and southern side of the TSF extension
- Solution trench

- Trench lined with 100 mm thick mesh reinforced concrete
- Trench will be trapezoidal with 1v:5h side slopes and bottom width of 1 m
- Around northern, western and southern side of TSF
- Will convey decant water and storm water from the side slopes, filter discharge (seepage water) from the outer drains and surface runoff from the side slopes to the RWD.
- Seepage and dirty water collector sump
 - Constructed on northern side of TSF
 - Will collect seepage water and dirty storm water running off the TSF walls from solution trench before it is pumped back to the north-western corner
- Catchment paddocks  Paddocks
 - Constructed around perimeter of facility at final outer wall toe location
 - Constructed using material from solution trench excavations and paddock basins; will be nominally compacted
 - Paddocks will be 50 m long and 20 m wide
 - Walls will be 1 m high with a crest width of 1 m and side slopes of 1v:1.5h
 - Designed to contain run-off from a 1:50 year storm event
- Starter wall  Starter Wall
 - The starter wall will contain tailings deposition during early development of TSF
 - 18 m in height at lowest point, crest width of 5 m and side slopes of 1v:2h downstream and 1v:5h upstream
 - Constructed using clay-based material from basin or other construction areas (parameters: percentage passing 0.075 mm sieve= 65-85%; clay content= 10-25%; PI= 12- 20; dispersity range= non-dispersive)
- Drainage system
 - Under drainage system located within TSF footprint, consisting of toe, intermediate and central drains and drain outlets
 - Filter drain system consisting of a trench lined with Geofabric, which prevents the ingress of fine clay / sand particles into drain, thus preventing clogging
 - Drain comprises
 - Slotted pipe, which runs for a length between the outlet pipes
 - Layer of 19 mm stone, overlain by a layer of 6 mm stone, surrounds pipes
 - Layer of graded filter sand and layer of coarse tailings placed over the stone drain
 - Drain outlets constructed at approximately 50-100m intervals to collect seepage water from filter drains and convey it to solution trench
 - The existing drain outlets will connect to a collector drain system then discharge into the solution trench on the southern flank where the two facilities connect.

- Decant system
 - Gravity pipe decant system to ensure water does not accumulate on top of TSF
 - Includes permanent double intake structure and intermediate intake structures
 - Permanent intake structure consists of two penstock intakes at ground level
 - Reinforced concrete intakes (2) and stacked pre-cast concrete penstock rings (to raise structure) will cater for decanting of supernatant water up to but not exceeding 20 m
 - Above 20 m, this system will be replaced with a siphon system
 - From the permanent intake structure the supernatant water will gravitate via a concrete spigot and socket penstock outlet pipeline to the new RWDs
 - Intermediate penstock intake structures positioned at different elevations along the penstock outlet pipeline
 - Ensure effective decanting of supernatant water during the development phase of TSF
 - Minimise delay in water returned to the reclamation sites
 - Intermediate intake structures will be constructed with a reinforced concrete base and a single intake tower raised with standard pre-cast penstock rings. These structures will be sealed as the TSF rises and pool moves to final intake structure position.
- Catwalk
 - Timber catwalk and floating walkway structure for access from pool wall to penstock intermediate and permanent intake structures respectively
 - Catwalk height will be raised when necessary and the floating walkway will increase with the dam pool level
 - Catwalk constructed from timber supports spaced at 2.5 m centres and three (3) 230 x 76 mm gum pole planks (4.8 m standard lengths) will be used for the walkway.
 - Floating walkway constructed from Jet floats with 4.5 mm thick aluminium chequer decking plate
- Energy dissipater
 - Concrete energy dissipater box where penstock outlet pipe daylights
 - Should reduce velocity of water from penstock before it flows into silt trap
- Silt trap  RWD Soil Trench and Silt Trap
 - Concrete-lined silt trap with twin compartments between penstock outlet and RWD
 - Sluice gates at inlets and outlets; outlet trench to RWD also to be constructed
 - Designed to settle grain of size 0.006 mm and specific gravity of 2.7; average settling time for this particle will be 12 minutes
 - Should reduce volume of suspended solids flowing into RWD
- Storm water dam  Stormwater Dam
 - Storm water dam will be located between TSF and RWDs and will contain dirty water running off the TSF

- Capacity will be 155 000 m³ and will cover 6.6 Ha
- RWD and related infrastructure  Return Water Dams
 - New RWDs with a combined capacity of 837 000 m³ (area of 30 Ha), south of the TSF and existing RWD complex
 - RWD will have three compartments (one for operation, the other two for dirty water containment)
 - Will be lined with double HDPE liner system and leakage-detection material (Hi-drain); double liner will consist of 2 mm geomembrane and 1.5 HDPE geomembrane
 - Sump structure will be constructed downstream of RWD for decanting via pump station
 - RWD will be 7 m at highest point (this will require a Dam Safety application), with crest of 3 m and side slopes of 1v:3h downstream and upstream
- Contractors yard  Contractor's Yard
 - Contractor's yard will be located on the south western side of the TSF extent on the right of the access road travelling south.
 - Contractor's yard will include the following infrastructure: site office, workshop, fuel storage facilities, wash bays, change houses, septic tanks.
- RWD emergency spillway  Emergency Spillway
 - Trapezoidal with 1:1.5 side slopes
 - Will cater for 1:100 year storm event
 - 1000 mm freeboard before wall crest is overtopped
- Pump Stations
 - Three main pump stations: one at the MWS complex, two at the outlying western TSFs
 - Three satellite pump stations: one at the Harties TSFs (probably at a later stage), one at the outlying western TSFs and one at the Buffels TSFs
- Process water pipelines  New Pipelines
 - Extended from the existing SPD and East Complex pump stations to the western outlying TSFs
 - Connecting MWS TSFs and MWS plant
- Slurry pipelines  New Pipelines
 - Extended from the existing SPD and East Complex pump stations to the western outlying TSFs
 - Connecting MWS TSFs and MWS plant
- Slurry launders  Slurry Launder/Trenches
 - Connecting the Buffels TSF to the East Complex pump station
 - Connecting Harties TSFs with the Harties 1 & 2 pump station
 - Connecting MWS TSFs to the proposed MWS pump station (GCS pers comm., 2019).

The additional infrastructure required across the operational footprint will include new pump stations, new satellite pump stations, slurry launders and connecting slurry and process water pipelines. As indicated in Figure 2, in the centre of operations, existing infrastructure (pump stations and main slurry and process water pipelines) will be utilised to process adjacent resources. Buffels 5 TSF will be connected to the East Complex Pump Station via a new slurry trench and Buffels 1 TSF will be pumped via a satellite pump station to the Buffels 5 TSF slurry trench feed. At the Harties 1 & 2 Pump Station, located centre to north of Figure 2, Harties 5 & 6 TSF will be directed via a slurry launder to the pump station and may require, at a later date, a satellite pump station to aid in reclamation of tailings that cannot be gravity fed. In the west, three new pump stations (West Pump Station 1, West Pump Station 2 and a satellite pump station) will be constructed, with main slurry and process water pipelines extended from the existing SPD and East Complex Pump Stations in the east to the west, allowing for the use of the SPD and East Complex Pump Stations as booster pump stations. In the north, the MWS 4 & 5 TSF's will be reclaimed and directed to a new pump station via slurry launders. New process water and slurry piping will be installed between the MWS 4 & 5 Pump Station and the MWS plant. In total, three new main pump stations and three new satellite pump stations will be built (GCS pers comm., 2019).

1.3. Terms of Reference

The aim of the study was to undertake and compile a biodiversity assessment for the proposed Mine Waste Solutions Kareerand Tailings Storage Facility Expansion Project located in the North West Province. It was limited to the study area indicated in Figure 4 as a previous botanical biodiversity survey was conducted in 2017 by De Castro & Brits and faunal assessment by Deacon in the same year.

The biodiversity assessment was informed by:

- Appendix 6 of GNR. 982 of the National Environmental Management Act, 1998: Environmental Impact Assessment Regulations, 2014 (as amended); and
- National Environmental Management: Biodiversity Act 2004; GN 255 (GG 38600, 31 March 2015):Threatened or Protected Species Regulations.

2. Location and Surrounding Environment

The project area is situated in the City of Matlosana and JB Marks Local Municipalities of the Dr Kenneth Kaunda District Municipality, in the North West Province (Figure 4). The project area is situated approximately 6 km South East of Stilfontein and approximately 25 km South West of Potchefstroom (Figure 4).

The site is located in the Highveld ecoregion, the C24A, C24B, and C23L sub-quadernary reaches, the Vaal Water Management Area (WMA_05), and the grassland biome. The site is situated within Quarter Degree Square (QDS) 2626DD.

2.1. Project Area

The project area is situated adjacent to the Vaal River, approximately 6 km South East of Stilfontein. The surrounding land use includes mines, farms, and townships. The project area slopes from approximately 1300 mamsl in the south of the area to approximately 1345 mamsl in the north. During the field visit the project area and specifically the sites for the proposed developments were traversed on foot, and the presence of important biodiversity features identified. The following specific areas were identified on the site:

- Proposed development site;
- Existing infrastructure and TSF;
- Artificial wetlands;
- Wetlands;
- Grasslands; and
- Savanna.

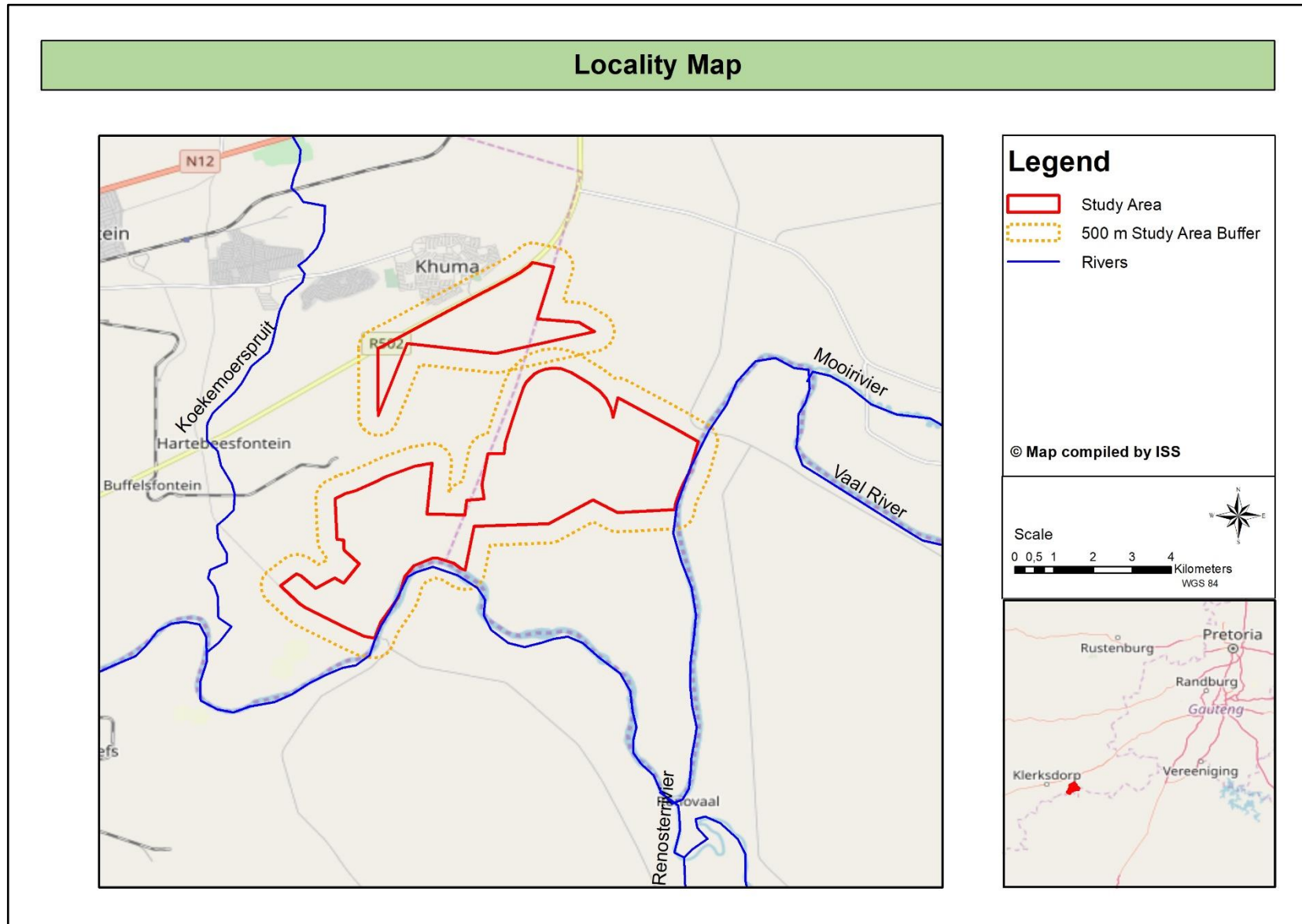


Figure 4: Locality of the study area

2.2. North West Biodiversity Sector Plan

In 2015, the North West Department: Rural, Environment and Agricultural Development (NWREAD) developed the North West Biodiversity Sector Plan (“NWBSPP”). In essence, the NWBSPP is a map guiding areas of conservation concern for the North West Province. Two maps have been developed, namely one for terrestrial biodiversity, and the other for freshwater/aquatic biodiversity.

The NWBSPP maps the terrestrial ecosystems of the North West under the following categories:

- Critical Biodiversity Areas (“CBAs”) – areas of high biodiversity value, needed to meet biodiversity targets. These areas should be maintained in natural or near natural state;
- Ecological Support Areas (“ESAs”) – these areas support CBAs, but are not essential for meeting conservation targets;
- Other Natural Areas – these areas have natural characteristics but have not been earmarked as priority areas for conservation. They perform a range of biological as well as ecological functions; and
- Heavily Modified Areas – areas which have been impacted and have had a significant or complete loss of natural habitat and ecological function.

According to the terrestrial NWBSPP, the study area crosses a terrestrial Critical Biodiversity Area 2 (Figure 5) (NWBSPP 2015) (NWREAD 2015). The southern portion, as well as portions of the west and north, of the study area are listed as Ecological Support Areas (ESAs), specifically ESA level 1 (ESA1). ESAs are terrestrial and aquatic areas not critical in terms of meeting biodiversity targets but are important for maintaining CBAs and/or delivering ecosystem services (Figure 5). Lastly there are ESA level 2 (ESA2) classified zones in the north of the study area as well as surrounding the study area (Figure 5).

The CBA2 and ESAs encompass, to varying ecological degrees, important terrestrial features, including critical patches associated with threatened ecosystems, important habitat for fauna (including vultures), kloofs, hills and ridges, important bird areas, ecological corridors and corridor systems, and buffers for Protected Areas. In terms of flora, there is a small section of the study area assigned as a CBA 2 due to the presence of important habitat for plant species.

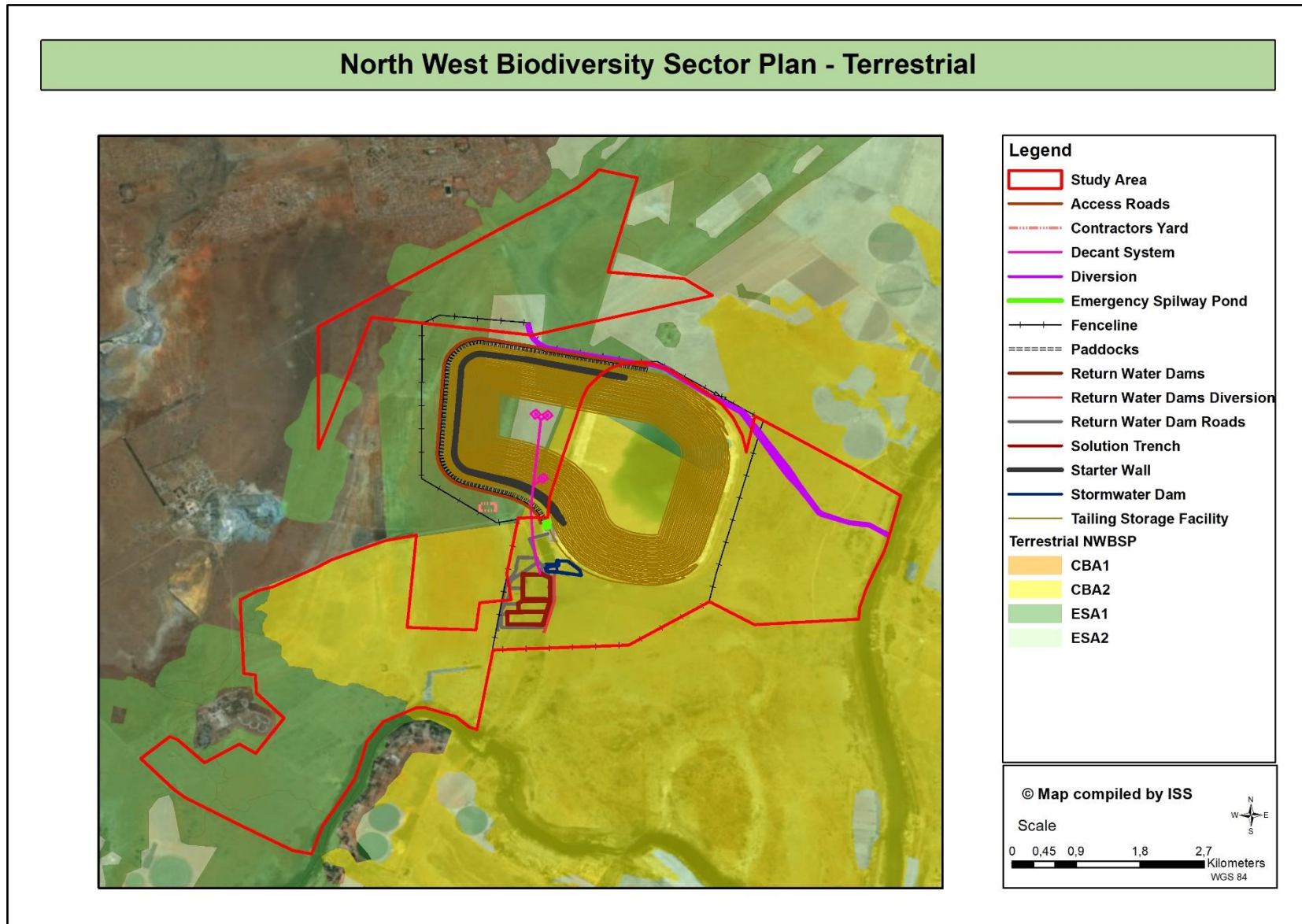


Figure 5: Study area and proposed infrastructure with respect to the terrestrial Critical Biodiversity Areas and Ecological Support Areas as per the North West Biodiversity Sector Plan

2.3. National Biodiversity Assessment 2011

The National Biodiversity Assessment (NBA) was completed as a collaboration between the South African National Biodiversity Institute (SANBI), the Department of Environmental Affairs and stakeholders, scientists and biodiversity management experts throughout the country over a three-year period (Driver *et al.*, 2012).

The purpose of the NBA is to assess the state of South Africa's biodiversity with a view to understanding trends over time and informing policy and decision-making across a range of sectors (Driver *et al.*, 2012).

The two headline indicators assessed in the NBA are ecosystem threat status and ecosystem protection level (Driver *et al.*, 2012). The study area is situated within ecosystems listed as Vulnerable (VU), Least Threatened (LT) and not protected (Figure 6, Figure 7).

2.4. Important Bird Areas and Protected Areas

There are no IBAs near the site. The nearest IBAs are the Sandveld and Bloemhof Dam Nature Reserves IBA (SW of site) and the Magaliesberg IBA (NE of site), both more than 90km from site (Figure 8).

There are no National Parks or Informal Protected Areas in the vicinity of the proposed site. The nearest Formal Protected Area is the Faan Meintjies Nature Reserve approximately 24km NW of the site (Figure 8). There are planned National Protected Area Expansion Strategy (NPAES) areas north of the N12, north of the site. The Vredefort Dome, a World Heritage Site, lies approximately 25km SE of site, which provides unique faunal habitat within the region. The nearest RAMSAR wetland is Baberspan more than 130km NW of site. The UNESCO Magaliesberg Biosphere, which encompasses the Cradle of Humankind (also a World Heritage Site), is 100km NE of site (Figure 8).

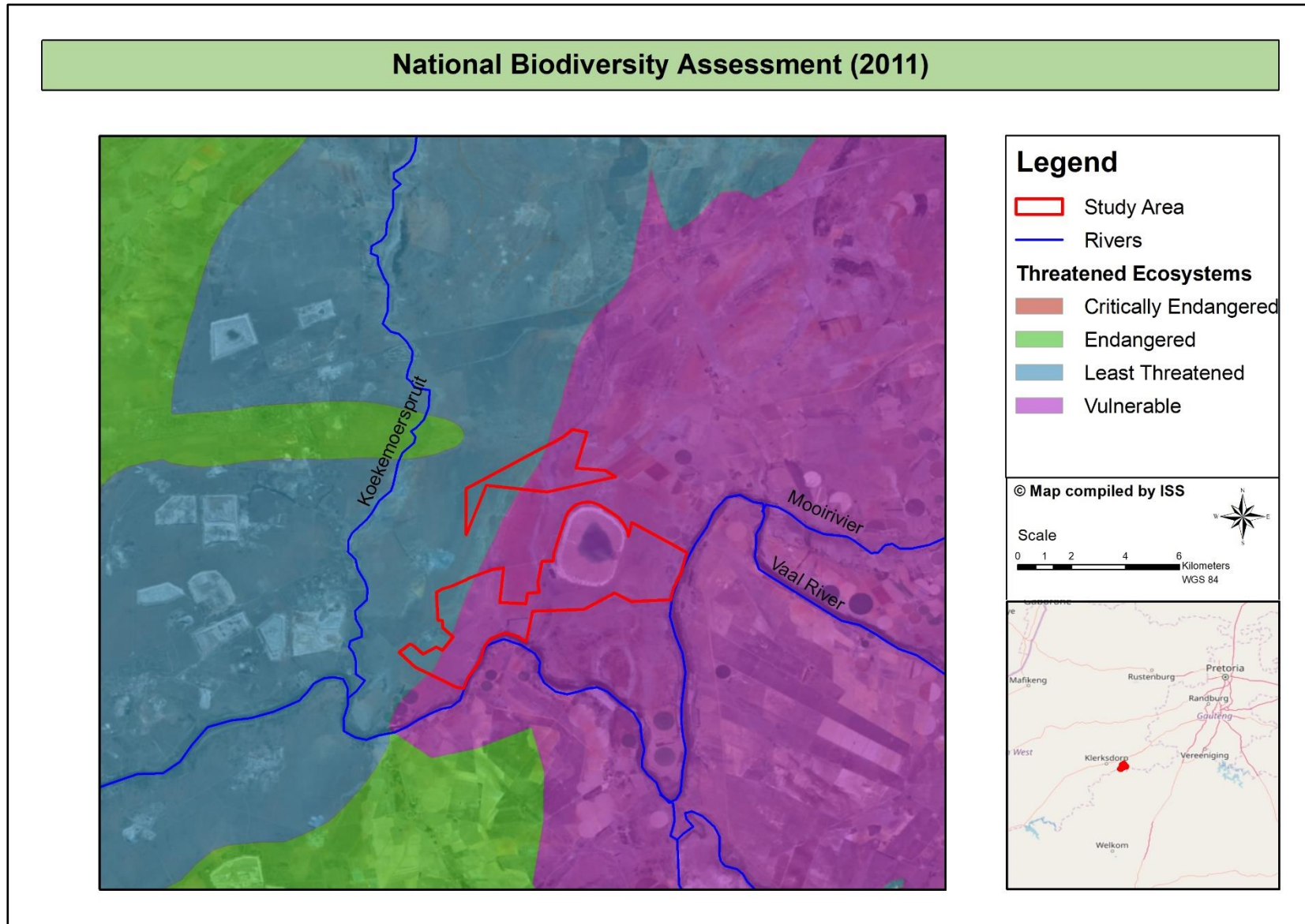


Figure 6: Threat status of terrestrial ecosystems associated with the proposed development based on the National Biodiversity Assessment (NBA, 2011)

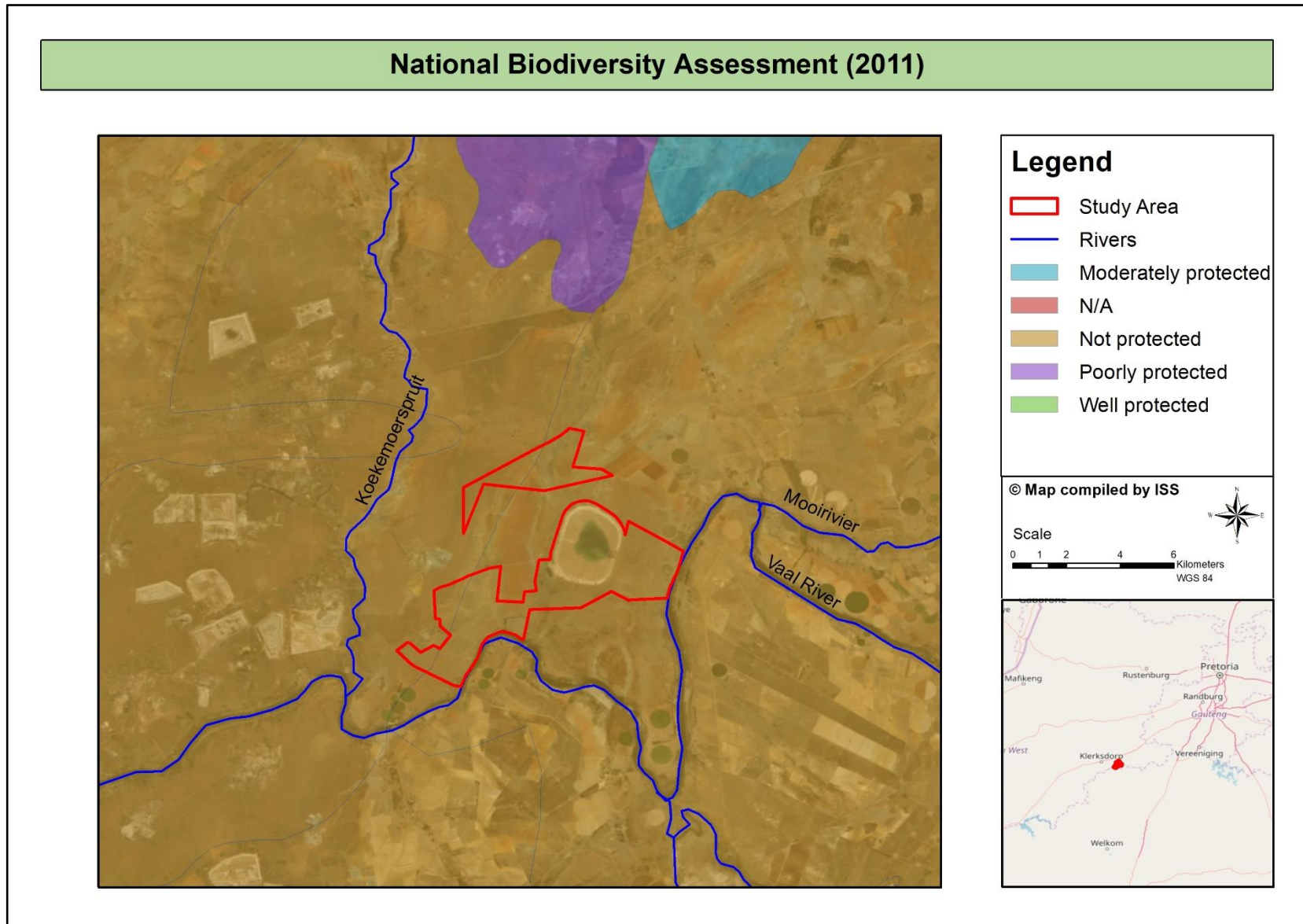


Figure 7: Protection level of terrestrial ecosystems associated with the proposed development based on the National Biodiversity Assessment (NBA, 2011)

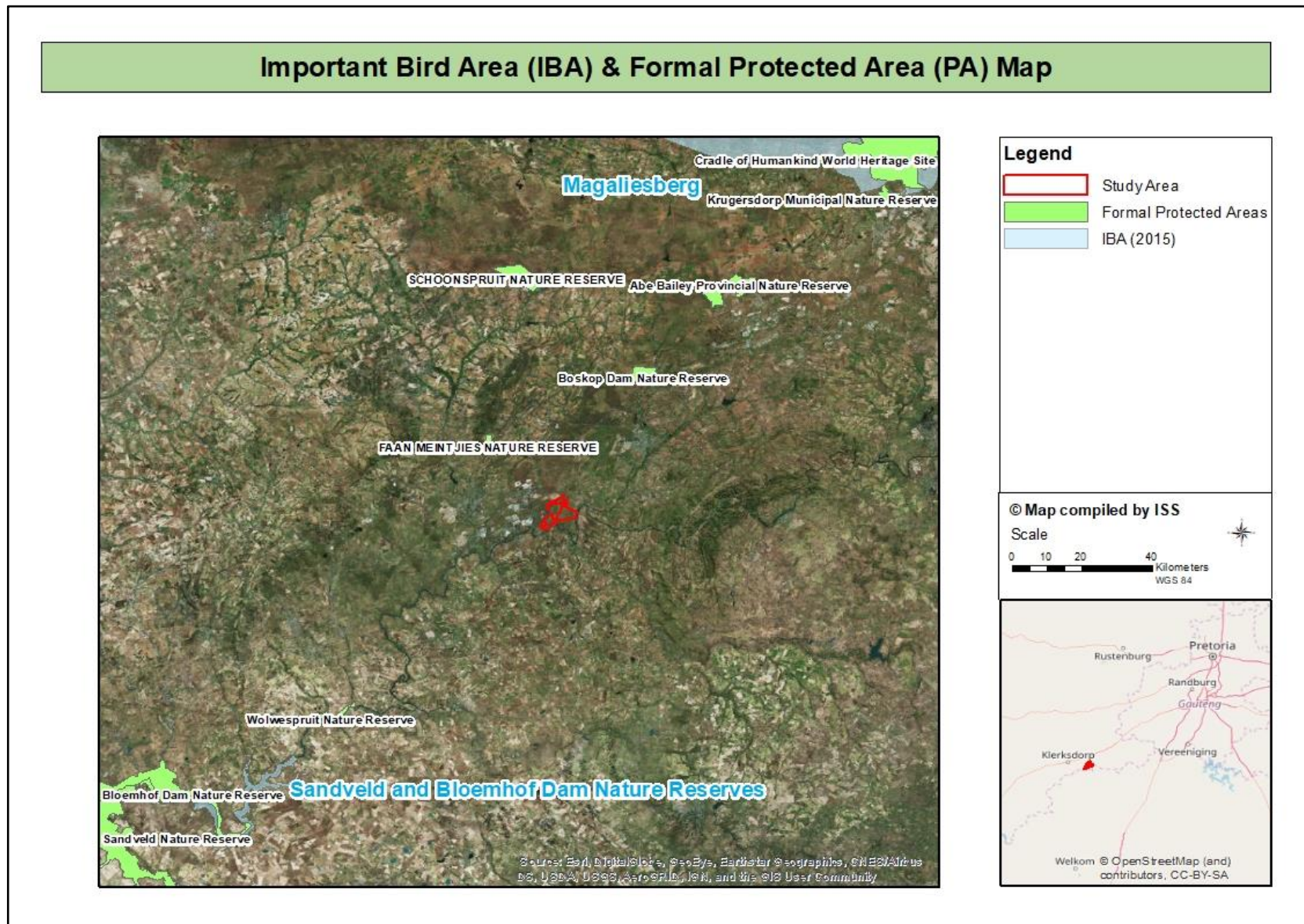


Figure 8: Important Bird Area's and Protected Areas associated with the study area

3. Methods

The methods were based on a desktop assessment as well as a site visit as described below. Additionally, a description of the impact assessment methodology is discussed in this section.

3.1. Fauna

Past surveys have been completed for the study area and surrounds. Where these studies overlapped with the current survey area, their results have been incorporated into the results from this study. The following studies have been consulted and included:

- Agreenco Environmental Projects. 2011. Biodiversity Baseline Assessments for First Uranium's Mine Waste Solutions Kareerand Tailings site. In association with Environmental Research Consulting and Zoological Consulting Services, May 2011.
 - Only species confirmed to occur have been included within this study. Appendix 2 fauna lists do not distinguish between species confirmed to occur and likely to occur and these species have been omitted.
- Deacon, A. 2015. Biodiversity Assessment for Anglogold Mine Waste Solutions: Specialist study: Local Fauna with Emphasis on Threatened Species. June 2015.
 - Study provides an assessment in relation to the BMUs. No detailed BMU plan or shape files for the BMUs were available at the time of compiling this report and the areas have been estimated where utilised.
- De Castro & Brits. 2015. Botanical Biodiversity Baseline Report for Anglogold Ashanti's Mine Waste Solution' surface Rights Area (Stilfontein, North-West Province). July 2015 Draft report.
 - Report is centred around flora but defines the BMUs.
- Clean stream Biological Services. 2015. Biodiversity Management Plan for Anglogold Ashanti, Mine Waste Solution (MWS) Operational Area. Draft Report.
 - Relevant management measures have been incorporated into this report.
- Deacon, A. 2017. Anglo Gold Ashanti: Mine Waste solutions – Kareerand Extension Storage Facility Extension Project – Terrestrial Fauna Impact Assessment Report. December 2017, Draft Report.

The survey focussed on the site boundaries (Survey Area). Where natural areas in neighbouring areas were visible, scan surveys were completed for potential habitats / micro-habitats (Scan Area). Findings from Scan Areas and / or Google Earth Imagery were utilised where extrapolation into neighbouring areas was required for results presented within this report.

3.1.1. TOP Species Lists for the Development Area

This terrestrial fauna report focussed on threatened and protected species (TOPS). Although the term TOPS (threatened and protected species) or TOP species was coined in terms of the threatened and protected species lists published under NEM:BA's General Notice 151 of 2007 (GN151, 2007), in this report TOP and TOP species refers to Red-listed species (focus on threatened - SA Red-list categories supplemented by IUCN threatened species) AND GN151 species.

The first sources for threatened species were the Red-Lists for mammals (sourced from Child *et al.*, 2016, as presented in the mammal Red-list on SANBI.org.za and the Endangered Wildlife Trust Red-listed mammal fact sheets on ewt.org.za/reddata), birds (Taylor *et al.*, 2015, supplemented by information on the Birdlife South Africa website), reptiles (Bates *et al.*, 2014), frogs (du Preez & Carruthers, 2009), butterflies (Mecenero *et al.*, 2013) and dragonflies (Samways & Simaika, 2016). The focus is on threatened categories (Critically Endangered, Endangered and Vulnerable).

The TOP species lists generated were also supplemented by the Threatened or Protected species listed on GN151 of 2007.

Lastly, the IUCN Red-lists species for South Africa (IUCNredlist.org) were consulted for mammals, birds, frogs and reptiles. The invertebrate group is too vast and has only considered South African lists as mentioned above. Only IUCN threatened categories (Critically Endangered, Endangered and Vulnerable) were consulted. Any additional species on the IUCN lists were also added to the TOP species lists, and where IUCN categories varied this was presented. In terms of reptiles and frogs, no additional species were relevant. In terms of birds, additional species were recorded from the IUCN Red-lists. All (Greater Spotted Eagle, European Turtle Dove, Steppe Eagle, Ruppell's Vulture and Sooty Falcon) but one (Slaty Egret) are vagrants to South Africa. The Slaty Egret is an opportunistic breeder in SA and its natural distribution is in the Okavango Delta. Regardless these species have been included in the TOPS lists. The mammal IUCN list indicated two species not recorded in South Africa. *Rusa unicolor* (Sambar) does not occur in South Africa and has been excluded from the list. The Mauritian Free-tailed Bat (*Mormopterus acetabulosus*) is also not regarded as a South African specimen as only a single specimen was collected from Durban (Monadjem *et al.*, 2010a) and is also excluded from the list.

In addition to TOP species, endemic species for mammals, birds, reptiles and frogs were also incorporated into the final TOP species lists for South Africa. The sources above were also used for endemic species, but birds (Chittenden *et al.*, 2016) and frogs (inaturalist.org) were also supplemented by other sources. There may be some variation between sources on endemic species (just South Africa or South Africa, Lesotho and Swaziland). In terms of the terrestrial fauna report, this variation is not seen as critical and will be discussed where relevant in the results.

This generated the Endemic and TOP Species lists for South Africa from which site-specific species were extracted for the Desktop species lists presented in the results. Sources for fauna distribution were also largely obtained from various animal resources mentioned above and were supplemented by various field guides (Stuart & Stuart, 2015; Monadjem *et al.*, 2010a; Monadjem *et al.*, 2010b; Chittenden *et al.*, 2016; Sinclair *et al.*, 2011; Tolley & Burger, 2012).

3.1.2. Survey Area Desktop Species Lists

Terrestrial fauna (mammal, bird, amphibian, reptile & available invertebrate species) desktop lists for the Quarter Degree Grid Square (QDGS) were collected from Citizen Science sites (VMUS.ADU.org and SABAP2.org), referred to as ADU and SABAP2 Species. The desktop lists focussed on data for the last 10 years. Where the survey area falls over multiple QDGSs then all data for all QDGSs was obtained.

It must be stressed that survey areas are smaller areas within the larger QDGS, and the species may not have been recorded at the specific site. Also, the limitations of citizen science sites must be kept in mind.

These species lists have been included in Appendices B to F of this report. The Endemic and TOP species from the ADU and SABAP2 lists have been extracted and included as needed to the Endemic and TOPS desktop species lists presented in the results.

Lastly, any exotic and / or Alien Invasive (AI) Species (AIS) recorded on the ADU and SABAP lists are also presented and discussed in the results where relevant.

3.1.3. Site Assessments and Site-Specific TOP Species List

Many TOPS are rare or shy and elusive species and may not be observed on site, even with extended periods of surveying. Thus, focussed surveys for, and within, preferred habitats / micro-habitats of TOPS were undertaken. This provided info as to whether a TOP species is (a) likely to reside on site for any length of time, (b) likely to just visit or forage over the area or (c) unlikely to occur on site. The presence of broad habitats and micro-habitats was used as the primary indicator for the likelihood of a TOPS species occurring within the survey area as further detailed below.

The various sources mentioned above were consulted where needed to assist in identification of species. In addition, field guides for tracks and signs were used (Murray, 2011; Stuart & Stuart, 2013; Tarboton, 2014).

Although an invertebrate survey did not form part of the scope of work, any invertebrates (with focus on the TOPS families) inadvertently spotted were recorded where possible. The Field Guide to Insects of South Africa (Picker *et al.*, 2012) and the Field Guide to Butterflies of South Africa (Woodhall, 2005) assisted in species identification which was completed to genus level where possible.

Overall site survey methodology included the following:

- Completing a site assessment, which entailed the following:
 - Overall assessment of broad fauna habitat types within the Survey Area and recording:
 - Signs of fauna species, including direct sightings, tracks, calls and/or other ecological indicators (scat, dung, nests, egg shells, burrows, feeding signs, skeletal remains, etc.). A sample of rocks and logs, where present, were overturned.
 - Any specific habitats or micro-habitats, such as substrate types, water resource types, rocky areas, wooded areas, man-made structures, cliffs, etc.
 - Visual scans for specialist habitat / micro habitat types within the Scan Area.
 - Fauna trapping, which included 3 baited camera traps and 8 Sherman traps left overnight.
 - Generating species lists for the survey site of species confirmed for the area from surveys and, where available, past studies.
- Completing a probability assessment to determine the likelihood of endemic and TOP species occurring on site based on the findings above, which considered overall distribution, habitat, micro-habitat, roosting and feeding requirements / preferences where relevant. The probability assessment should be seen as a ranking system rather than an absolute and is designed to reduce subjectivity of results. Likelihood of occurrence was assessed as follows:
 - Confirmed: Either through past or current surveys or through sightings, ecological indicators and local knowledge where provided.
 - Highly Likely: Distribution of the species occurs over the Survey Area; the site and immediate surrounds provides habitat, roosting and food requirements of the specific species. There is nothing to prevent the species from residing on site for a length of time (season or year).
 - Possible: Distribution of the species occurs over the Survey Area; the specific habitats, roosting and/or food requirements are absent from site, but are present in the greater area. Species are not likely to reside on site but may forage over or traverse the Survey Area.
 - Unlikely: Distribution is on the edge of Survey Area and habitat, roosting and/or food requirements are absent or sparse in the Survey Area and surrounds.

3.1.4. Fauna Sensitivity Mapping

The site survey and likelihood of TOPS species informed the fauna sensitivity mapping. Sensitivity mapping considered the following:

- Areas of high sensitivity:
 - All streams, rivers, wetlands are deemed legally sensitive environments in terms of NWA and NEMA and are automatically regarded as highly sensitive areas where they provide ecological connectivity and have at least remnant natural vegetation. Ridges, rocky outcrops and rocky hills are also considered sensitive environments and are deemed highly sensitive areas in terms of fauna. Both aquatic and rocky environments provide unique habitat within the larger terrestrial setting and support Red-listed species. In addition, they provide ecological corridors and maintain connectivity between areas that may otherwise become isolated. Fauna are very susceptible to genetic diseases associated with inbreeding and isolation of populations could result in local extinctions. Therefore, habitats providing for ecological corridors are critical for fauna biodiversity.
 - Any habitats that are in a good condition and that are highly likely to support TOP species or have high faunal assemblages were also designated as highly sensitive in terms of fauna.
- Areas of moderate sensitivity:
 - Any areas that are in a good condition, but that may not necessarily support TOP species, were considered as moderately sensitive in terms of fauna.
 - Any areas that may be disturbed but contained some semblance of natural vegetation or habitat / micro-habitat for general fauna were also considered as moderately sensitive where these provided a buffer between a disturbed area and a highly sensitive area.
- Areas of low sensitivity:
 - Any areas that have been highly disturbed, over-run by AIS, are isolated areas within a developed / disturbed landscape and provide no meaningful use for fauna are designated as areas of low sensitivity in terms of fauna.

A sensitivity plan is presented in the results. This plan must be considered along with the floral and wetland sensitivity maps to obtain an overall biodiversity sensitivity plan.

3.2. Flora

3.2.1. Desktop Assessment

The following datasets and sources were reviewed for the flora study:

- The Vegetation of South Africa, Lesotho & Swaziland (Mucina and Rutherford, 2006); and
- Botanical Database of Southern Africa (BODATSA) (SANBI, 2018).

Based on the data sets, a species list of TOPS or SCC which may possibly occur within the study area was generated. Prior to the site visit characteristics related to habitat as well as dominant features of each of these TOPS or SCC were looked up in literature sources as well as online databases (SANBI, 2018; Raimondo *et al.*, 2009; Smith *et al.*, 2017; Coates-Pelgrave, 2002; van Outshoorn, 2002; Van Wyk & Smith, 2013; Van Wyk & Van Wyk, 2014).

Additionally, the following specialist reports were consulted prior to the field visit:

- De Castro & Brits. 2015. Botanical Biodiversity Baseline Report for AngloGold Ashanti's Mine Waste Solution' surface Rights Area (Stilfontein, North-West Province). July 2015 Draft report.
- De Castro & Brits. 2017. Botanical Biodiversity Baseline and Impact Assessment Report for the Mine Waste Solutions Kareerand Tailings Storage Facility Extension Project, Silfontein, North West Province, March 2018, Final Draft.

Plants of conservation concern:

The International Union for Conservation of Nature (IUCN) is responsible for detecting the risk of possible extinction of species. The IUCN developed a Red List system which is designed to detect risk of extinction. The following categories have been identified by the IUCN:

- 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.
- Least Concern: 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.
- 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 a threatened classification is appropriate.

- 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 risk of extinction is not possible.

3.2.2. *Field Survey*

Prior to the site visit vegetation communities were delineated using Google Earth satellite imagery. A minimum of three sample plots were selected in each vegetation community using random stratified sampling. In the field, sampling plots of 10 m x 10 m were measured out and demarcated (Brown *et al.*, 2016). Every plant species observed within the sample plots was recorded as well as the relative abundance of each species per plot using the Braun-Blanquet method (Braun-Blanquet, 1932, Brown *et al.*, 2016). When moving between plots, plant species of conservation concern were noted and recorded with a GPS.

The field survey was conducted from the 20th to the 23rd of November 2018. A follow up survey was conducted from the 5th to the 7th of February 2019. A total of 65 sample points was planned for the November 2018 and February 2019 surveys however only 42 plots were sampled. A map of the sampling plot is given in Annexure F.

The field survey focussed on identifying areas of natural and untransformed vegetation, unique features that could indicate local sensitivities such as threatened and protected plants, as well as sensitive ecological features such as wetlands, rocky areas and rivers. These features are essential for the maintenance of ecosystem functionality and ecological processes and are likely to support plant species of conservation concern. Additional features thought to have ecological significance, such as dominant species vegetation cover, erosion, rocky cover, the presence of alien invasive plants, as well as plant species of conservation concern and/or their habitat were also recorded. Plant identification and description of vegetation communities was based on species recorded in sampling plots, in transects, in areas driven through, as well as on relevant literature and distribution data. Plant identification was carried out using field guides as well as websites such as iNaturalist, Redlist and PlantZAfrica (Bromilow, 2018; Smith *et al.*, 2017, Coates-Pelgrave, 2002; van Outshoorn, 2002; Van Wyk & Smith, 2013; Van Wyk & Van Wyk, 2014).

3.2.3. *Vegetation Sensitivity*

The analysis methodology has been described and previously applied by Antoinette Eyssel Knox of Dimela Eco-Consulting and is currently unpublished.

It has been clearly demonstrated that vegetation not only forms the basis of the trophic pyramid in an ecosystem, but also plays a crucial role in providing the physical habitat within which organisms complete their life cycles (Kent and Coker, 1992). Vegetation is thus an important determination of the biodiversity of an area.

The vegetation sensitivity assessment aimed to identify whether the broad vegetation associations within the proposed development are of ecological importance and vulnerable to infrastructure development. Such associations may be, amongst others:

- Situated in a listed ecosystem or threatened vegetation unit;
- Protected by national or provincial legislation;
- Habitat or potential habitat to plant species of conservation concern, protected plants or protected trees; and
- Situated within ecologically sensitive areas such as wetlands, riparian areas, rocky areas or ridges, that provide an important ecological function.

During the sensitivity analysis, both the currently prevailing ecological landscape and the possibility of 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) should be born in mind.

The following criteria and weighting were used to determine the vegetation sensitivity, function and conservation importance:

The status of the regional vegetation that is expected to occur on the study site, only where natural vegetation is remaining.

CONSERVATION STATUS*	SCORING
Critically Endangered	3
Endangered	2
Vulnerable	1
Least threatened	0

*This scoring is not applicable (N/A) for areas devoid of natural vegetation.

Whether the study area is situated within a Listed Ecosystem in terms of Section 52 of the National Environmental Management: Biodiversity Act (Act 10 of 2004) or in a vegetation that is classified as Vulnerable or Endangered. The status of the vegetation within the listed ecosystem is assessed based on the level of current and or historic disturbance.

LISTED ECOSYSTEM*	SCORING
Primary state	3
Sub-climax state	2
Secondary state	1

No natural vegetation remaining	0
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Whether the vegetation or ecological feature is protected by legislation:

LEVEL OF LEGISLATIVE PROTECTION	SCORING
National legislation	3
Provincial policies and guidelines	2
Municipal or other protection	1
No legislated protection	0

The presence of suitable habitat for plants of conservation concern as well as the actual occurrence thereof.

SUITABLE HABITAT / PRESENCE	SCORING
Confirmed presence of Red listed species (Threatened)	3
Confirmed presence of Orange listed (Near threatened, Declining), or provincially protected species or suitable habitat and some likelihood of occurrence of Threatened species	2
Suitable habitat but unlikely to occur	1
No suitable habitat	0

Ecological Function: areas important to ecological processes such as ecological corridors, hydrological systems and important topographical features such as ridges.

ECOLOGICAL FUNCTION	SCORING
High: Sensitive vegetation communities with low inherent resistance or resilience towards disturbance factors; vegetation communities that are considered important for the maintenance of ecosystem integrity. Most of these vegetation communities represent late succession ecosystems with high connectivity with other important ecological systems.	3
Medium to high: Vegetation communities that occur at disturbances of low-medium intensity and are representative of secondary succession stages with a high degree of connectivity with other ecological systems OR disturbed vegetation connected to an ecological and protected system e.g. ridge, wetland or river.	2
Medium: Vegetation communities that occur at disturbances of low-medium intensity and are representative of secondary succession stages with some degree or limited connectivity with other ecological systems.	1
Low: Degraded and highly disturbed vegetation with little ecological function.	0

Ecological Importance: indication of the necessity to conserve areas based on factors such as the importance of the site on a national and/or provincial scale and on the ecological state of the area (degraded or pristine). This is determined by the presence of a high diversity, rare or endemic species and areas that are protected by legislation.

ECOLOGICAL IMPORTANCE	SCORING
High: Ecosystems with high species diversity and usually provide suitable habitat for several threatened species. OR protected ecosystems e.g. wetlands, riparian vegetation etc. These areas should be protected.	3
Medium to high: Ecosystems with intermediate levels of species with the possible occurrence of threatened species.	2
Medium: Ecosystems with intermediate levels of species diversity without any threatened species.	1
Low: Areas with little or no conservation potential and usually species poor (most species are usually exotic).	0

To determine the sensitivity of the vegetation groups in the study area, weighting scores and criteria as above were applied. The results of the scoring places the vegetation in one of the below sensitivity classifications. Vegetation with a low score is not considered to be sensitive. Vegetation with a score of 7 is considered as being of medium-low sensitivity, while a score of 13 is regarded as being of medium-high sensitivity.

SCORING	13-18	7-12	1-6
Sensitivity / ecological condition	High	Medium	Low

4. Discussion and Evaluation of Faunal Results

The study focussed on the Sites 1 to 23 (Figure 9) within the new survey area of the development boundary (Survey Area). A scan survey was completed for potential habitats in undeveloped nearby areas that were reasonably accessible and visible (Scan Area). The site visit was undertaken during summer on 20th to the 23rd of November 2018 with a follow up survey over 5th to the 8th of February 2019. The area seemed to have received rainfall, as vegetation was sparse during November and denser in February. Weather was hot and sunny, with some windy periods which slightly hampered fauna surveying. Overall conditions were good for fauna surveying. Figure 9 indicates the routes travelled (walking and driving) and the specific sites sampled (Sites 1 to 23).

In addition to the survey areas indicated above, Sherman and Camera traps were established around site during the two survey periods. Sherman traps were set out over night at locations near sites 3 and 17 during the November surveys and day-time trapping was attempted near site 16 during the February surveys. Camera traps were left out for 2 full days at locations near sites 1,3, 6 during the November surveys and overnight along the eastern boundary of the existing TSF during the February surveys. In addition, one camera trap was set out during the day near site 16.

Sherman traps were unsuccessful, and fauna caught on cameras were included in the fauna lists discussed below.

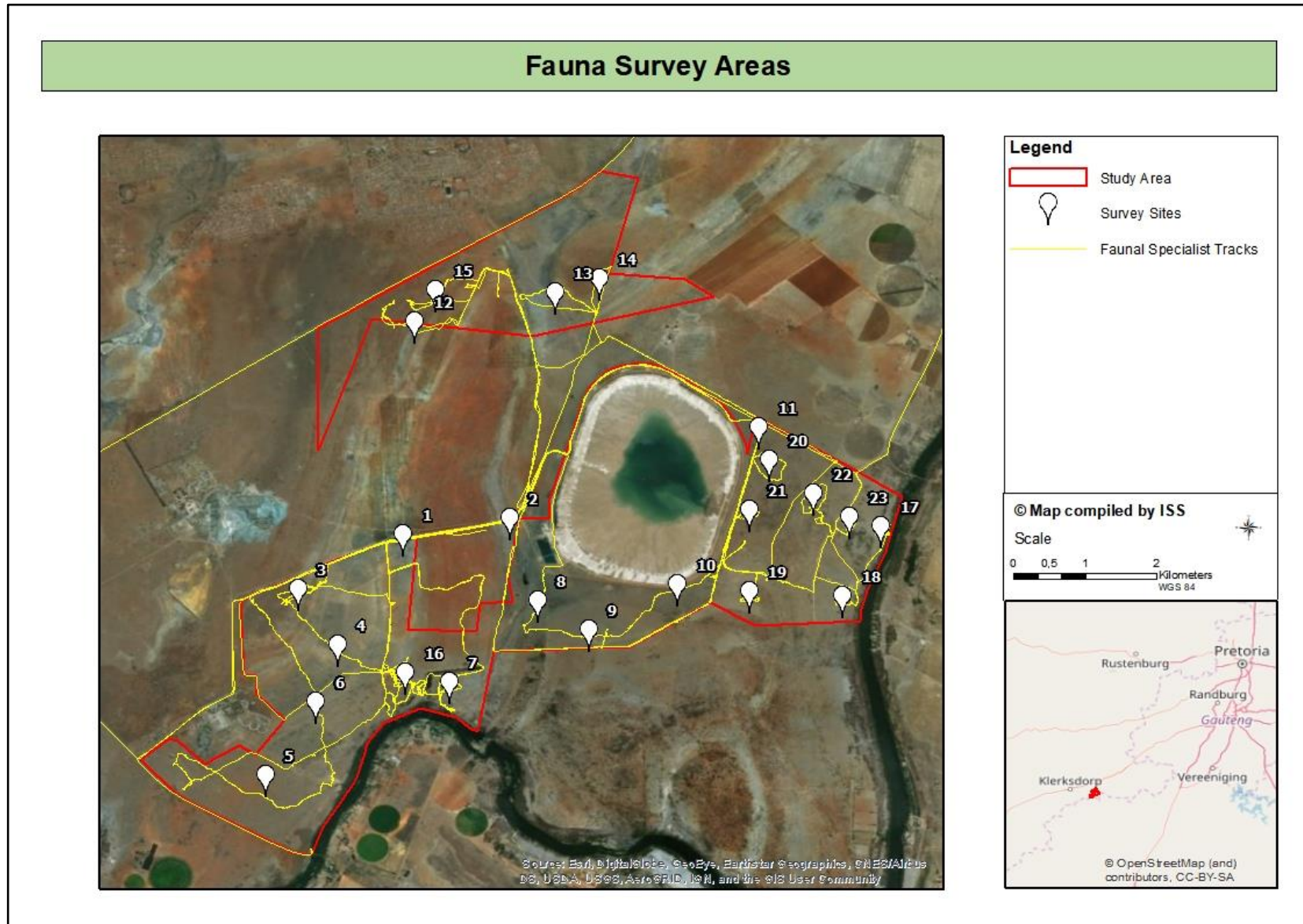




Figure 9: Fauna survey area, GPS tracks, and sites assessed




4.1. Overall Faunal Site Assessment

Table 1 provides a brief summary of the sites assessed in terms of overall habitat type and, where relevant, micro-habitats and specialised food sources as relevant to fauna.

The area is dominated by grassland which is to be expected for the Grassland Biome. In addition, many habitat types were noted within the area as described in Table 1. Such features, which include various rocky habitats and wetland habitats, increase the habitat heterogeneity of the site. Biogeographically, more habitat diversity will result in greater faunal richness and diversity.

Table 1: Sites assessed, and general characteristics as may be relevant to fauna

SITES	GENERAL CHARACTER, MICRO-HABITATS & OVERALL SITE OBSERVATIONS
 <p style="text-align: center;">Site 1, 7, 16</p>	<p>Isolated AIS Stand</p> <p>Area is largely composed of short grass with patches of bare ground and patches of taller, tufted grasses within and around the stand of AIS.</p> <p>Good layer of organic debris from the trees.</p> <p>Soils are loamy; no clays or sandy soils observed.</p> <p>Tall trees provide for arboreal habitats.</p> <p>No rocky habitats and no surface water features in the vicinity.</p>
	<p>Open Grasslands</p> <p>Majority of the undeveloped land is composed of grassland, including recently burnt / overgrazed short grassland and tall grassland.</p> <p>Soils were loam varying from clay-loams to sandy-loams, with true clay soils limited to pans (see below); no true sandy soils were noted during surveys.</p> <p>Grasslands support grasses and other small plants, including succulents, aloes, herbs, forbs and other grassland specialists.</p>

	<p>Grazing herbivores were prevalent in the southern grasslands. It is also assumed that the area supports a healthy small mammal population, evidenced by several burrows, scat and activity of raptors.</p>
<p>Sites 2, 3, 4, 5, 6, 9, 10, 12, 14, 15, 16, 18, 23</p>	<p>Rocky Grasslands / Habitats</p>
	<p>Rocky habitats were scattered throughout the area and represented at several sites.</p> <p>Rocky habitats included rock-strewn grasslands, rocky ridges, rocky koppies and flat rocky areas.</p> <p>Rocky areas provide unique habitats in the greater terrestrial setting and increase habitat heterogeneity. Rocky ridges and outcrops also often create ecological corridors.</p>
<p>Sites 3, 5, 6, 8, 9, 11, 12, 15, 16, 20, 21, 22</p>	<p>Several reptiles, baboon spiders and scorpions will make use of rocky habitats, although none were observed during the surveys. Some TOP mammals and birds prevail in rocky habitats.</p>
	<p>Pans & Dams</p>
<p>Site 5, 13, 19</p>	<p>Two pans were noted during the survey and were dry at the time of the survey.</p> <p>Pans are unique wetland habitats and again increase habitat heterogeneity.</p> <p>Pans provide water / wetland habitats during the rainy season and are preferred habitats for the Giant Bullfrog, not observed on site (most likely due to the lack of good rains).</p> <p>The Wildebeespan was dry at the time of survey, but provided short, sparse grassland on fairly exposed hard substrate created by the dry clay soils. Several ground beetles utilised the area.</p> <p>In addition, scattered watering holes occur through site. Some are associated with dams on drainage lines (see below) while some are artificial water holes. Some dams have been created by excavations near Site 19, which provide additional watering holes for fauna. The muddy wallows showed signs of fauna activity.</p>



Sites 16, 17

Drainage Lines

Drainage line and tributary to the Vaal River flowed through largely short, lush grassland.

The drainage line is dammed at a few locations which creates small dams and muddy wallows for fauna.

The drainage line is bordered by rocky outcrops, with scattered isolated shrubs and very limited isolated trees, except for nearby AIS stands.



Sites 3, 5, 6, 7, 10, 19, 21, 23

Wooded Grasslands

Patches of indigenous trees were scattered throughout the area. Density of trees varied from isolated, solitary trees within the grassland to patches of trees creating wooded grasslands.

Wooded areas provided arboreal habitats utilised by birds, reptiles and mammals.






Site 5

Thorny Thickets

An area along the Vaal River is dominated by Asparagus thickets.

Although this is a sign of disturbance, the thorny shrubs provide habitat to fauna with preference for dense shrubs and thickets.

	<p>Vaal River & Associated Riverine Thicket & Woodland</p> <p>The Vaal river provided the most significant surface water resource in the area and was utilised by water birds.</p> <p>The banks of the river were dominated by riverine woodland and thickets, and provided dense, well foliated, arboreal habitats as well as dense cover and refuge for fauna.</p>
 <p style="text-align: center;">Site 17</p>	<p>Disturbed & Developed Areas</p> <p>The grassland to the north near the R502 is utilised by the community for recreation and grazing of their stock and was quite disturbed.</p> <p>The mine dump, infrastructure area, roads can be considered developed and provide limited habitat to fauna.</p> <p>More generalist, less sensitive fauna, capable of adapting to disturbances are most likely to utilise such areas.</p>
 <p style="text-align: center;">Site 12</p>	

4.1.1. *Habitat Characteristics Specific to Ecologically Significant Fauna*

The availability of overall habitat types and specific micro-habitats is the first step in determining the likelihood of fauna occurring on site. In terms of fauna, with focus on ecologically significant species:

- Although it is unreasonable to survey the entire area, the survey indicated no true deep sandy soils, and any species with specific preferences for sandy soils are unlikely to reside in the area.
- No caves, mine adits/shafts or caverns were noted within the area, but may occur in the surrounds. Species with preference for such sites, such as some bats, are unlikely to reside in the area, but may forage over the area.
- Other than the Vaal River, no large bodies of surface water exist on site. Fauna with a preference for water bodies would therefore only periodically occur on site when high rainfall fills the existing pans and dams on site or if foraging over the area.

4.2. Mammals

The mammal ADU desktop list is provided in Annexure A with an endemic and TOPS assessment provided in Table 2. The combined list of mammals observed during past and current surveys has been provided in Table 2. It must be stated that the vegetation was denser during the February survey (sites 13 to 23) and tracks and fauna indicators were more difficult to observe.

4.2.1. Species of Conservation Concern

Four TOPS were recorded for the area: From prior observations (2017) the Endangered Southern Mountain Reedbuck and Near Threatened Brown Hyena (the latter Protected under GN151, 2007) have been observed in the surrounds. From current surveys the Protected Aardvark (feeding signs) and the Protected Black Wildebeest (both Protected under GN151, 2007) were confirmed.

The Aardvark is a keystone species as its burrows create a micro-habitat which facilitates the existence of many other vertebrates and provides roosting for the threatened Blue Swallow (Taylor *et al.*, 2016). Threats faced by the species are likely due to cumulative habitat loss from agricultural and human settlement expansion and associated subsistence hunting and persecution (Taylor *et al.*, 2016). Climate change may also represent an emerging threat (Taylor *et al.*, 2016).

Historical threats to the Black Wildebeest included hunting pressure, habitat loss, and periodic outbreak of disease (Vrahimis *et al.*, 2016). Although the species has recovered, it still faces threats, including hybridisation with the Blue Wildebeest, habitat fragmentation and isolation of species leading to inbreeding (Vrahimis *et al.*, 2016).

The main threats to the Southern Mountain Reedbuck (*Redunca fulvorufula*) includes expansion of human settlements, and associated increase in rates of poaching, disturbance by cattle herders and their livestock, and hunting by domestic dogs (Taylor *et al.*, 2016).

As a scavenger and predator, the Brown Hyaena (*Parahyaena brunnea*) plays two main ecological roles: its cleans up carrion and keeps other similar predator numbers in check. The main threat facing the species is direct persecution by farm owners (Yarnell, *et al.*, 2016).

As a cautionary approach, the Wild Cat scat observed on site, was assumed to belong to the Vulnerable Black-footed Cat (*Felis Nigrripes*) as opposed to the African Wild Cat (*Felis silvestris*). According to the EWT Fact Sheets, threats to the species includes predation, diseases, declining Springhare populations (also rely on burrows of this species for dens) and unsuitable farming practices. Fragmented populations limit dispersal opportunities and restrict genetic exchange within the species.

Feeding signs of Vlei Rats (*Otomys sp.*) were recorded in several areas and again as a cautionary approach these were assumed to belong to the Southern African Vlei Rat (*O. auratus*), a Near Threatened Red-listed species, highly likely to occur in the area. The Near Threatened Swamp Musk Shrew was confirmed for the area. Both species are threatened by loss of habitat (grassland and wetland) through degradation and fragmentation.

TOP species that are highly likely to occur on site include:

- Endangered Southern Mountain Reedbuck (*Redunca fulvorufula*): Threats include expansion of human settlements, and associated increase in rates of poaching, disturbance by cattle herders and their livestock, and hunting by domestic dogs (EWT Fact Sheets).
- Vulnerable Sable Antelope (*Hippotragus niger niger*): Species faces threats associated with climate change (decline in preferred habitats and restriction of species by fences), poor land management, and poorly planned translocation of species (EWT Fact Sheets).
- Vulnerable White-tailed Mouse (*Mystromys albicaudatus*): Threatened by loss of grassland habitats (EWT Fact Sheets).
- Vulnerable Spotted-necked Otter (*Hydrictis maculicollis*): Also Protected under GN151, 2007. Threatened by loss of habitat through alteration or degradation of freshwater habitats and riparian vegetation (EWT Fact Sheets).
- Vulnerable Hartmann's Mountain Zebra (*Equus zebra hartmannae*): Also Endangered under GN151, 2007. Hybridisation with Cape Mountain Zebra and Plains Zebra is the only major threat (EWT Fact Sheets).
- Southern African Hedgehog (*Atelerix frontalis*): Protected under GN151, 2007. Threatened by habitat loss, degradation and fragmentation from urban and agricultural development, illegal harvesting for food and trade as pets and traditional medicine (EWT Fact Sheets).
- Brown Hyaena (*Parahyaena brunnea*): Protected under GN151, 2007. Main threats include direct persecution by farm owners (EWT Fact Sheets).
- Cape Fox (*Vulpes chama*): Protected under GN151, 2007. Main threats include direct persecution by farm owners (EWT Fact Sheets).
- Serval (*Leptailurus serval*): Protected under GN151, 2007. Main threats include wetland and associated grassland habitat destruction (EWT Fact Sheets).
- Honey Badger (Ratel) (*Mellivora capensis*): Protected under GN151, 2007. Main threats include direct persecution by bee farmers (EWT Fact Sheets).
- Southern Reedbuck (*Redunca arundinum*): Protected under GN151, 2007. Main threats include habitat destruction and hunting (EWT Fact Sheets).

4.2.2. Invasive Species

One non-categorised invasive species (categorised for offshore islands), the Domestic Cat, and one exotic species, the One-humped Camel, was confirmed in the QDGS. The One-humped Camel was confirmed on site. In addition, domestic animals such as donkeys, goats and cows were noted on site and in the surrounds (Table 2).

Table 2: Mammals of interest

COMMON NAME	TAXON NAME	ENDEMISM	SA STATUS	IUCN (2016)	SITE OCCURRENCE: SPECIFIC SITES (PAST SURVEYS)
SITE SPECIES					
Aardvark	<i>Orycteropus afer</i>		(Protected*)		3, 4
Blesbok	<i>Damaliscus pygargus phillipsi</i>	Endemic			3, 4, 9, 11
Bushpig	<i>Potamochoerus larvatus</i>				3, 10
Caracal	<i>Caracal caracal</i>				9
Cat, Wild	<i>Felis sp. (most likely F. nigripes)</i>		Vulnerable (Protected*)	Vulnerable	11
Civet, African	<i>Civettictis civetta</i>				5, 9, 18, 22
Duiker, Common	<i>Sylvicapra grimmia</i>				1, 2, 3, 5, 12, 16 (2014)
Gemsbok	<i>Oryx gazella</i>				3, 9 (2014)
Gerbil (most likely Highveld Gerbil)	<i>Gerbilliscus sp. (most likely G. brantsii)</i>				10 (2017)
Giraffe	<i>Giraffa camelopardalis</i>			Vulnerable	(2014)
Hare, Cape	<i>Lepus capensis</i>				(2014, 2017)
Hare, Savanna	<i>Lepus victoriae</i>				3, 8, 13, 15, 23
Hyaena, Brown	<i>Parahyaena brunnea</i>		Near Threatened (Protected*)	Near Threatened	(Observed in 2017)
Impala	<i>Aepyceros melampus</i>				3, 4, 7, 9, 11, 16, 23
Jackal, Black-backed	<i>Canis mesomelas</i>				3, 4 (2014, 2017)
Mole-rat, Common (African)	<i>Cryptomys hottentotus</i>	Endemic			12, 15 (2014, 2017)
Mongoose, Slender	<i>Galerella sanguinea</i>				4, 6, 9 (2014)
Mongoose, Water	<i>Atilax paludinosus</i>				(2017)
Mongoose, Yellow	<i>Cynictis penicillata</i>				1-12, 15, 22 (2014, 2017)
Monkey, Vervet	<i>Cercopithecus aethiops</i>				19 (2014)
Mouse, Namaqua Rock	<i>Micaelamys namaquensis</i>				(2011)
Mouse, Southern Multimammate	<i>Mastomys coucha</i>				(2011)
Mouse, Xeric Four-striped Grass	<i>Rhabdomys pumilio</i>	Endemic			(2009, 2014)

Porcupine	<i>Hystrix africaeaustralis</i>				2, 3, 4, 8, 22 (2014, 2017)
Rabbit, Jameson's Red Rock	<i>Pronolagus randensis</i>				3, 4
Rat, Vlei	<i>Otomys sp. (Most likely O. auratus)</i>	Near Endemic	Near Threatened	Near Threatened	8, 9, 10
Reedbuck, Southern Mountain	<i>Redunca fulvorufula</i>	Near Endemic	Endangered		(Observed in 2017)
Shrew, Swamp Musk	<i>Crocidura mariquensis</i>		Near Threatened		(2011)
Springbok	<i>Antidorcas marsupialis</i>				3, 5, 19 (2014)
Squirrel, South African Ground	<i>Xerus inauris</i>				3, 11 (2014, 2017)
Steenbok	<i>Raphicerus campestris</i>				3, 9 (2014 2017)
Warthog	<i>Phacochoerus africanus</i>				7, 8, 9
Waterbuck	<i>Kobus ellipsiprymnus</i>				5
Wildebeest, Black	<i>Connochaetes gnou</i>	Endemic	(Protected*)		7, 16
Wildebeest, Blue	<i>Connochaetes taurinus taurinus</i>				4, 7
Zebra, Plains	<i>Equus quagga</i>				4 (2014)
OTHER SPECIES OF CONSERVATION IMPORTANCE					
Antelope, Roan	<i>Hippotragus equinus</i>		Endangered (Vulnerable*)		Unlikely – Outside main distribution
Rhino, Southern-central Black	<i>Diceros bicornis minor</i>		Endangered (Endangered*)	Critically Endangered	Unlikely – Restricted species
Antelope, Sable	<i>Hippotragus niger niger</i>		Vulnerable		Highly likely
Bontebok	<i>Damaliscus pygargus pygargus</i>	Endemic	Vulnerable (Vulnerable*)	Near Threatened	Unlikely – ADU species, outside distribution. Possible misidentification with Blesbok
Leopard	<i>Panthera pardus</i>		Vulnerable (Vulnerable*)	Vulnerable	Possible – Edge of distribution
Mouse, White-tailed	<i>Mystromys albicaudatus</i>		Vulnerable	Endangered	Highly likely
Otter, Spotted-necked	<i>Hydricis maculicollis</i>		Vulnerable (Protected*)	Near Threatened	Highly likely
Pangolin	<i>Smutsia temminckii</i>		Vulnerable (Vulnerable*)	Vulnerable	Unlikely – Outside main distribution
Tsessebe	<i>Damaliscus lunatus lunatus</i>		Vulnerable (Endangered*)		Possible – Limited preferred habitat on site.
Zebra, Hartmann's Mountain	<i>Equus zebra hartmannae</i>		Vulnerable (Endangered*)	Vulnerable	Highly likely

Hedgehog, Southern African	<i>Atelerix frontalis</i>		Near Threatened (Protected*)		Highly likely
Otter, Cape Clawless	<i>Aonyx capensis</i>		Near Threatened	Near Threatened	Highly likely – ADU species
Rhebok, Grey	<i>Pelea capreolus</i>	Endemic	Near Threatened	Near Threatened	Possible – Just inside very patchy distribution range
Rhino, White	<i>Ceratotherium simum simum</i>	Near Endemic	Near Threatened (Protected*)	Near Threatened	Unlikely – Restricted species
Serval	<i>Leptailurus serval</i>		Near Threatened (Protected*)		Highly likely
Weasel, African Striped	<i>Poecilogale albinucha</i>		Near Threatened		Highly likely
Fox, Cape	<i>Vulpes chama</i>		(Protected*)		Highly likely
Honey Badger (Ratel)	<i>Mellivora capensis</i>		(Protected*)		Highly likely
Reedbuck, Southern	<i>Redunca arundinum</i>		(Protected*)		Highly likely
Tete Veld Rat	<i>Aethomys ineptus</i>	Near Endemic			Possible – Edge of distribution
Mole, Hottentot's Golden	<i>Amblysomus hottentous</i>	Endemic			Unlikely – Outside main distribution area
Genet, Cape	<i>Genetta tigrina</i>	Endemic			Unlikely – ADU species, outside distribution area, most likely misidentified species
Shrew, Forest	<i>Myosorex varius</i>	Endemic			Possible – Edge of distribution
ALIEN SPECIES					
Cat, Domestic (ADU)	<i>Felis Catus</i>		Exotic		Highly likely (ADU species)
Camel, One-humped	<i>Camelus dromedarius</i>		Exotic		Confirmed – 4 and 7

* GN151 of 2007, South African TOPS List

GN864 of 2016, South African AIS List

4.3. Avifauna

The avifauna desktop list is provided in Annexure B (SABAP2.org) with an endemic and TOPS assessment provided in Table 3. Table 3 indicates birds recorded for the site during past and current surveys.

4.3.1. Species of Conservation Concern

Two Red-listed (Vulnerable) birds are confirmed for the site, the Secretary bird (*Sagittarius serpentarius*) and the Lanner Falcon (*Falco biarmicus*). The Near Threatened Red-footed Falcon (*Falco vespertinus*) is also confirmed for the site.

As per Taylor *et al.* (2015), the main threats faced by the Secretary bird (*Sagittarius serpentarius*) include the loss and degradation of grassland habitat through poor grazing and fire management, urban development and agriculture. Trade, hunting and nest raiding, collisions with power-lines, drowning in sheer-walled reservoirs and wind-farms are further potential risks faced by the species.

Threats to the Lanner Falcon (*Falco biarmicus*) include loss and degradation of grassland habitat through agriculture and afforestation, which reduces its prey numbers. Poisoning, collisions with power-lines and persecution by fowl farmers and pigeon enthusiasts also threatens this species (Taylor *et al.*, 2015).

TOP species that are highly likely to occur on site include:

- Endangered African Marsh Harrier (*Circus ranivorus*): Also Protected under GN151, 2007. Main threats include deterioration and loss of wetlands through draining and damming, poor land management practices, and direct disturbance by humans during the breeding season (Taylor *et al.*, 2015).
- Endangered Yellow-billed Stork (*Mycteria ibis*): Main threats include loss of wetland habitats, including systems of pans, marshes and floodplains, and loss of suitable trees for roosting/nesting (Taylor *et al.*, 2015).
- Vulnerable White-backed Night Heron (*Gorsachius leuconotus*): Main threats include degradation and clearance of sensitive riverbank habitats and activities that alter water flow, sediment loads and chemistry, such as impoundments (Taylor *et al.*, 2015).
- Vulnerable Caspian Tern (*Sterna caspia*): Main threats include disturbance during the breeding season, egg collection and predation of eggs by predators, including domestic animals. Additional potential threats include extreme weather that affects water levels and bio-accumulation of heavy metals, pesticides and pollution which may also affect breeding success (Taylor *et al.*, 2015).

Only one endemic bird, the Cape White-eye (*Zosterops virens*), was confirmed for the site. The area is not regarded as an area of endemism in terms of avifauna (Table 3).

4.3.2. Invasive Species

In terms of birds, three Category 3 invasive species (GN864, 2016) were recorded for the QDGS: the Rock Dove, Common Myna and House Sparrow. The latter two being confirmed for the site. The Mallard Duck (Category 2) has also been recorded for the QDGS. These species have extensive distributions in South Africa, are closely related to human settlements and no proper control programmes have been implemented in South Africa for these species (Picker and Griffiths, 2011). Control efforts will need to be applied provincially and nationally if control of these species is to be successful.

Table 3: Birds of interest

COMMON NAME	TAXON NAME	ENDEMISM	SA STATUS	IUCN (2016)	SITE OCCURRENCE: SPECIFIC SITES (PAST SURVEYS)
SITE SPECIES					
Barbet, Acacia Pied	<i>Tricholaema leucomelas</i>				(2009, 2014)
Barbet, Black-collared	<i>Lybius torquatus</i>				(2009, 2014)
Barbet, Crested	<i>Trachyphonus vaillantii</i>				16 (2009, 2014)
Bee-eater, European	<i>Merops apiaster</i>				3, 16 (2009, 2014, 2017)
Bee-eater, Little	<i>Merops pusillus</i>				(2009, 2014)
Bee-eater, White-fronted	<i>Merops bullockoides</i>				(2014)
Bishop, Southern Red	<i>Euplectes orix</i>				8, 15, Vaal (2009, 2014, 2017)
Bishop, Yellow-crowned	<i>Euplectes afer</i>				(2009, 2014)
Bokmakierie	<i>Telophorus zeylonus</i>				(2009, 2014, 2017)
Brubru, Southern	<i>Nilaus afer</i>				5 (2014)
Bulbul, African Red-eyed	<i>Pycnonotus nigricans</i>				(2009, 2014)
Bulbul, Dark-capped	<i>Pycnonotus tricolor</i>				Vaal
Bunting, Cinnamon-breasted	<i>Emberiza tahapisi</i>				(2009, 2014)
Buttonquail Common	<i>Turnix sylvaticus</i>				(2017)
Buzzard, Common	<i>Buteo buteo (vulpinus)</i>				(2009, 2014)
Canary, Black-throated	<i>Crithagra atrogularis</i>				(2009, 2014)
Canary, Yellow	<i>Crithagra flaviventris</i>				(2014)
Canary, Yellow-fronted	<i>Crithagra mozambica</i>				(2014)
Chat, Anteating	<i>Myrmecocichla formicivora</i>				6 (2014, 2017)
Chat, Familiar	<i>Cercomela familiaris</i>				(2014)
Cisticola, Cloud	<i>Cisticola textrix</i>				(2009, 2014, 2017)
Cisticola, Desert	<i>Cisticola aridulus</i>				(2009, 2014, 2017)
Cisticola, Levaillant's	<i>Cisticola tinniens</i>				(2009, 2014, 2017)
Cisticola, Rattling	<i>Cisticola chiniana</i>				(2014)
Cisticola, Wing-snapping	<i>Cisticola ayresii</i>				(2014, 2017)
Cisticola, Zitting	<i>Cisticola juncidis</i>				(2009, 2014, 2017)
Coot, Red-knobbed	<i>Fulica cristata</i>				(2014)

COMMON NAME	TAXON NAME	ENDEMISM	SA STATUS	IUCN (2016)	SITE OCCURRENCE: SPECIFIC SITES (PAST SURVEYS)
Cormorant, Reed	<i>Phalacrocorax africanus</i>				19 (2009, 2014)
Cormorant, White-breasted	<i>Phalacrocorax carbo</i>				(2014)
Crombec, Long-billed	<i>Sylvietta rufescens</i>				(2014)
Crow, Pied	<i>Corvus albus</i>				1, 4 (2009, 2014, 2017)
Cuckoo, Diderick	<i>Chrysococcyx caprius</i>				(2009, 2014)
Cuckoo, Klaas's	<i>Chrysococcyx klaas</i>				(2014)
Cuckoo, Red-chested	<i>Cuculus solitarius</i>				(2014)
Darter, African	<i>Anhinga rufa</i>				Vaal (2014)
Dove, Cape Turtle	<i>Streptopelia capicola</i>				3 (2009, 2014, 2017)
Dove, Laughing	<i>Streptopelia senegalensis</i>				3, 15, 16 (2009, 2014, 2017)
Dove, Namaqua	<i>Oena capensis</i>				11, 20 (2014)
Dove, Red-eyed	<i>Streptopelia semitorquata</i>				(2009, 2014, 2017)
Duck, Yellow-billed	<i>Anas undulata</i>				(2009, 2014)
Eagle, African Fish	<i>Haliaeetus vocifer</i>				16
Eagle, Long-crested	<i>Lophaetus occipitalis</i>				17
Egret, Cattle	<i>Bubulcus ibis</i>				5, 6 (2009, 2014, 2017)
Falcon, Lanner	<i>Falco biarmicus</i>		Vulnerable		(2009)
Falcon, Red-footed	<i>Falco vespertinus</i>		Near Threatened		(2009)
Finch, Scaly-feathered	<i>Sporopipes squamifrons</i>				(2017)
Firefinch, Jameson's	<i>Lagonosticta rhodopareia</i>				(2014)
Firefinch, Red-billed	<i>Lagonosticta senegala</i>				(2014)
Fiscal, Common (Southern)	<i>Lanius collaris</i>				7 (2009, 2014, 2017)
Fish-eagle, African	<i>Haliaeetus vocifer</i>				5, 10
Flycatcher, Fiscal	<i>Sigelus silens</i>				16 (2014)
Flycatcher, Spotted	<i>Muscicapa striata</i>				(2014)
Francolin, Coqui	<i>Peliperdix coqui</i>				(2009, 2014)
Francolin, Orange River	<i>Scleroptila levillantoides</i>				(2009, 2014)
Goose, Egyptian	<i>Alopochen aegyptiacus</i>				Vaal (2009, 2014, 2017)
Goose, Spur-winged	<i>Plectropterus gambensis</i>				18 (2009, 2014)

COMMON NAME	TAXON NAME	ENDEMISM	SA STATUS	IUCN (2016)	SITE OCCURRENCE: SPECIFIC SITES (PAST SURVEYS)
Guineafowl, Helmeted	<i>Numida meleagris</i>				1-12, 16 (2009, 2014, 2017)
Hamerkop	<i>Scopus umbretta</i>				(2017)
Heron, Black-headed	<i>Ardea melanocephala</i>				12 (2009, 2014, 2017)
Heron, Goliath	<i>Ardea goliath</i>				(2014)
Honeyguide, Lesser	<i>Indicator minor</i>				11
Hoopoe, African	<i>Upupa africana</i>				16 (2014)
Ibis, African Sacred	<i>Threskiornis aethiopicus</i>				(2009)
Ibis, Glossy	<i>Plegadis falcinellus</i>				(2014)
Ibis, Hadeda	<i>Bostrychia hagedash</i>				2, 3 (2014, 2017)
Kestrel, Greater	<i>Falco rupicoloides</i>				(2009, 2017)
Kestrel, Lesser	<i>Falco naumanni</i>				(2014, 2017)
Kestrel, Rock	<i>Falco rupicolus</i>				(2014, 2017)
Kingfisher, Brown-hooded	<i>Halcyon albiventris</i>				(2014)
Kite, Black-shouldered	<i>Elanus caeruleus</i>				8, 12 (2009, 2014, 2017)
Korhaan, Blue	<i>Eupodotis caerulescens</i>				(2009, 2014)
Korhaan, Northern Black	<i>Afrotis afraoides</i>				3, 4, 5, 6, 9, 11, 12, 13, 15 (2009, 2017)
Lapwing, African Wattled	<i>Vanellus senegallus</i>				(2014)
Lapwing, Blacksmith	<i>Vanellus armatus</i>				4, Vaal (2009, 2014, 2017)
Lapwing, Crowned	<i>Vanellus coronatus</i>				4, 8, 12, 15, 16 (2009, 2014, 2017)
Lark, Eastern Clapper	<i>Mirafra fasciolata</i>				(2009, 2014, 2017)
Lark, Eastern Long-billed	<i>Certhilauda semitorquata</i>				(2017)
Lark, Melodious	<i>Mirafra cheniana</i>				(2009)
Lark, Pink-billed	<i>Spizocorys conirostris</i>				(2009, 2017)
Lark, Red-capped	<i>Calandrella cinerea</i>				(2009)
Lark, Rufous-naped	<i>Mirafra africana</i>				(2009, 2014, 2017)
Lark, Sabota	<i>Calendulauda sabota</i>				(2014)
Lark, Spike-heeled	<i>Chersomanes albofasciata</i>				17 (2009, 2014)
Longclaw, Cape	<i>Macronyx capensis</i>				(2009, 2014, 2017)
Martin, Common House	<i>Delichon urbicum</i>				9, 16

COMMON NAME	TAXON NAME	ENDEMISM	SA STATUS	IUCN (2016)	SITE OCCURRENCE: SPECIFIC SITES (PAST SURVEYS)
Moorhen, Common	<i>Gallinula chloropus</i>				(2014)
Mousebird, Red-faced	<i>Urocolius indicus</i>				5 (2014)
Mousebird, Speckled	<i>Colius striatus</i>				(2014)
Mousebird, White-backed	<i>Colius colius</i>				(2009, 2014)
Neddicky	<i>Cisticola fulvicapilla</i>				16, 17 (2009, 2014, 2017)
Ostrich, Common	<i>Struthio camelus</i>				5, 19, 20 (2014, 2017)
Owl, Marsh	<i>Asio capensis</i>				(2014)
Owl, Western Barn	<i>Tyto alba</i>				(2014)
Palm-swift, African	<i>Cypsiurus parvus</i>				2014, 2017
Pigeon, Speckled	<i>Columba guinea</i>				(2009, 2014, 2017)
Pipit, African	<i>Anthus cinnamomeus</i>				(2009, 2014, 2017)
Plover, Three-banded	<i>Charadrius tricollaris</i>				(2009)
Prinia, Black-chested	<i>Prinia flavicans</i>				(2009, 2014, 2017)
Prinia, Tawny-flanked	<i>Prinia subflava</i>				(2014)
Pytilia, Green-winged	<i>Pytilia melba</i>				(2014)
Quail-finch, African	<i>Ortygospiza atricollis</i>				(2009, 2014, 2017)
Quail, Common	<i>Coturnix coturnix</i>				(2009)
Quelea, Red-billed	<i>Quelea quelea</i>				20 (2009, 2014, 2017)
Reed-warbler, African	<i>Acrocephalus baeticatus</i>				(2014)
Reed-warbler, Great	<i>Acrocephalus arundinaceus</i>				(2014, 2017)
Robin-chat, Cape	<i>Cossypha caffra</i>				(2014)
Rush-warbler, Little	<i>Bradypterus baboecala</i>				(2014)
Sandpiper, Common	<i>Actitis hypoleucos</i>				(2009)
Scimitarbill, Common	<i>Rhinopomastus cyanomelas</i>				(2009, 2014)
Scrub-robin, Kalahari	<i>Cercotrichas paena</i>				(2014)
Secretarybird	<i>Sagittarius serpentarius</i>		Vulnerable		1
Shelduck, South African	<i>Tadorna cana</i>				(2014)
Shoveler, Cape	<i>Anas smithii</i>				(2014)
Shrike, Crimson-breasted	<i>Laniarius atrococcineus</i>				(2014)

COMMON NAME	TAXON NAME	ENDEMISM	SA STATUS	IUCN (2016)	SITE OCCURRENCE: SPECIFIC SITES (PAST SURVEYS)
Shrike, Lesser Grey	<i>Lanius minor</i>				(2014)
Shrike, Red-backed	<i>Lanius collurio</i>				(2009, 2014)
Sparrow-lark, Chestnut-backed	<i>Eremopterix leucotis</i>				(2009)
Sparrow-weaver, White-browed	<i>Plocepasser mahali</i>				16 (2009, 2014, 2017)
Sparrow, Cape	<i>Passer melanurus</i>				(2009, 2017)
Sparrow, Southern Grey-headed	<i>Passer diffusus</i>				(2009, 2014)
Spurfowl, Swainson's	<i>Pternistis swainsonii</i>				All (2009, 2014)
Starling, Cape Glossy	<i>Lamprotornis nitens</i>				(2009, 2014)
Starling, Pied	<i>Spreo bicolor</i>				(2014, 2017)
Starling, Wattled	<i>Creatophora cinerea</i>				(2009, 2014, 2017)
Stilt, Black-winged	<i>Himantopus himantopus</i>				(2014)
Stonechat, African	<i>Saxicola torquatus</i>				(2014, 2017)
Sunbird, White-bellied	<i>Cinnyris talatala</i>				(2014)
Swallow, Barn	<i>Hirundo rustica</i>				(2009, 2014, 2017)
Swallow, Greater Striped	<i>Hirundo cucullata</i>				8 (2009, 2014)
Swallow, South African Cliff	<i>Hirundo spilodera</i>				4 (2009, 2014)
Swallow, White-throated	<i>Hirundo albigularis</i>				(2014)
Swamphen, African Purple	<i>Porphyrio madagascariensis</i>				(2014)
Swift, Little	<i>Apus affinis</i>				Vaal (2009, 2014)
Swift, White-rumped	<i>Apus caffer</i>				(2014)
Tchagra, Black-crowned	<i>Tchagra senegalus</i>				8 (2014)
Teal, Red-billed	<i>Anas erythrorhyncha</i>				(2009, 2014)
Tern, Whiskered	<i>Chlidonias hybrida</i>				Vaal
Thick-knee, Spotted	<i>Burhinus capensis</i>				(2017)
Tit-babbler (Warbler), Chestnut-vented	<i>Parisoma subcaeruleum</i>				(2009, 2014)
Wagtail, African Pied	<i>Motacilla aguimp</i>				(2014)
Wagtail, Cape	<i>Motacilla capensis</i>				8 (2014)
Warbler, Willow	<i>Phylloscopus trochilus</i>				(2014)
Waxbill Black-faced	<i>Estrilda erythronotos</i>				(2014)

COMMON NAME	TAXON NAME	ENDEMISM	SA STATUS	IUCN (2016)	SITE OCCURRENCE: SPECIFIC SITES (PAST SURVEYS)
Waxbill, Blue	<i>Uraeginthus angolensis</i>				(2009, 2014)
Waxbill, Common	<i>Estrilda astrild</i>				8 (2009, 2014)
Waxbill, Orange-breasted	<i>Amandava subflava</i>				(2009, 2014)
Waxbill, Violet-eared	<i>Granatina granatina</i>				8
Weaver, Cape	<i>Ploceus capensis</i>				4
Weaver, Southern Masked	<i>Ploceus velatus</i>				8, Vaal (2009, 2014, 2017)
Wheatear, Capped	<i>Oenanthe pileata</i>				(2014, 2017)
White-eye, Cape	<i>Zosterops virens</i>	Endemic			(2009, 2014)
Whydah, Long-tailed Paradise	<i>Vidua paradisaea</i>				(2009)
Whydah, Pin-tailed	<i>Vidua macroura</i>				(2014)
Widowbird, Long-tailed	<i>Euplectes progne</i>				11, 13, 20 (2009, 2014, 2017)
Widowbird, Red-collared	<i>Euplectes ardens</i>				8 (2009, 2014)
Widowbird, White-winged	<i>Euplectes albonotatus</i>				(2009, 2014)
Wood-hoopoe, Green	<i>Phoeniculus purpureus</i>				(2009)
Woodpecker, Cardinal	<i>Dendropicos fuscescens</i>				(2014)
Woodpecker, Golden-tailed	<i>Campethera abingoni</i>				16, 19
OTHER SPECIES OF ECOLOGICAL SIGNIFICANCE					
Flufftail, White-winged	<i>Sarothrura ayresi</i>		Critically Endangered		Unlikely – last records pre-1909
Vulture, White-backed	<i>Gyps africanus</i>		Critically Endangered		Possible – Fragmented range & erratic occurrence
Eagle, Martial	<i>Polmaetus bellicosus</i>		Endangered (Vulnerable*)		Possible – SABAP2, low density area
Eagle, Tawny	<i>Aquila rapax</i>		Endangered (Vulnerable*)		Unlikely – just inside historic range, just outside low density area
Harrier, African Marsh	<i>Circus ranivorus</i>		Endangered (Protected*)		Highly likely – SABAP2
Harrier, Black	<i>Circus maurus</i>	Near Endemic	Endangered		Possible – Low density area
Stork, Yellow-billed	<i>Mycteria ibis</i>		Endangered		Highly Likely – SABAP2
Cursorer, Burchell's	<i>Cursorius rufus</i>	Near Endemic	Vulnerable		Unlikely – nearby historic records & nearby isolated population
Eagle, Verreaux's	<i>Aquila verreauxii</i>		Vulnerable		Possible – Low density area
Heron, White-backed Night	<i>Gorsachius leuconotus</i>		Vulnerable		Highly Likely
Korhaan, White-bellied	<i>Eupodotis senegalensis</i>		Vulnerable		Unlikely – just outside range of isolated populations
Owl, African Grass	<i>Tyto capensis</i>		Vulnerable (Vulnerable*)		Unlikely – just outside main distribution, nearby isolated population

COMMON NAME	TAXON NAME	ENDEMISM	SA STATUS	IUCN (2016)	SITE OCCURRENCE: SPECIFIC SITES (PAST SURVEYS)
Pelican, Great White	<i>Pelecanus onocrotalus</i>		Vulnerable		Unlikely – Visitor only
Pelican, Pink-backed	<i>Pelecanus rufescens</i>		Vulnerable (Endangered*)		Unlikely – Low density area, visitor only
Pipit, Short-tailed	<i>Anthus brachyurus</i>		Vulnerable		Unlikely – just outside distribution of nearby isolated population
Stork, Black	<i>Ciconia nigra</i>		Vulnerable (Vulnerable*)		Possible – Low density area
Tern, Caspian	<i>Sterna caspia</i>		Vulnerable		Highly likely – SABAP2
Crane, Blue	<i>Anthropoides paradiseus</i>	Endemic	Near Threatened (Endangered*)	Endemic	Unlikely – just outside distribution of nearby isolated population
Curlew, Eurasian	<i>Numenius arquata</i>		Near Threatened		Unlikely – Visitor only
Duck, Maccoa	<i>Oxyura maccoa</i>		Near Threatened		Possible – Low density area
Flamingo, Greater	<i>Phoenicopterus ruber</i>		Near Threatened		Highly Likely
Flamingo, Lesser	<i>Phoenicopterus minor</i>		Near Threatened		Highly Likely – SABAP2
Harrier, Pallid	<i>Circus macrourus</i>		Near Threatened		Highly Likely
Kingfisher, Half-collared	<i>Alcedo semitorquata</i>		Near Threatened		Unlikely – just outside main distribution range
Lark, Short-clawed	<i>Certhilauda chuana</i>	Near Endemic	Near Threatened	Near Endemic	Unlikely – isolated nearby record only
Painted-snipe, Greater	<i>Rostratula benghalensis</i>		Near Threatened		Unlikely – just outside distribution of nearby isolated population
Plover, Chestnut-banded	<i>Charadrius pallidus</i>		Near Threatened		Possible – Isolated population & low density area
Pratincole, Black-winged	<i>Glareola nordmanni</i>		Near Threatened		Possible – SABAP2, low density area
Roller, European	<i>Coracias garrulus</i>		Near Threatened		Possible – SABAP2, low density area
Stork, Abdim's	<i>Ciconia abdimii</i>		Near Threatened		Highly Likely – SABAP2
Stork, Marabou	<i>Leptoptilos crumeniferus</i>		Near Threatened		Possible – Low density area
Falcon, Peregrine	<i>Falco peregrinus</i>		(Vulnerable*)		Unlikely – SABAP2, Outside main distribution
Dove, European Turtle	<i>Streptopelia turtur</i>	Vagrant		Vulnerable	Unlikely – just outside main distribution range
Kestrel, Lesser	<i>Falco naumanni</i>				Highly likely – SABAP2
Swallow, South African Cliff	<i>Hirundo (Petrochelidon) spilodera</i>	Breeding Endemic			Highly likely – SABAP2
Lark, Eastern Long-billed	<i>Certhilauda semitorquata</i>	Endemic			Possible – SABAP2, low density area
Starling, Pied	<i>Spreo bicolor</i>	Endemic			Highly likely – SABAP2
Sunbird, Greater Double-collared	<i>Cinnyris afer</i>	Endemic			Possible – Low density area
Weaver, Cape	<i>Ploceus capensis</i>	Endemic			Highly Likely
ALIEN SPECIES					
Myna, Common	<i>Acridotheres tristis</i>		Category 3 Invasive #		Confirmed
Sparrow, House	<i>Passer domesticus</i>		Category 3 Invasive #		Confirmed

COMMON NAME	TAXON NAME	ENDEMISM	SA STATUS	IUCN (2016)	SITE OCCURRENCE: SPECIFIC SITES (PAST SURVEYS)
Dove, Rock	<i>Columba livia</i>		Category 3 Invasive #		Highly Likely (SABAP2 species)
Duck, Mallard (+Hybrids)	<i>Anas platyrhynchos</i>		Category 2 Invasive #		Highly Likely (SABAP2 species)

* GN151 of 2007, South African TOPS List

GN864 of 2016, South African AIS List

4.4. Reptiles

The ADU reptile desktop list is provided in Annexure C (VMUS.ADU.org). A summary of reptiles noted on site during the survey and endemic and TOP species with distribution ranges overlapping the Survey Area are included in Table 4.

4.4.1. *Species of Conservation Concern*

No TOP species were recorded from the area and none are likely to occur in the area.

Only one endemic species was recorded for the site, the Common slug-eater. The species is not restricted to the area and the area is not considered as an area of endemism with regards to reptiles.

4.4.2. *Invasive Species*

Bates *et al.* (2014) provide lists of exotic snakes that have been collected around South Africa. None were noted on site, but cannot be excluded from the area, especially considering the urban nature of the area.

Table 4: Reptiles of interest

COMMON NAME	TAXON NAME	ENDEMISM	SA STATUS	IUCN (2016)	SITE OCCURRENCE: SPECIFIC SITES (PAST SURVEYS)
SITE SPECIES					
Adder, Puff	<i>Bitis arietans arietans</i>				1
Agama, Southern Rock	<i>Agama atra</i>				(2014, 2017)
Centipede-eater, Black-headed	<i>Aparallactus capensis</i>				(2014)
Gecko, Cape (Common) Dwarf Day	<i>Lygodactylus capensis capensis</i>				(2014, 2017)
Monitor, Water	<i>Varanus niloticus</i>				2014 (BMU1)
Rinkhals	<i>Hemachatus haemachatus</i>				9
Skink, Speckled Rock	<i>Trachylepis punctatissima</i>				(2017)
Skink, Variable	<i>Trachylepis varia</i>				(2014, 2017)
Slug-eater, Common	<i>Duberria lutrix lutrix</i>	Endemic			(2014, 2017)
Snake, Herald	<i>Crotaphopeltis hotamboeia</i>				(2017)
Terrapin, Marsh (Helmeted)	<i>Pelomedusa subrufa</i>				(2014)
OTHER SPECIES OF ECOLOGICAL SIGNIFICANCE					
Skink, Thin-tailed Legless	<i>Acontias gracilicauda</i>	Endemic			Highly likely – ADU species
Agama, Eastern Ground	<i>Agama aculeata distanti</i>	Endemic			Highly likely
Snake, Spotted Harlequin	<i>Homoroselaps lacteus</i>	Endemic			Possible – Edge of distribution
Snake, Aurora House	<i>Lamprophis aurora</i>	Endemic			Highly likely
ALIEN SPECIES					
None recorded from the area					

* GN151 of 2007, South African TOPS List

GN864 of 2016, South African AIS List

4.5. Amphibians

The ADU amphibian desktop list is provided in Annexure D. A summary of frogs noted on site during past surveys and endemic and TOP species with distribution ranges overlapping the Survey Area are included in Table 5.

4.5.1. *Species of Conservation Concern*

No TOP species or endemic species have been recorded from the area.

The only Red-listed species that may occur in the greater area is the Near Threatened Giant Bull Frog, also Protected under GN151, 2007. Two unrestricted endemic species, the Raucous Toad and Rattling Frog, could occur in the area. The area is not an area of endemism in terms of frogs.

4.5.2. *Invasive Species*

No categorised alien invasive frogs are likely to occur on site.

Table 5: Amphibians of interest

COMMON NAME	TAXON NAME	ENDEMISM	SA STATUS	IUCN (2016)	SITE OCCURRENCE: SPECIFIC SITES (PAST SURVEYS)
SITE SPECIES					
Caco, Boettger's	<i>Cacosternum boettgeri</i>				(2014, 2017)
Kassina, Bubbling	<i>Kassina senegalensis</i>				(2014)
Platanna, Common	<i>Xenopus laevis</i>				(2014, 2017)
Puddle Frog, Snoring	<i>Phrynobatrachus natalensis</i>				(2014)
River Frog, Common	<i>Amietia queckettii</i>				(2014)
Toad, Guttural	<i>Amietophrynus gutturalis</i>				(2014, 2017)
OTHER SPECIES OF ECOLOGICAL SIGNIFICANCE					
Toad, Raucous	<i>Amietophrynus rangeri</i>	Endemic			Highly likely
Bullfrog, Giant	<i>Pyxicephalus adspersus</i>		Near Threatened (Protected*)		Highly likely
Frog, Rattling	<i>Semnodactylus wealii</i>	Endemic			Unlikely – Outside distribution range
ALIEN SPECIES					
None recorded from the area					

* GN151 of 2007, South African TOPS List

GN864 of 2016, South African AIS List

4.6. Invertebrates

The ADU invertebrate desktop lists are provided in Appendix E. A summary of TOPS (butterflies and dragonflies) with distribution ranges over and near the survey area are included in Table 6. It must be stressed that the distribution of many species listed GN151 (2007) are unknown and it is very possible that these species do not occur in the area. They have been included as a cautionary measure. In terms of this, no likelihood of occurrence has been completed for invertebrates.

Opisththalmus pugnax (Burrowing Scorpions) was recorded for the QDGS (ScorpionMAP). All Burrowing Scorpions in this genus are protected under GN151, 2007.

Several Carabidae (Ground Beetles) species were observed at survey sites around the Wildebeespan. Some were identified as far as possible, while some retreated and could not be identified. Many Carabidae are protected under GN151 of 2007 and it is very possible that protected ground beetles occur in the area.

Although a specific invertebrate assessment did not form part of the scope of work, the following species were recorded from past and current surveys (ID of some specimens contributed by iNaturalist members):

- Moths and Butterflies: the African Monarch (*Danaus chrysippus*), Broad Scarlet (*Crocothemis sanguinolenta*), Broad-bordered Grass Yellow (*Eurema brigitta brigitta*), Citrus Swallowtail (*Papilio demodocus demodocus*), Yellow Pansy (*Junonia hierta cebrene*), Dotted Blue (*Tarucus sybaris*), Twin-spot Blue (*Lepidochrysops plebeia plebeia*), Cream-striped Owl (*Cyligramma latona*), Crimson-speckled Footman (*Utetheisa pulchella*) and African / Common Vagrant (*Catopsilia florella*).
- Beetles: Velvet Ground Beetle (*Graphipterus bilineatus*), *Prothyma angusticollis* (both Coleoptera: Carabidae) and unknown dung beetle (Coleoptera: Scarabidae).
- Dragon Flies: Two-striped Skimmer (*Orthetrum caffru*), Pantala (*Pantala flavescens*) and Swamp Bluet (*Africallagma glaucum*).

Table 6: Invertebrates of interest (ADU species in bold)

COMMON NAME	TAXON NAME	SA STATUS	TOPS STATUS (GN151, 2007)
Roodepoort Copper Butterfly	<i>Aloeides dentatis dentatis</i>	Endangered	
Horned Baboon Spiders (All)	<i>Ceratogyrus sp.</i>		Protected
Heidelberg Opal Butterfly	<i>Chrysothrix aureus</i>	Endangered	
Stag Beetles (All)	<i>Colophon sp.</i>		Endangered
Tiger Beetles (All)	<i>Dromica sp.</i>		Protected
Velvet Ground Beetle	<i>Graphipterus assimilis</i>		Protected
Fruit Chafer Beetles (All)	<i>Ichnestoma sp.</i>		Protected
Highveld Blue Butterfly	<i>Lepidochrysops praeterita</i>	Endangered	
Monster Tiger Beetles (All)	<i>Manticora sp.</i>		Protected
Tiger Beetles	<i>Megacephala asperata</i>		Protected
Tiger Beetles	<i>Megacephala regalis</i>		Protected
Stag Beetles	<i>Nigidius auriculatus</i>		Protected
Stag Beetles	<i>Oonotus adspersus</i>		Protected
Stag Beetles	<i>Oonotus interioris</i>		Protected
Stag Beetles	<i>Oonotus rex</i>		Protected
Stag Beetles	<i>Oonotus sericeus</i>		Protected
Creeping Scorpions (All)	<i>Opisthacanthus sp.</i>		Protected
Burrowing Scorpions (All)	<i>Opisthophthalmus sp.</i>		Protected
Tiger Beetles	<i>Platychila pallida</i>		Protected
Stag Beetles	<i>Prosopocoilus petitclerci</i>		Protected
Tiger Beetles	<i>Prothyma guttipennis</i>		Protected
Golden Baboon Spiders (All)	<i>Pterinochilus sp.</i>		Protected
Flat Rock Scorpions (All)	<i>Xadogenes sp.</i>		Protected
Common Baboon Spiders (All)	<i>Xarpactira sp.</i>		Protected

Schedule 2: List of Specially Protected Species in the North West biodiversity Management Act (Act No. 4 of 2016) lists species that are further protected within the province. None of the species recorded from site are listed in Schedule 2.

4.7. Habitat Sensitivity in Terms of Fauna

Figure 10 depicts the sensitive areas as reported in the latest fauna report (Deacon, 2017). It must be stressed that this is in fact the botanical sensitivity report, and although habitat is very important in terms of fauna biodiversity, other aspects also determine whether an area is sensitive in terms of fauna.

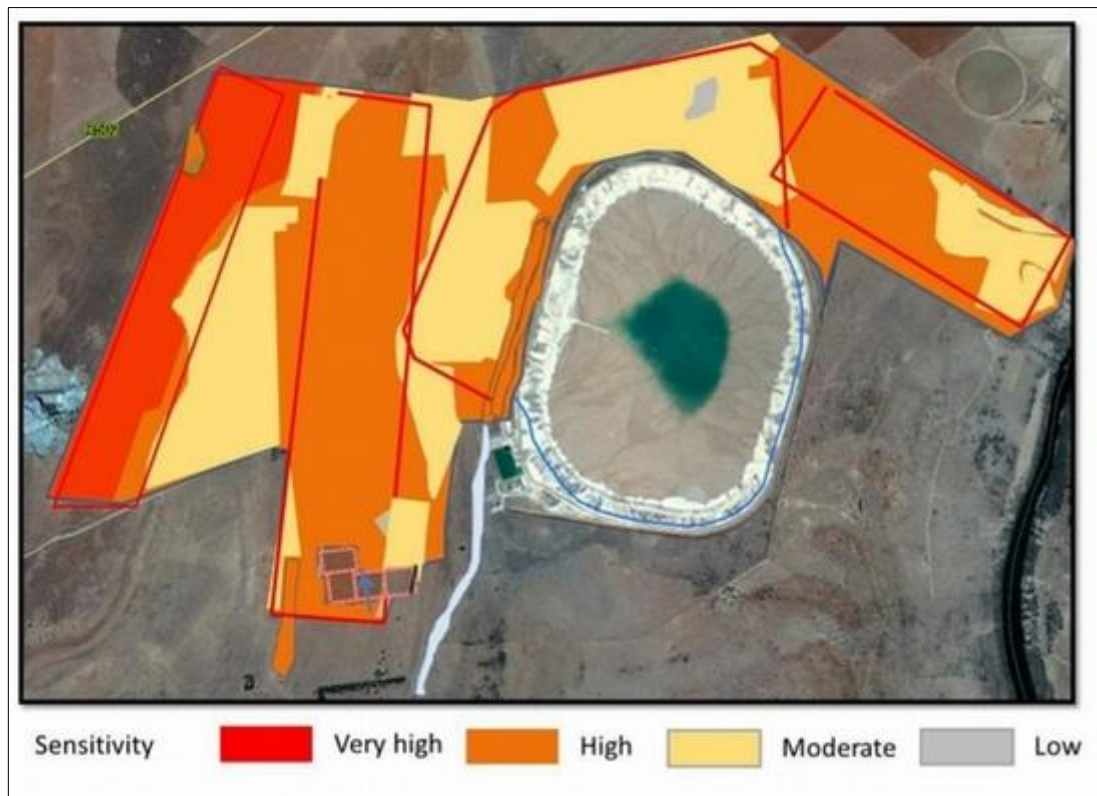


Figure 10: Fauna Sensitivity plan for original expansion area (Deacon 2017)

Thirteen BMUs have been identified (Figure 11) and have been rated in terms of terrestrial fauna and overall biodiversity value as follows:

- BMU1: Vaal River ecosystem, rated as very high in terms of terrestrial fauna and high in terms of overall biodiversity.
- BMU2: Koekemoerspruit ecosystem, rated as high for terrestrial fauna and biodiversity value (not relevant to the current site).
- BMU3: Valley Bottom Wetlands, rated as moderate-high in terms of terrestrial fauna and high in terms of overall biodiversity.
- BMU4: *Acacia karoo* Woodland, rated as moderate in terms of terrestrial fauna and high in terms of overall biodiversity.
- BMU5: *Acacia erioloba* Woodland, rated as very high in terms of terrestrial fauna and high in terms of overall biodiversity.
- BMU6: Mixed *Acacia* Woodland, rated as very high in terms of terrestrial fauna and high in terms of overall biodiversity (not relevant to the current site).
- BMU7: Clay Grassland, rated as very high in terms of terrestrial fauna and very high in terms of overall biodiversity.

- BMU8: Dolomite Grassland, rated as very high in terms of terrestrial fauna and very high in terms of overall biodiversity.
- BMU9: Sandy Grassland, rated as very high in terms of terrestrial fauna and very high in terms of overall biodiversity.
- BMU10: Secondary Grassland, rated as moderate in terms of terrestrial fauna and moderate in terms of overall biodiversity.
- BMU11: Secondary Wetlands, rated as moderate in terms of terrestrial fauna and low in terms of overall biodiversity.
- BMU12: AIS trees, rated as negligible in terms of terrestrial fauna and negligible in terms of overall biodiversity.
- BMU13: Infrastructure, rated as negligible in terms of terrestrial fauna and negligible in terms of overall biodiversity.

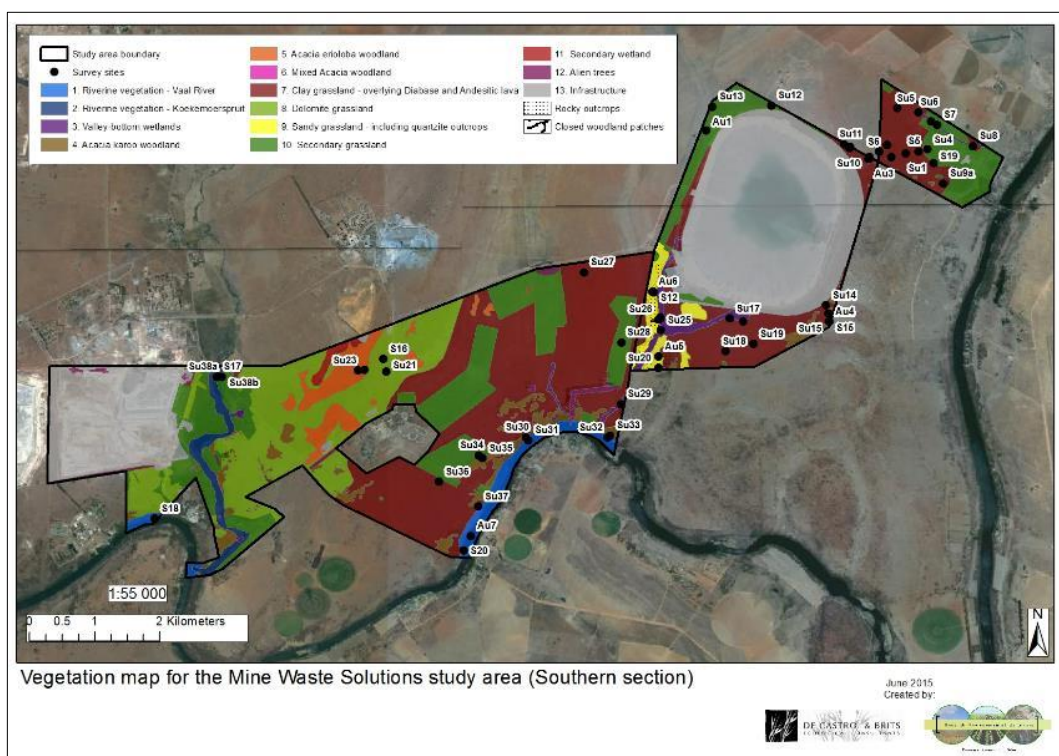


Figure 11: BMUs relevant to the current study area (Clean Streams, 2015; De Casro & Brits, 2015)

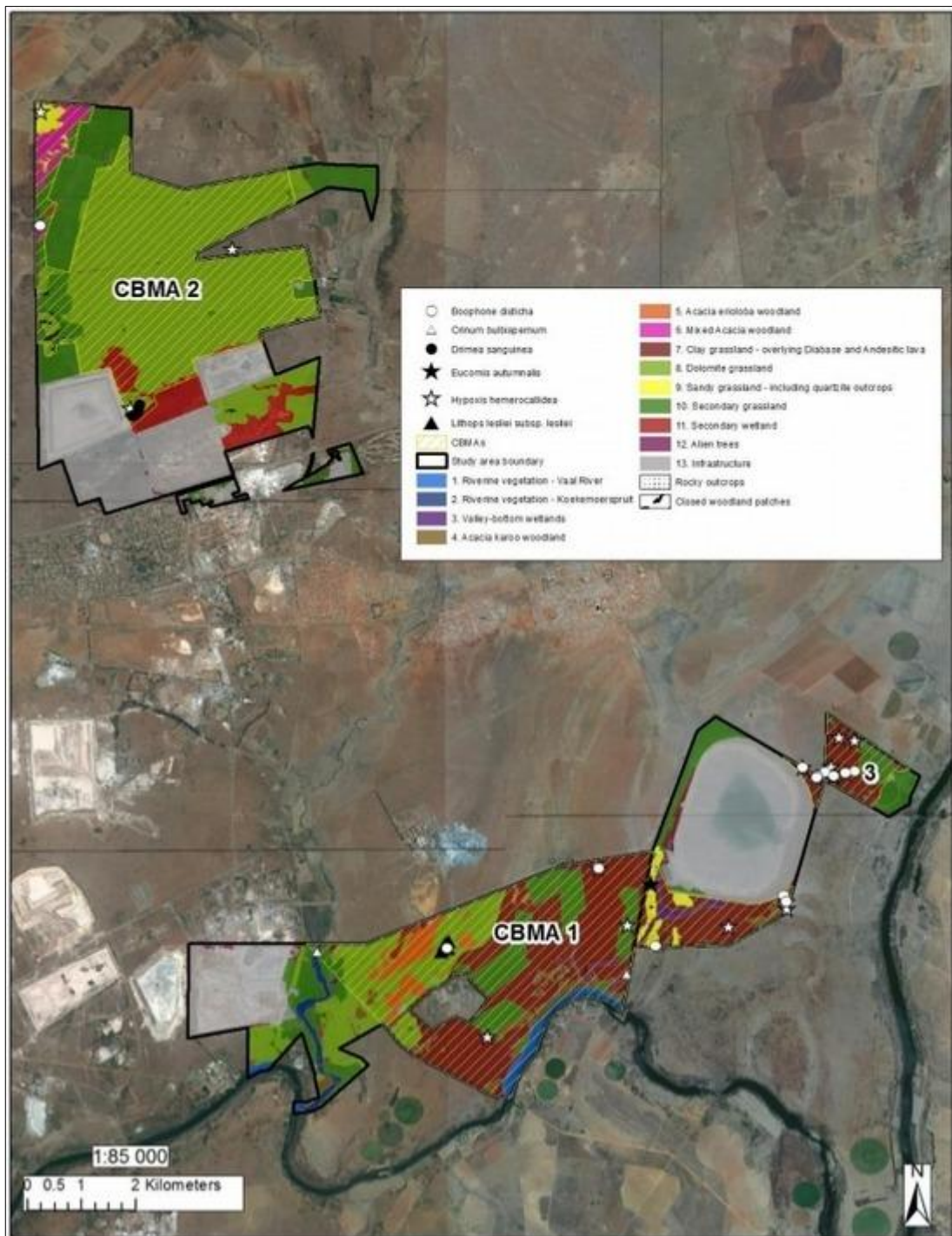


Figure 12: Core Biodiversity Management Areas relevant to the project (Clean Streams, 2015)

The Clean Stream report (2015) has correctly combined various BMUs into larger Core Biodiversity Management Areas (CBMAs) (Figure 12). Combining BMUs into larger management units is critical for fauna conservation for the following reasons:

- The combinations of different BMUs, which were originally delineated based on habitat units, results in increased habitat heterogeneity. In accordance with principles of biogeography, higher habitat diversity will result in higher faunal biodiversity.

- Targeting small areas for conservation at the exclusion of surrounding areas will cause loss of ecological connectivity and result in the isolation of populations. Isolation of fauna populations reduces breeding success, increases in-breeding and associated genetic weakness and could result in local extinctions of populations.
- In addition, the CBMAs incorporated the vast majority of habitats for TOP species.

Three CBMAs were identified (Clean Stream, 2015); CBMAs 1 and 3 are relevant to the current study area as depicted in Figure 12.

In terms of the fauna sensitivity plan presented in Figure 13, the overall assessment as detailed in Section 3.1.4 also considered the following:

- All areas with BMUs identified as having very high and high biodiversity value have been designated as highly sensitive. All areas with BMUs identified as having very high and high value in terms of terrestrial fauna have been designated as highly sensitive. This included BMU1, BMU3, BMU4, BMU5, BMU7, BMU8 and BMU9.
- All aquatic CBAs and ESAs have been incorporated into highly sensitive areas, except where these have been clearly and directly impacted.
- All terrestrial CBAs have been incorporated into highly sensitive areas, except where these have been clearly impacted, such as the TSF footprint which overlaps the CBA area.
- In addition, the flora sensitivity units (Figure 10) from the previous survey area were considered in the overall sensitivity plan (Figure 13) to ensure continuity and ecological connectivity between the previous and new survey areas.
- All wetland / riverine areas and pans are designated as highly sensitive.
- Identified rocky ridges and outcrops are designated as highly sensitive.
- BMUs identified as having moderate biodiversity value or moderate terrestrial fauna biodiversity are designated as moderately sensitive. This included BMU10 and BMU11.
- Remaining areas were further assessed in terms of Section 3.1.4.

This provided an initial fauna sensitivity unit which was further evaluated in terms of overall connectivity to present the fauna sensitivity plan. For both plans the survey areas can be considered confirmed areas and the remaining areas have been extrapolated from the various plans above.

Figure 13 indicates the sensitivity plan overlaid with the TSF and associated proposed fence.

shows the fauna sensitivity plan overlaid with the proposed infrastructure. In addition, the plan indicates proposed regional ecological corridors that should remain in their current state. The corridors have considered connectivity between existing sensitive areas, rocky habitats, grassland habitats and wetland/riverine habitats.

Corridors should have at least 700m width. The core (500m central width) should encompass highly sensitive areas as a priority with the outer 200m encompassing highly sensitive and then moderately sensitive areas. Where these intersect the proposed operational areas / properties, consideration should be given to refrain from developing or fencing off these areas.

The fauna sensitivity plan must be read together with the flora sensitivity plan and wetland sensitivity plan and will be updated on completion of the final surveys.

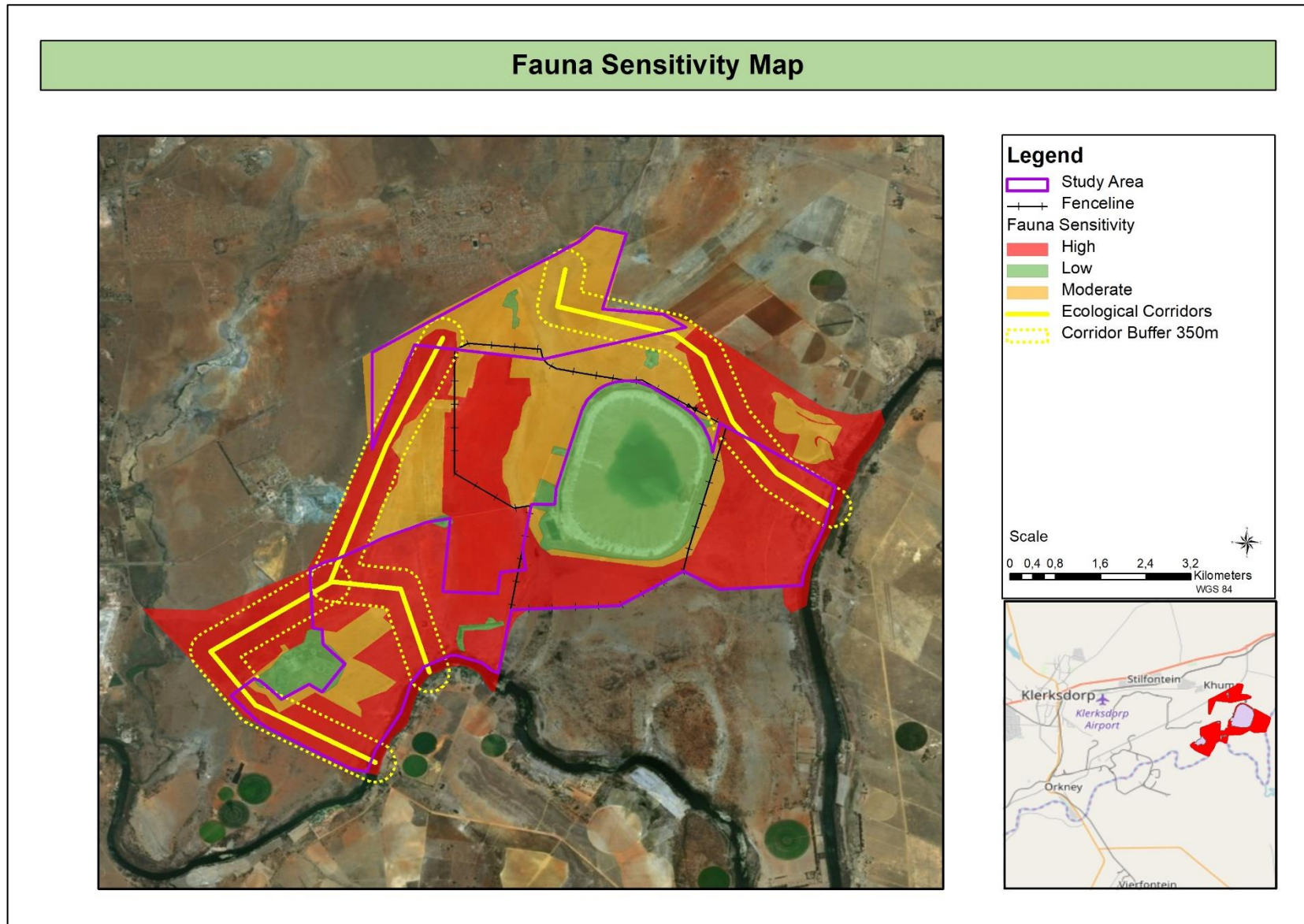


Figure 13: Fauna Sensitivity map overlaid onto the overall TSF and associated infrastructure area and proposed fence line

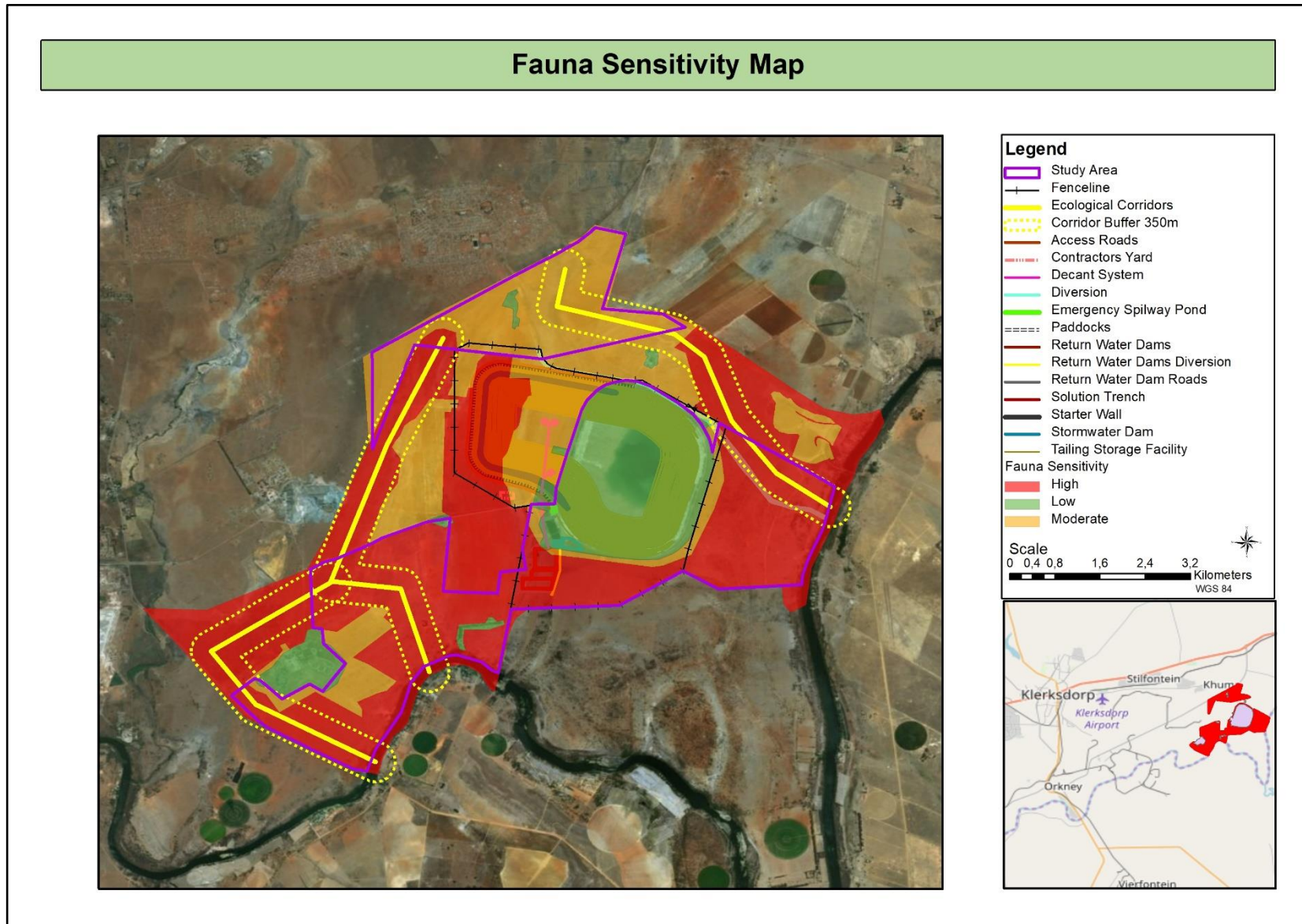


Figure 14: Fauna Sensitivity map and ecological corridors overlaid onto areas proposed for infrastructure and TSF

5. Discussion and Evaluation of Vegetation Results

5.1. Vegetation

The desktop assessment of vegetation included the Vegetation Map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006), as well as a search for protected species which may occur in within or within the proximity of the project area on BODATSA website (SANBI, 2018).

5.1.1. Vegetation Map

The study area is situated in the grassland biome (Mucina & Rutherford, 2006). The grassland biome experiences summer rainfall and dry winters with frost (and fire), which is unfavourable to tree growth. Therefore, grasslands comprise mainly of grasses and plants with perennial underground storage organs, for example bulbs, tubers and suffrutex species. In some grassland areas, the surface topography (e.g. rocky hills and protected valleys) creates habitats that are favourable to shrublands and trees (Mucina & Rutherford, 2006). Generally, the higher the surface rock cover, the higher the occurrence of woody vegetation such as trees and shrubs, relative to herbaceous vegetation (Mucina & Rutherford, 2006). The grassland biome comprises a number of vegetation types. The study area occurs within the Vaal Reefs Dolomite Sinkhole Woodland (Gh 12) and the Rand Highveld Grassland (Gm 11) vegetation type (Mucina & Rutherford, 2006) (Figure 16).

The **Vaal Reefs Dolomite Sinkhole Woodland (Gh 12)** lies within a slightly undulating landscape dissected by prominent rocky chert ridges and supporting a grassland-woodland vegetation complex. This vegetation occurs in the North West and Free State Provinces: small areas are associated with the dolomite sinkholes in and around Stilfontein and Orkney (Vaal Reefs) (Mucina & Rutherford, 2006). Important taxa include small trees such as *Vachellia erioloba* (d), tall shrubs such as *Diospyros lycioides* subsp. *lycioides* (d), low shrubs such as *Gymnosporia heterophylla* (d), geoxylic suffrutex such as *Elephantorrhiza elephantina*, woody climbers such as *Asparagus africanus*, graminoids such as *Aristida congesta* (d), herbs such as *Commelina africana* (d) and geophytic herbs such as *Albuca setosa* (Mucina & Rutherford, 2006). Almost a quarter of this vegetation unit has been transformed already—mainly by mining, cultivation, urban sprawl and road-building (Mucina and Rutherford, 2006). The region of this unit contains possibly the highest concentration of mines of any other vegetation in South Africa (Mucina & Rutherford, 2006). The vegetation unit is considered vulnerable and a conservation target of 24% has been set for the Vaal Reefs Dolomite Sinkhole Woodland (Mucina & Rutherford, 2006). The **Vaal Reefs Dolomite Sinkhole Woodland** is not listed as a threatened ecosystem in GN 1002 (GG 34809 of 9 December 2011) published under NEM:BA.

The **Rand Highveld Grassland (Gm 11)** lies within a highly variable landscape with extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species-rich, wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. It is rich in plant taxa (especially when in pristine condition) and constitutes sour grassland dominated by graminoid genera such as *Themeda*, *Heteropogon*, *Eragrostis* and *Elionurus*. Good examples are preserved in the Bronkhorstspuit Dam Nature Reserve. It is poorly conserved and large parts of this vegetation type have been transformed by agriculture, forestation, mining, and urbanisation. The vegetation type is considered endangered and a conservation target of 24% has been set for the Rand Highveld Grassland (Mucina & Rutherford 2006). The **Rand Highveld Grassland** is listed as a **vulnerable** ecosystem in GN 1002 (GG 34809 of 9 December 2011) published under NEM:BA.

5.1.2. BODATSA

The polygon used to obtain the plant species data from BODATSA is illustrated in Figure 15 below:

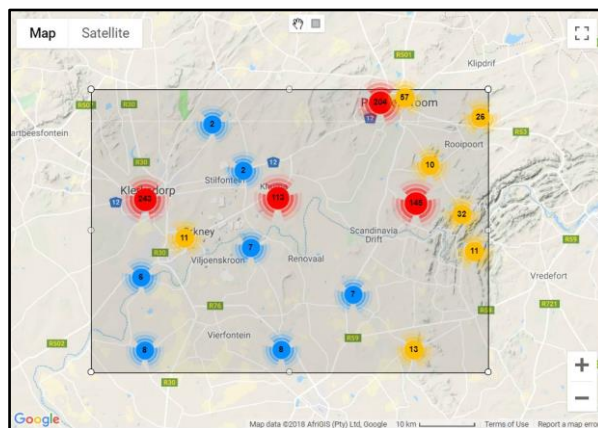


Figure 15: Records included in the search for protected species close to the site from the BODATSA (SANBI, 2018)

A total of 564 plant species are expected within the rectangle on the BODATSA database; this data is available on request. Based on the results obtained from the BODATSA database, the expected plant species of conservation concern (SCC) include three (3) Data Deficient (DD) species, as well as two (2) Near Threatened (NT) species (

Table 7). Data Deficient species are species that are poorly known, with insufficient information on their habitat, population status or distribution to make an assessment. If a Data Deficient species is likely to be impacted upon by a proposed activity, the subpopulation should be well surveyed, and the data sent to the Threatened Species Programme. The species will be reassessed and the new status of the species, with a recommendation, will be provided within a short timeframe (Raimondo *et al.*, 2009).

Table 7: Plant species of conservation concern which may occur within the project area

SPECIES	IUCN (2017)	ECOLOGY	HABITAT	LIKELIHOOD OF OCCURANCE IN STUDY AREA
<i>Myrothamnus flabellifolius</i>	DD	Indigenous	Geophyte which possesses an extensive root system which extends into the crevices of the rocky slopes on which it grows. It usually forms large stands in shallow soil on sunny rocky hills or along cracks and crevices in rocks.	Not likely – no bedrock observed within study area
<i>Kniphofia typhoides</i>	NT	Indigenous; Endemic	Low lying wetlands and seasonally wet areas in climax <i>Themeda triandra</i> grasslands on heavy black clay soils, tends to disappear from degraded grasslands.	Moderately likely to occur. Clay soils present however, disturbance levels high
<i>Pearsonia bracteata</i>	NT	Indigenous; Endemic	Plateau grassland.	Highly likely -previously confirmed within study area (De Castro & Brits, 2015)
<i>Lessertia phillipsiana</i>	DD	Indigenous; Endemic	Uncertain, possibly rocky hills or plains. A widespread, but very poorly known species. It is possibly overlooked but may also have become rare due to habitat loss and degradation.	Unsure – information about this species very limited.
<i>Acalypha caperonioides</i>	DD	Indigenous	Terrestrial but not well-known.	Unsure – information about this species very limited.

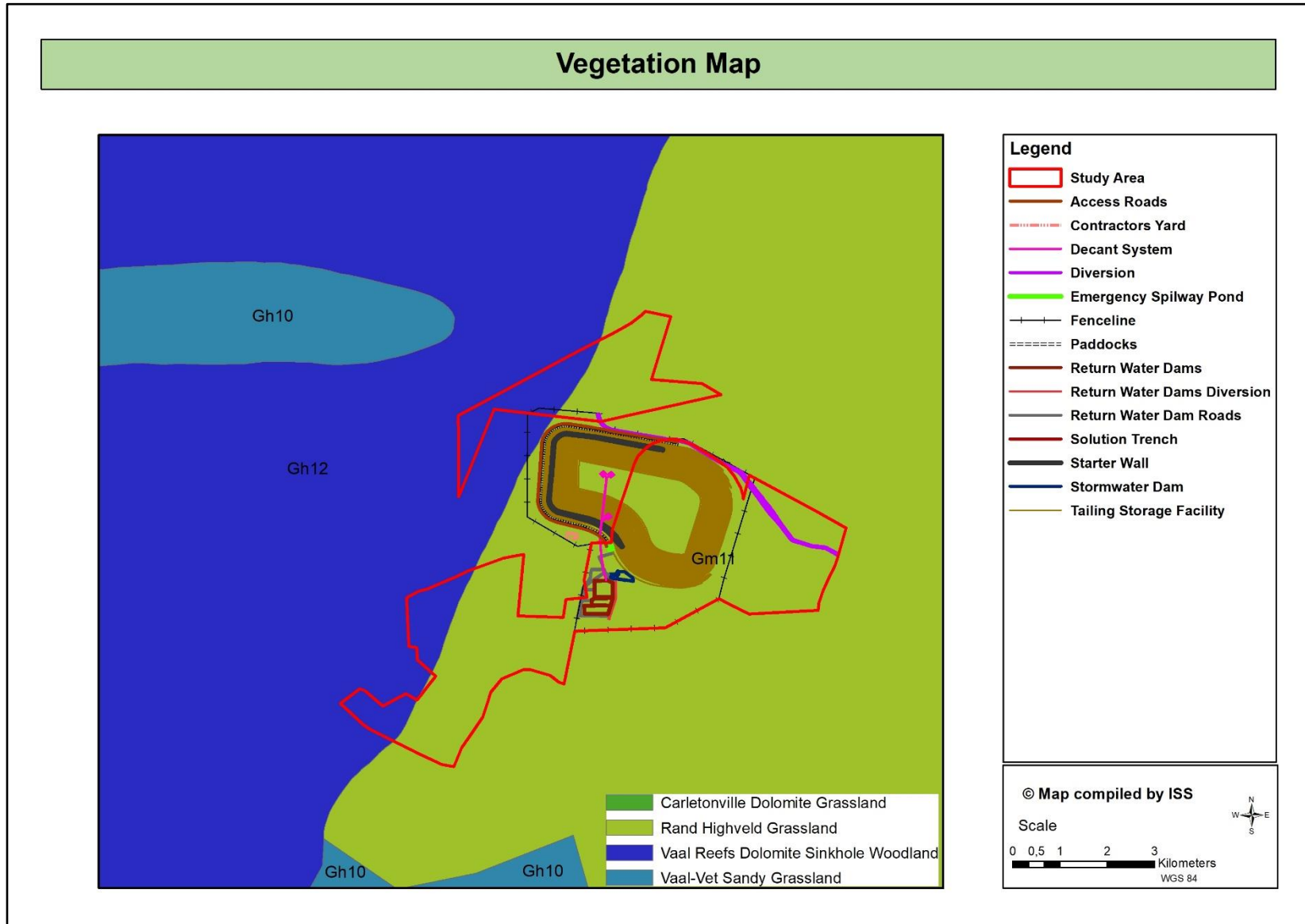


Figure 16: Study area showing the vegetation type based on the Vegetation of South Africa, Lesotho & Swaziland (SANBI, 2006-)

5.2. Vegetation Assessment

Prior to the vegetation assessment large sections of the study area were burnt. The veld was still largely dormant, which particularly affected the herb-grass layer. Species identification for these layers was therefore limited. A full species list of plants recorded will not be included in this phase 1 assessment but will be included in the phase 2 assessment.

It is important to note that vegetation communities identified are preliminary, however due to the previous surveys conducted by De Castro & Brits (2015 & 2018) the level of confidence in the preliminary communities as well as in the preliminary sensitivity assessment is high.

The vegetation communities identified after the site visits in November 2018 and February 2019 were mainly defined by changes in moisture gradients, soil types, geology and levels of disturbance. The following main vegetation communities were identified during the November 2018 season survey:

- *Asparagus laricinus* – *Vachellia karroo* floodplain thicket;
- Clay grassland;
- Dolomitic grassland;
- Doloritic grassland;
- Sandy grassland;
- Secondary grassland;
- *Vachellia karroo* savanna;
- *Vachellia erioloba* savanna;
- Wetlands;
- *Eucalyptus camaldulensis* woodland; and
- Transformed vegetation.

The localities of the plant communities are indicated in Figure 17. Each of the identified vegetation communities are described below in (Table 11-Table 13). The vegetation communities are represented in Figure 10. Please note that the wetlands areas were delineated based on the delineations and wetland report by Limosella Consulting (2019).

Transformed vegetation will not be described in detail but include the following areas; current TSF, offices, PCD's trenches, roads as well as remnants of former agricultural homesteads.

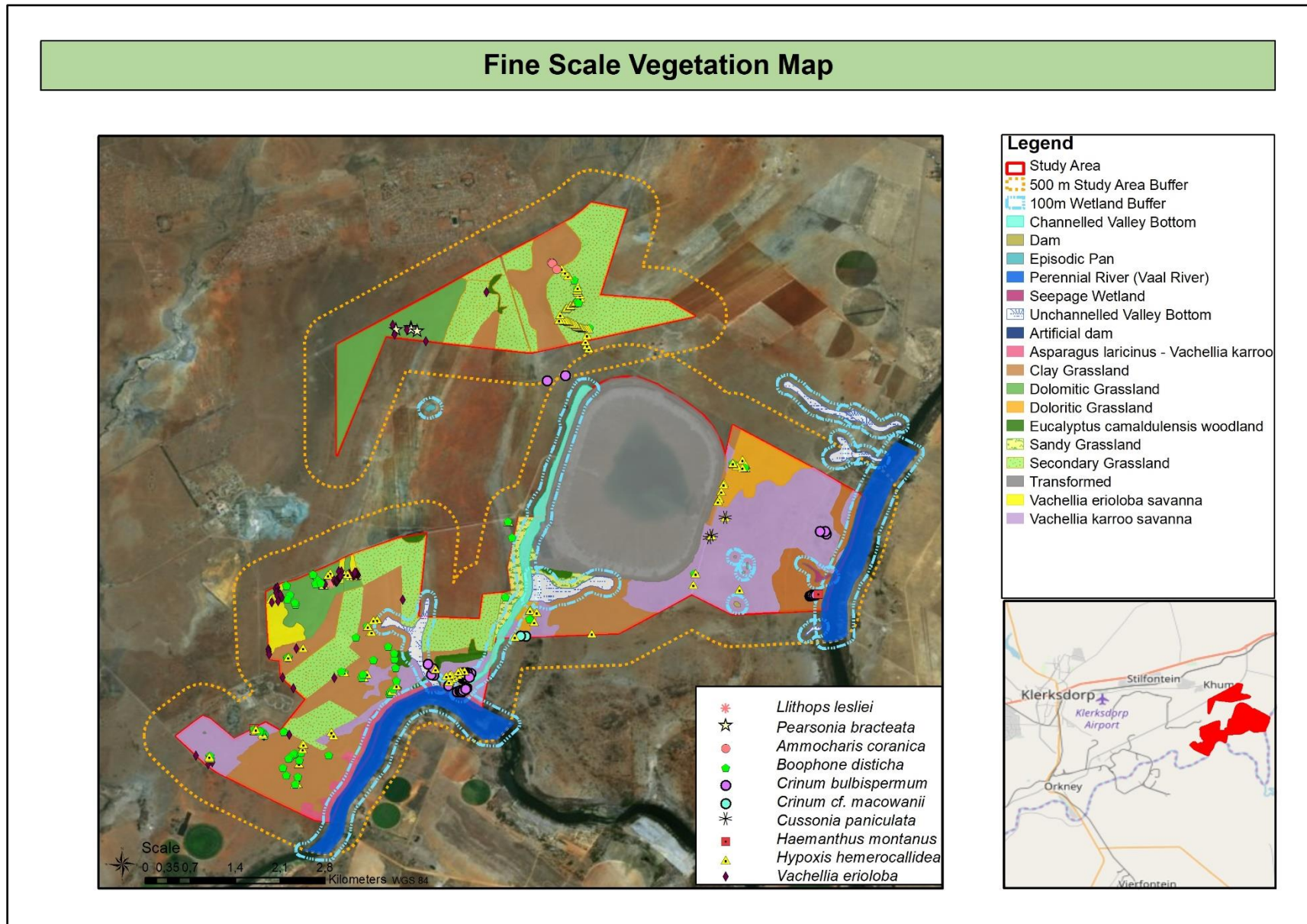


Figure 17: Fine-Scale vegetation map

Table 8: *Asparagus larycinus* – *Vachellia karroo* floodplain thicket


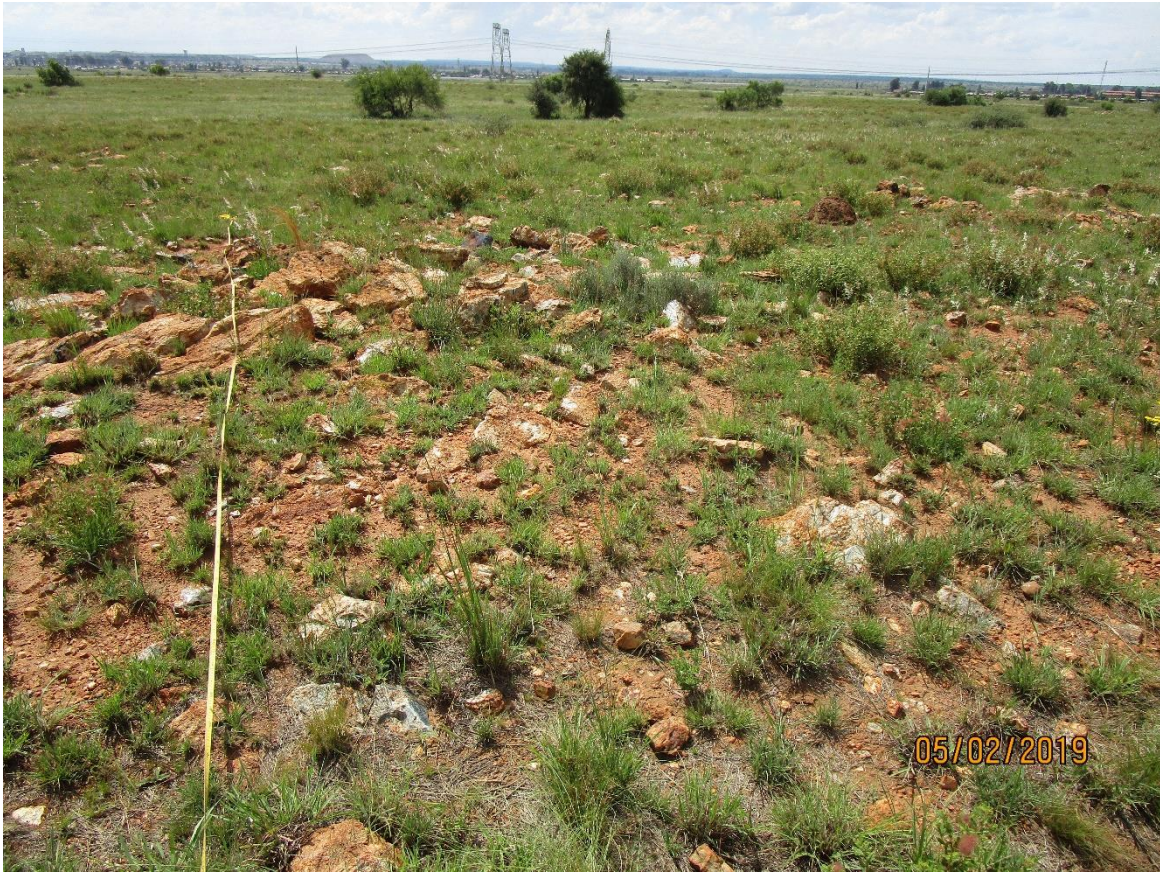
DOMINANT VEGETATION LAYER	SENSITIVITY
<p>Shrub layer is dominant. Tree layer subdominant and herb-grass layer not well developed.</p>	<p>Medium</p>
	
<p>DESCRIPTION</p>	<p>The community is situated adjacent to the riparian woodland formed by the Vaal River. A very dense thicket of <i>Asparagus larycinus</i> (Bergkatbos) dominated this community. Some individual trees are present including <i>Vachellia karroo</i> (Sweet thorn) and <i>Ziziphus mucronata</i> (Buffalo Thorn). Species diversity within the community was low. Some other climbers were present within the community namely <i>Pentarrhinum insipidum</i> (African Heartvine). The spiny small shrub <i>Ziziphus zeyheriana</i> (Haakbessie) was also present within the community – further aiding in the impenetrability.</p> <p>In terms of invasion no NEM:BA listed species were observed during the site visits.</p>
<p>CONFIRMED PLANTS OF CONSERVATION CONCERN</p>	<p>No plants of conservation concern were found within the community.</p>
<p>RATIONAL OF SENSITIVITY RATING</p>	<p>A rating of medium was assigned to the community, largely attributed to the fact that it is within the Rand Highveld Grassland which is a threatened terrestrial ecosystem. The scoring was just within the medium range. Although species diversity was low, the community does act as a flood plain to the Vaal River and hence does offer some ecosystem services. No plant SCC were identified or likely to occur within the community.</p>
<p>RECOMMENDATIONS RELATED TO PROPOSED TSF EXPANSION</p>	<p>No activities are planned to occur within this plant community.</p>

Table 9: Clay grassland

DOMINANT VEGETATION LAYER	PRELIMINARY SENSITIVITY
Grass layer is dominant with scattered indigenous tree species.	Medium
<div style="display: flex; justify-content: space-around;">   </div> <p style="text-align: center;">Clay grassland a) sparser vegetative cover in northern, western and southern sections of the study area, recovering after a fire event on black turf soils b) lush vegetative cover in the eastern sections, unaffected by the fire event.</p>	
DESCRIPTION	<p>Due to the fire event prior to the November site visit sections of the clay grassland were still recovering in the November as well as the February site visit. Sections of this community occurring closer to the Vaal River in the flood plain area, in particular, were not affected by the fire. Some sections in the west were not affected and were moribund and still largely dormant even in the February site visit. Due to limited amounts of rain, identification of all grass species was not possible due to the lack of inflorescence present. Diversity recorded within the plant community is considered to be moderate, although higher species diversity was recorded by De Castro & Brits, 2017. This can be attributed to lack of rains prior to both surveys in this report as well as the fire event prior to the November survey and the vegetative cover still recovering after the fire event in the February survey.</p> <p>Levels of disturbance varied throughout this community, which can be attributed to the sections of the community either being affected by the fire event or the grazing pressure experienced in the particular section. During the site visit it was evident that the northern clay grasslands were grazed extensively by cattle from the nearby Khuma village. Moderate to high levels of grazing were also observed in the western and southern sections of the community due to game. Scattered rocks do occur on occasion throughout the community but mostly no rocks/ boulders were present within this plant community. During both surveys, in areas with black turf soils, species identification was limited as per figure a above.</p> <p>In terms of vegetation structure, the grass layer was dominant in this plant community with the shrub/herb layer being subdominant. Dominant grass species include <i>Themeda triandra</i>, <i>Andropogon schirensis</i>, <i>Aristida congesta</i> subsp. <i>congesta</i>, <i>Cymbopogon caesius</i>, <i>Eragrostis curvula</i>, <i>Panicum coloratum</i> and <i>Setaria sphacelata</i>. Bush clumps containing <i>Vachellia karroo</i>, <i>Ziziphus zeyhrana</i> as well as <i>Elephantorrhiza elephantina</i>, both geoxylic suffrutices, were abundant in this community. The herb layer included <i>Baleria macrostegia</i>, <i>Bulbine narcissifolia</i>, <i>Chascanum hederaceum</i>, <i>Felecia muricata</i>, <i>Gazania krebsiana</i>, <i>Hermannia depressa</i>, <i>Ledebouria minima</i>, <i>Lotononis calycina</i>, <i>Lotononis spp.</i>, <i>Menodora africana</i> <i>Solanum supinum</i>, <i>Hypoxis rigidula</i> and <i>Hilliardiella oligocephala</i>. Trees and shrubs, albeit limited within the community, included <i>Vachellia karroo</i>, <i>V. erioloba</i>, <i>Ziziphus mucronata</i>, <i>Celtis africana</i>, <i>Searsia lanceae</i>, <i>S. rigida</i>, <i>Diospyros austro-africana</i>, <i>Diospyros lycioides</i> and <i>Grewia flava</i>. Climbers included <i>Pentarrhinum inspidum</i>, <i>Coccinia sessilifolia</i>, <i>Mormordica balsamina</i> and <i>Rubia horrida</i>,</p> <p>Medicinal plants present in this community included <i>Ammocharis coranica</i> (Karoo lily), <i>Hypoxis hemerocallidea</i> (Star flower), <i>Boophone disticha</i> (Poison Bulb), <i>Haemanthus montanus</i> and <i>Crinum cf. bulbispermum</i> (Orange River Lily). All of these medicinal plants are currently listed under Least Concern (LC) by SANBI. However, <i>Ammocharis coranica</i> and <i>Crinum cf. bulbispermum</i> are protected under the Transvaal Nature Conservation Ordinance (Ordinance 12 of 1983) and North West Biodiversity Management Act (2016) which repeals the entire Transvaal Nature Conservation</p>


	Ordinance Act. Due to the pressures on the medicinal plant species as a result of the muthi trade it is recommended that, where possible, the conservation of these plant species occur <i>in situ</i> . If found within the planned footprint area of the TSF or related infrastructure it is recommended that the plants are relocated to other areas of the clay grassland with similar soil profiles (consult soil report compiled by TerraAfrica) as well as similar slopes.
CONFIRMED PLANTS OF CONSERVATION CONCERN	The only plant species of conservation concern present within this community were <i>Ammocharis coranica</i> , <i>Haemanthus montanus</i> and <i>Crinum cf. bulbispermum</i> . These species are provincially protected. Additionally, a few individuals of <i>Vachellia erioloba</i> (Camel Thorn), a TOPS listed tree species, is scattered throughout the community (Notice of The List of Protected Tree Species Under the National Forests Act, 1998 (Act No. 84 Of 1998) Amended 7 September 2018). Localities of this species are indicated on Figure 17 and Annexure G.
RATIONAL OF SENSITIVITY RATING	A rating of medium was assigned to commaunity. Species diversity was lower in this community than observed by De Castro and Brits (2017). The sensitivity ratings were also calculated using different methods which might also have led to a lower sensitivity score in this assessment.
RECOMMENDATIONS RELATED TO PROPOSED TSF EXPANSION	It is recommended that prior to the construction phase the footprint areas should be ground-truthed for the presence of the SCC recorded within the community. Where required, the necessary permits to relocate TOPS must be obtained prior to construction. A plant rescue plan should be developed by a botanist/horticulturist and during the relocation of any SCC, a botanist/ horticulturist should supervise the relocation.

Table 10: Dolomitic grassland

DOMINANT VEGETATION LAYER	PRELIMINARY SENSITIVITY
Grass-forb layer is dominant with scattered indigenous tree species.	High
	
DESCRIPTION	This vegetation community is situated in the western parts of the study area on rocky outcrops. These rocky outcrops are situated on ridges with gentle slopes and the ridges are chert rich. The associated soils are rocky brown clay loams (De Castro & Brits, 2017). The vegetation community resembles the Vaal Reefs Dolomite sinkhole Woodland vegetation unit as described by Mucina & Rutherford (2006).


	<p>Apart from littering due to herders, the litter from the R502 and cattle grazing, the vegetation community is largely intact. The dolomitic grassland community is untransformed, despite the northern sections being in close proximity to the Khuma village and R502. Another impact on the community is increased fire frequency.</p> <p>In terms of vegetation composition, the dominant layer is the grass layer which contains mostly sour grass species. The grass layer is sparse, relatively short and resembles an arid grassland. There are bush clumps of <i>Vachellia erioloba</i>, <i>Searsia lancea</i> and <i>S. pyroides</i>. Shrubs include <i>Diospyros lyciodes</i>, <i>Grewia flava</i> and <i>Erretia rigida</i>. Geoxylic suffrutices include <i>Elephantorrhiza elephantina</i> and <i>S. magalismontanum</i>. The dominant grasses include <i>Melinis repens</i>, <i>Brachiaria serrata</i>, <i>Elionurus muticus</i>, <i>Eragrostis nindensis</i> and <i>Cynodon dactylon</i>. The forb layer contains a high species richness which contributed to the sensitivity of the vegetation community containing two near threatened (NT) species- namely <i>Lithops lesliei</i> subsp. <i>lesliei</i> and <i>Pearsonia bracteata</i>. Other forb species include <i>Triumfetta sonderi</i>, <i>Chameocrista comosa</i>, <i>Crabbea angustifolia</i>, <i>Dianthus zeyheri</i>, <i>Dicoma anomala</i>, <i>Lasiosiphon capitatus</i>, <i>Justicia anagalloides</i>, <i>Kohautia amatymbica</i>, <i>Ornithogalum tenuifolium</i>, <i>Tephrosia longipes</i>. Climbers include <i>Pentarrhinum insipidum</i>, <i>Coccinia sessilifolia</i> and <i>Asparagus cooperi</i>.</p> <p>Medicinal plant species included <i>Hypoxis hemerocallidea</i> (Star flower), <i>Ledebouria marginata</i> (tough-leaved African hyacinth), <i>Boophone disticha</i> (Poison Bulb) and <i>Crinum cf. bulbispermum</i> (Orange River Lily).</p>
<p>CONFIRMED PLANTS OF CONSERVATION CONCERN</p>	<p><i>Crinum cf. bulbispermum</i> is provincially protected. Additionally, a few individuals of <i>Vachellia erioloba</i> (Camel Thorn), aTOPS listed tree species is scattered throughout the community. There are two NT plant species in this plant community namely <i>Lithops lesliei</i> subsp. <i>lesliei</i> and <i>Pearsonia bracteata</i>. There are photographic records of these plant species in Annexure H. Localities of this species are indicated on Figure 17 and Annexure G. The recommended buffer requirements for the NT species is discussed under the sensitivity of the plant communities.</p>
<p>RATIONAL OF SENSITIVITY RATING</p>	<p>A rating of high was assigned to this community. This is largely attributed to the fact that the grassland is situated within the Rand Highveld Grassland which is a protected Terrestrial Ecosystem and the vegetation unit resembles a variation of the Vaal Reefs Dolomite Sinkhole Woodland which is unique to the North West province. The community contains two NT plant species as well as a protected tree species and numerous medicinal plants under the threat of the muthi trade. The community has relatively good connectivity to other plant communities and also provides good habitat for fauna. The grasses in this community are not as palatable as in the Clay Grassland therefore grazing is also lower and species diversity higher than recorded in the Clay Grassland.</p>
<p>RECOMMENDATIONS RELATED TO PROPOSED TSF EXPANSION</p>	<p>Only the fence line slightly impedes on this plant community. It is recommended that the fence line be adjusted to exclude this community. It is however recommended that a management plan for both of the NT plant species is developed to ensure their <i>in-situ</i> conservation. Dust fall out should be carefully monitored during the construction and operational phases to ensure that the plant species are not negatively affected by the increased dust. It is recommended that dust suppression measures should strictly be adhered to.</p>

Table 11: Doloritic grassland

DOMINANT VEGETATION LAYER	PRELIMINARY SENSITIVITY
<p>Grass-forb layer is dominant with scattered indigenous shrub species.</p>	<p>Medium</p>
	
<p>DESCRIPTION</p>	<p>The vegetation community is situated in the eastern parts of the study area on rocky outcrops it borders the <i>Vachellia karoo</i> savanna and, in sections, wetlands. Large dolorite (diabase) boulders are interspersed in the community and often occur in a row or linear formation. The community resembles the Rand Highveld Grassland. Compared to the dolomitic grassland, the doloritic grassland's grass layer in particular is denser.</p> <p>The community is largely unimpacted apart from grazing in some areas. Prior to the November survey sections of the community directly south of the current TSF were affected by the fire event and vegetative cover was sparse.</p> <p>In terms of vegetation composition, the dominant layer is the grass layer which contains mostly sour grass species. The grass layer is dense, in some instances even moribund, and of moderate length. There were interspersed trees and shrubs present including but not limited to <i>Vachellia karroo</i>, <i>Searsia lanceae</i>, <i>Diospyros austro-africana</i>, <i>Euclea crispa</i>, <i>Ximenia caffra</i> and <i>Searsia spp.</i> The dominant grasses include <i>Melinis repens</i>, <i>Eragrostis chloromelas</i>, <i>Cymbopogon pospischilli</i>, <i>Themeda triandra</i>, <i>Brachiaria serrata</i>, <i>Setaria sphacelata</i> var. <i>torta</i>, <i>Schizachyrium sanguineum</i> and <i>Cynodon dactylon</i>. The forb layer contains a moderate level of floristic diversity, less than the dolomitic grassland. No NT species are present within this plant community. Other forb species include <i>Triumfetta sonderi</i>, <i>Hibiscus microcarpus</i>, <i>Wahlenbergia virgata</i>, <i>Tephrosia longipes</i>, <i>Ipomoea bathycolpos</i>, <i>Chamaecrista mimosoides</i>, <i>Hypoxis rigidula</i>, <i>Hypoxis iridifolia</i>, <i>Gomphocarpus fruticosus</i>, <i>Chlorophytum fasciculatum</i>, <i>Ledebouria burkei</i>, <i>Carex spp.</i>, <i>Commelina africana</i>, <i>Pellaea calomelanos</i>, <i>Cyanotis speciosa</i>, <i>Limeum fenestratum</i> <i>Scabiosa columbaria</i> and <i>Aloe greatheadii</i> var. <i>davyana</i>. Climbers include <i>Clematis brachiata</i> <i>Pentarrhinum inspidum</i> and <i>Asparagus laricinus</i></p> <p>Medicinal plant species include <i>Hypoxis hemerocallidea</i> (Star flower), <i>Ledebouria burkei</i>, <i>Boophone disticha</i> (Poison Bulb) and <i>Crinum cf. macowani</i> (Cape Lily).</p>

CONFIRMED PLANTS OF CONSERVATION CONCERN	<i>Crinum cf. macowani</i> is provincially protected. Localities of this species are indicated on Figure 17 and Annexure G.
RATIONAL OF SENSITIVITY RATING	A rating of medium was assigned to community. This is largely attributed to the fact that the grassland is situated within the Rand Highveld Grassland which is a protected Terrestrial Ecosystem. The community contains a provincially protected plant species as well as medicinal plants under the threat of the muthi trade. The community has relatively good connectivity to other plant communities and also provides good habitat for fauna. The grasses in this community are not as palatable as in the Clay Grassland therefore grazing is also lower and species diversity higher than recorded in the Clay Grassland.
RECOMMENDATIONS RELATED TO PROPOSED TSF EXPANSION	The fence line as well as the stormwater diversion channel is located within this plant community. The current layout of the storm water diversion channel does not affect the SCC. However, it is recommended that prior to the construction phase the footprint area of the fence line should be checked by a botanist to determine if any SCC should be removed or relocated in accordance to the plant rescue plan.

Table 12: Sandy Grassland

DOMINANT VEGETATION LAYER	PRELIMINARY SENSITIVITY
Grass-forb layer is dominant with scattered indigenous shrub species.	Medium
	
DESCRIPTION	This vegetation community is situated in the southern parts of the study area in close proximity to the existing TSF. The community borders the wetland community, in particular channelled valley bottoms and unchannelled valley bottoms. Boulders are present in some sections of the community, but a major part has little to no rocky cover present. The community resembles the Rand Highveld Grassland as described by Mucina & Rutherford (2006). In terms of vegetative structure, the grass layer is dominant and is considered a primarily short grassland. Although there are some taller grass species present as observed in the photo above. The community is less dense than the dolomitic grasslands.

	<p>The community is largely unimpacted apart from grazing and dirt roads. The community was not affected by the fire event prior to the November survey.</p> <p>In terms of vegetation composition, the dominant layer is the grass layer. The dominant grass species is <i>Themeda triandra</i>. Subdominant grass species include <i>Triraphis andropogonoides</i>, <i>Melinis repens</i>, <i>Eragrostis curvula</i>, <i>Eragrostis chloromelas</i>, <i>Setaria sphacelata</i>, <i>Brachiaria serrata</i>, <i>Panicum coloratum</i> var. <i>coloratum</i>. The forb layer contains a moderate level of floristic diversity, less than the dolomitic grassland. No NT species are present within this plant community. Other forb species included <i>Acalypha caperonioides</i>, <i>Aloe greatheadii</i> var. <i>davyana</i>, <i>Bulbine capitata</i>, <i>Bulbine narcissifolia</i>, <i>Helichrysum nudifolium</i>, <i>Chascanum adenostachyum</i>, <i>Cyanotis speciosa</i>, <i>Felicia muricata</i>, <i>Cucumis zeyheri</i>, <i>Limeum viscosum</i>, <i>Phyllanthus parvulus</i>, <i>Pollichia campestris</i>, <i>Tephrosia elongata</i> var. <i>elongata</i>, <i>Chamaecrista mimosoides</i>, <i>Crabbea hirsuta</i> and <i>Indigofera heterotricha</i>. <i>Ziziphus zeyheriana</i> (Klein-wag-'n-bietjie) is the only geoxylic suffrutex observed in the plant community. Shrubs are limited to <i>Stoebe plumosa</i> (Bankrupt bush). Climbers include <i>Clematis brachiata</i>, <i>Pentarrhinum insipidum</i>, and <i>Asparagus larinus</i>.</p> <p>Medicinal plant species include <i>Boophone disticha</i> (Poison Bulb).</p>
<p>CONFIRMED PLANTS OF CONSERVATION CONCERN</p>	<p>No plant SCC were noted in the plant community.</p>
<p>RATIONAL OF SENSITIVITY RATING</p>	<p>A rating of medium was assigned to community. This is largely attributed to the fact that the grassland is situated within the Rand Highveld Grassland which is a protected Terrestrial Ecosystem. The community contains medicinal plants under the threat of the muthi trade. The community has relatively good connectivity to other plant communities and also provides good habitat for fauna. Additionally the community acts as an additional buffer area to the wetland community which is deemed sensitive.</p>
<p>RECOMMENDATIONS RELATED TO PROPOSED TSF EXPANSION</p>	<p>There is quite a number of activities planned within the community including the return water dam roads, solution trench and the decant system. The current layout of the proposed infrastructure does not affect the SCC. However, it is recommended that prior to the construction phase, the footprint area of the proposed activities should be checked by a botanist to determine if any SCC should be removed or relocated in accordance to the plant rescue plan and under the relevant permit.</p>

Table 13: Secondary Grassland

DOMINANT VEGETATION LAYER	PRELIMINARY SENSITIVITY
Grass-forb layer is dominant with scattered indigenous shrub species.	Medium



DESCRIPTION	<p>Secondary grasslands develop where the original, primary (undisturbed) grassland vegetation was removed (e.g. by cultivation, vegetation clearing, dumping, infilling etc.). After such disturbances cease, pioneer grassland species, as well as weedy plants, colonise the disturbed areas leading to a secondary grassland state with lower species diversity as opposed to the primary (climax) state prior to any disturbances. Where grasslands were historically disturbed although no cultivation took place (e.g. compaction of the soils), the result could also resemble a secondary grassland state with limited species diversity. An indicator of secondary grasslands is the presence of <i>Hyparrhenia hirta</i> and <i>Melinis repens</i>.</p> <p>Most of the vegetation community is affected by frequent fire events. Prior to the November survey large sections of this community was burnt. Historical agricultural activities, limited rainfall prior to the February survey as well as grazing pressure resulted in a lower than expected species richness for the plant community. The community comprises of derelict agricultural fields.</p> <p>Many grass species within this community could not be identified to genus or species level during the November and February surveys due to the fire event as well as lack of rains and high grazing pressure particularly in the northern sections of the study area.</p> <p>The dominant layer in this community is the grass layer with some scattered forb species. A few individuals of the three <i>Vachellia erioloba</i> are present on borders with the clay grassland in particular. The dominant grass species observed within the community is <i>Melinis repens</i>. Sub dominant grass species include <i>Eragrostis lehmanniana</i>, <i>Eragrostis superba</i>, <i>Eragrostis chloromelas</i>, <i>Aristida adscensionis</i> and <i>Cynodon dactylon</i>., The forb layer contains weedy species such as <i>Gomphrena celosioides</i>, <i>Verbena officinalis</i>, <i>Hibiscus trionum</i>, <i>Solanum elaeagnifolium</i> and <i>Tagetes minuta</i>. Other forb species observed within the plant community include <i>Gomphocarpus fruticosus</i>, <i>Osteospermum muricatum</i>, <i>Cucumis zeyheri</i>, <i>Pollichia campestris</i>, <i>Zornia linearis</i>, <i>Solanum incanum</i>, <i>Kohautia</i></p>
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	<p><i>amatymbica</i>, <i>Hermannia depressa</i> and <i>Bulbine narcissifolia</i>. Climbers are limited to <i>Pentarrhinum insipidum</i>.</p> <p>Medicinal plant species include <i>Hypoxis hemerocallidea</i> (Star flower) and <i>Boophone disticha</i> (Poison Bulb).</p>
CONFIRMED PLANTS OF CONSERVATION CONCERN	A few individuals of <i>Vachellia erioloba</i> (Camel Thorn), a TOPS listed tree species are scattered throughout the community.
RATIONAL OF SENSITIVITY RATING	A rating of medium was assigned to this community. This is largely attributed to the fact that the grassland is situated within the Rand Highveld Grassland which is a protected Terrestrial Ecosystem. The community contains medicinal plants under the threat of the muthi trade as well as the TOP species <i>Vachellia erioloba</i> . The community has relatively good connectivity to other plant communities and also provides good habitat for fauna.
RECOMMENDATIONS RELATED TO PROPOSED TSF EXPANSION	Only a small portion of the storm water diversion as well as the fence line crosses this plant community. Due to the moderate sensitivity and levels of disturbance it is unlikely that the community will be adversely affected if the mitigation measures are adhered too. The current layout of the proposed infrastructure does not affect the SCC. However, it is recommended that prior to the construction phase the footprint area of the proposed activities should be checked by a botanist to determine if any SCC should be removed or relocated in accordance with the plant rescue plan.

Table 14: *Vachellia karroo* savanna


DOMINANT VEGETATION LAYER	PRELIMINARY SENSITIVITY
Tree layer with sub-dominant grass shrub layer.	Medium



DESCRIPTION	The <i>Vachellia karroo</i> savanna is an open canopy savanna in most instances throughout the study area but in sections there are clumps of <i>Vachellia karroo</i> and other dominant tree species. Densities of other tree species vary throughout the study area. The south-western portion of the of the study area is best described as an open savanna whilst in areas in the south east on Umfula there are patches of closed canopies with limited amounts of herbs and grasses growing in the sub-canopy. In the eastern parts of this plant community, especially on Umfula where the tree canopy is open or bush clumps
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	<p>are present, the grass-herb layer is moribund and underutilised in terms of grazing capacity. The community borders the doleritic grassland, clay grassland, wetlands, <i>Asparagus larycinus</i> – <i>Vachellia karroo</i> floodplain thicket and secondary grassland communities. There are sections of this community with no or hardly any rocky cover while those bordering the doleritic grasslands have large doleritic boulders present.</p> <p>The dominant layer in this community is the tree layer. The dominant tree species is <i>Vachellia karroo</i>. Subdominant tree species include <i>Searsia lanceae</i>, <i>Ziziphus mucronata</i>, <i>Celtis africana</i> and <i>Vachellia robusta</i>. <i>Olea europaea</i> subsp. <i>africana</i> Shrubs occurring within the community include <i>Grewia flava</i>, <i>Ehretia rigida</i>, <i>Euclea undulata</i>, <i>Searsia pyroides</i>, <i>Gymnosporia buxifolia</i>, <i>Gymnosporia senegalensis</i>, <i>Asparagus larycinus</i>. <i>Themeda triandra</i> is the dominant grass species within this plant community and other grasses include <i>Panicum coloratum</i> var. <i>coloratum</i>, <i>Aristida adscensionis</i>, <i>Cymbopogon caesius</i>, <i>Setaria sphacelata</i>, <i>Setaria lundenbergiana</i>, <i>Eragrostis capensis</i>, <i>Eragrostis curvula</i>, <i>Eragrostis lehmaniana</i>, <i>Elionurus muticus</i>, <i>Melinis repens</i>, <i>Digitaria eriantha</i>, <i>Digitaria argyrograpta</i> and <i>Cynodon nlemfuensis</i>.</p> <p>Forbs are not abundant in this community, but this might be attributed to the lack of significant rains prior to the site visit. Forbs present in the community include <i>Lasiosiphon capitatus</i>, <i>Hibiscus pusillus</i>, <i>Bulbine abyssinica</i>, <i>Bulbine narcissifolia</i>, <i>Verbena tenuisecta</i>, <i>Jamesbrittenia</i> spp., <i>Convolvulus sagittatus</i> subsp. <i>sagittatus</i> var. <i>phyllosepalus</i>, <i>Ipomoea crassipes</i> and <i>Crabbea</i> spp.. Weedy species include <i>Achyranthes aspera</i>, <i>Bidens bipinnata</i>, <i>Bidens pilosa</i>, <i>Tagetes minuta</i>, <i>Schkuhria pinnata</i>. Climbers include <i>Rubida horrida</i>, <i>Clematis brachiata</i>, <i>Pentarrhinum insipidum</i>, <i>Asparagus larycinus</i> and <i>Asparagus cf. cooperi</i>. The geoxylic suffrutex <i>Ziziphus zeyheriana</i> is also abundant within this plant community.</p> <p>Medicinal plant species include <i>Hypoxis hemerocallidea</i> (Star flower) and <i>Boophone disticha</i> (Poison Bulb).</p>
CONFIRMED PLANTS OF CONSERVATION CONCERN	A few individuals of <i>Vachellia erioloba</i> (Camel Thorn), a TOPS listed tree species are scattered throughout the community. Species protected on a provincial level include <i>Cussonia paniculata</i> (Mountain Cabbage Tree), <i>Crinum cf. mocawanii</i> and <i>Crinum cf. bulbispermum</i> . These species are provincially protected.
RATIONAL OF SENSITIVITY RATING	A rating of medium was assigned to community. This is largely attributed to the fact that the community is situated within the Rand Highveld Grassland which is a protected Terrestrial Ecosystem. The community contains medicinal plants under the threat of the muthi trade as well as the TOP species <i>Vachellia erioloba</i> . The community has relatively good connectivity to other plant communities and also provides good habitat for fauna.
RECOMMENDATIONS RELATED TO PROPOSED TSF EXPANSION	The following activities will affect this plant community: storm water diversion and fence line. Should invasive species be used for the passive treatment area, it is imperative that the spread of the invasive species be closely monitored to ensure that they do not encroach into the <i>Vachellia karroo</i> savanna. It is unlikely that the community will be adversely affected if the mitigation measures are adhered too. The current layout of the proposed infrastructure does not affect the SCC. However, it is recommended that prior to the construction phase the footprint area of the proposed activities should be checked by a botanist to determine if any SCC should be removed or relocated in accordance to the plant rescue plan.

Table 15: *Vachellia erioloba* savanna

DOMINANT VEGETATION LAYER	PRELIMINARY SENSITIVITY
Tree layer with sub-dominant grass shrub layer.	High
	
DESCRIPTION	<p>The <i>Vachellia erioloba</i> savanna is an open canopy savanna which occurs on sandy soils as well as the dolomitic ridge in the south west of the study area. The vegetation unit resembles the Vaal Reefs Dolomite Sinkhole Woodland as described by Mucina & Rutherford (2006). Vegetative cover of this plant community was quite sparse as it was affected by high grazing pressure, fire events and lack of rainfall prior to the February survey. The <i>Vachellia erioloba</i> savanna borders the secondary grassland and dolomitic grassland communities and comprises of only a small portion of the southern section of the study area.</p> <p>The dominant tree species within this community is <i>Vachellia erioloba</i>, Other tree species recorded during the site visits include <i>Vachellia karro</i> and <i>Searsia lanceae</i>. Shrubs included <i>Ehretia rigida</i>, <i>Vachellia hebeclada</i>, <i>Searsia pyriodes</i>, <i>Gymnosporia buxifolia</i>, <i>Gymnosporia senegalensis</i> and <i>Grewia flava</i>.</p> <p>The inflorescences of the grass species were not all present during the November or February surveys, so not all of the grass species present could be identified. Species which were identified during the site visits included <i>Eragrostis lehmanniana</i>, <i>Eragrostis superba</i>, <i>Eragrostis obtusa</i>, <i>Setaria sphacelata</i> var. <i>sphacelata</i>, <i>Setaria sphacelata</i> var. <i>torta</i>, <i>Cymbopogon caesius</i>, <i>Cymbopogon ospischilli</i>, <i>Cynodon nlemfuensis</i>, <i>Hyparrhenia hirta</i>, <i>Aristida congesta</i> subsp. <i>barbicollis</i>, and <i>Themeda triandra</i>.</p> <p>Forbs were not abundant in this community, but it might be attributed to the lack of significant rains prior to the site visit. Forbs present in the community included <i>Thrichodesma angustifolium</i>, <i>Ledebouria ovatifolia</i>, <i>Convolvulus sagittatus</i>, <i>Solanum eleagnifolium</i>, <i>Hibiscus pusillus</i>, <i>Sida chrysantha</i>, <i>Corchorus asplenifolius</i>, <i>Moldenke</i> var. <i>hederaceum</i>, <i>Bulbine abyssinica</i>, <i>Bulbine narcissifolia</i>, <i>Barleria macrostegia</i>, <i>Indigofera daleoides</i> var. <i>daleoides</i>, <i>Lasiosiphon capitatus</i>, <i>Hibiscus pusillus</i> and <i>Hilliardiella oligocephala</i>. Medicinal plant species were limited to <i>Hypoxis hemerocallidea</i> (Star flower).</p>

CONFIRMED PLANTS OF CONSERVATION CONCERN	The TOPS listed <i>Vachellia erioloba</i> (Camel Thorn) is abundant in this plant community.
RATIONAL OF SENSITIVITY RATING	A rating of high was assigned to community. The community is situated on the dolomitic ridge which is suitable habitat for a species namely <i>Lithops lesliei</i> subsp. <i>lesliei</i> and <i>Pearsonia bracteata</i> . Vegetation present in this community is primary and the level of disturbance apart from grazing is low. The community contains TOP species <i>Vachellia erioloba</i> . The community has relatively good connectivity to other plant community acts as a buffer for the dolomitic grassland and also provides good habitat for fauna.
RECOMMENDATIONS RELATED TO PROPOSED TSF EXPANSION	According to the layout none of the current activities are planned within this plant community. Dust fall out should be carefully monitored during the construction and operational phases to ensure that the plant species are not negatively affected by the increased dust. It is recommended that dust suppression measures should strictly be adhered to.

Table 16: Wetlands

DOMINANT VEGETATION LAYER	PRELIMINARY SENSITIVITY
Riparian woodland along the Vaal River; the dominant layer is the tree layer. All of the other wetland types or hydrogeomorphic units the dominant layer is the grass, reed and sedge layer.	High
 <p>Examples of the different wetland types present within the study area a) Channelled Valley Bottom b) Dam c) Riparian woodland along the Vaal River d) Unchannelled Valley Bottom</p>	
DESCRIPTION	<p>Wetlands were delineated based on the report by Limosella (2019). The different wetland types or hydrogeomorphic (HGM) units present within the study area include channelled valley bottoms, dams, episodic pans, perennial river (Vaal River), seepage wetlands, unchannelled valley bottoms and artificial dams. The buffer zones of the wetlands are also as per recommendation by Limosella (2019).</p> <p>The seepage wetlands were not visited by the botanical specialist however they are described in the wetland report by Limosella (2019). The episodic pan was part of the study area covered by De Castro & Brits (2017) and this HGM unit was not visited by the specialist.</p>

	<p>Channelled valley bottoms were present along the existing TSF and the current stormwater dams are in close proximity to this HGM unit. The channelled valley bottom wetlands drain into the Vaal River. Vegetative cover varies significantly within the community. The grass layer was not well developed in the sections to the south in close proximity to the Vaal River as it was still recovering after the fire event prior to the November site visit. <i>Typha capensis</i> was dominant in the northern sections of the HGM unit. Other herbs observed within this community include <i>Persicaria attenuata</i>, <i>Potamogeton pectinatus</i> and <i>Marsilea farinosa</i> subsp. <i>farinosa</i>, Sedges included <i>Schoenoplectus decipiens</i>, <i>Cyperus congestus</i>, <i>Cyperus longus</i> cf. <i>longus</i> <i>Eleocharis dregeana</i>, <i>Fuirena coeruleascens</i>, <i>Juncus punctorius</i>, <i>Bulbostylis humilis</i> and <i>Kyllinga erecta</i>. Herbaceous species included <i>Berkheya radula</i>, <i>Berkheya onopordifolia</i> var. <i>onopordifolia</i>, <i>Ranunculus multifidus</i>, <i>Conyza podocephala</i>, <i>Senecio inornatus</i>, <i>Oenothera rosea</i>, <i>Senecio erubescens</i> and <i>Verbena officinalis</i>.</p> <p>Unchanneled valley bottoms are dominated by <i>Phragmites australis</i>. Sub-dominant to <i>Phragmites australis</i> is <i>Typha capensis</i>. The reed and rush form dense impenetrable stands. Other plants noted within the unchanneled valley bottoms include <i>Leersia hexandra</i>, <i>Paspalum dilatatum</i>, <i>Sporobolus africanus</i> and <i>Cynodon dactylon</i>. The NEM:BA listed invasive species <i>Cirsium vulgare</i> is abundantly present along the periphery of the unchanneled and channelled valley bottoms in close proximity to the existing TSF.</p> <p>The riparian woodland forms a dense canopy all along the Vaal River. The sub-canopy cover is limited and the areas close to the bridge to the south west of the study area are impacted by littering and recreational activities such as fishing. Levels of invasion are also higher in the south west corners of this plant community and the invasive tree <i>Morus alba</i> (NEM:BA category 1b) was abundant within the tree canopy. <i>Morus alba</i> was the dominant tree species present in the south western section of this plant community with <i>Ziziphus mucronata</i> as subdominant. The only grass species present was <i>Panicum maximum</i> and <i>Setaria sphacelata</i>. To the east of the community occurring along the Vaal River, disturbance and invasion is much lower.</p> <p>The undisturbed riparian woodland in the south eastern section in close proximity to the Vaal River is less disturbed and also lower levels of invasion. The tree canopy is still interlocking. Dominant tree species in this community is <i>Ziziphus mucronata</i> with <i>Vachellia karroo</i> as subdominant. Other woody species present included <i>Celtis africana</i> and <i>Searsia pyroides</i>. Two grass species were <i>Setaria</i> cf. <i>incrassata</i> and <i>Panicum maximum</i>. present and subdominant. Climbers were limited to <i>Rubida horrida</i>, and <i>Asparagus laricinus</i>.</p> <p>Dams and artificial wetlands include water holes for game species. Vegetation along these are altered and contain mostly weedy species.</p>
<p>CONFIRMED PLANTS OF CONSERVATION CONCERN</p>	<p>The only plant species of conservation concern present within this community is <i>Crinum</i> cf. <i>bulbispermum</i>. Localities of this species are indicated on Figure 17 and Annexure G.</p>
<p>RATIONAL OF SENSITIVITY RATING</p>	<p>All wetlands are protected by national legislation (National Water Act). The wetlands also perform valuable ecosystem services. The systems provide habitat for fauna species, act as a corridor for species movement and improve connectivity throughout the study area. A rating of high was assigned to all of the wetlands present within the study area. Please refer to the wetland report by Limosella (2019) for a more comprehensive assessment of the wetlands present within the study area.</p>
<p>RECOMMENDATIONS RELATED TO PROPOSED TSF EXPANSION</p>	<p>The following infrastructure is proposed to occur within the wetland plant community: solution trench, return water dam diversion, return water dams, return water dam roads and decant system. Ideally the proposed activities should not be placed within the wetland systems which are highly sensitive but rather in the neighbouring moderate sensitivity systems. Alternatively, as suggested in the wetland report by Limosella (2019), the loss of wetland habitat should be offset or rehabilitated. It is recommended that prior to the construction phase the footprint areas should be ground-truthed for the presence of the SCC recorded within the community. Where required, the necessary permits must be obtained prior to construction. A plant rescue plan should be developed by a botanist/horticulturist and during the relocation of any SCC a botanist/ horticulturist should supervise the relocation.</p>

Table 17: *Eucalyptus camaldulensis* woodland

DOMINANT VEGETATION LAYER	PRELIMINARY SENSITIVITY
Tree layer	Low
	
DESCRIPTION	<p>The plant community occurred in modified and secondary vegetation as a result of the plantation of <i>Eucalyptus camaldulensis</i> (NEM:BA Category 1b) as well as other <i>Eucalyptus spp.</i> The dominant layer within this community is the tree layer. The most abundant grass species within the community was <i>Cynodon nlemfuensis</i>; other grass species included <i>Themeda triandra</i> and <i>Eragrostis chloromelas</i>. Herbaceous species included weedy species such as <i>Bidens bipinnata</i>, <i>Tagetes minuta</i> and <i>Solanum spp.</i> Climbers included <i>Rubida horrida</i>, <i>Clematis brachiata</i>, <i>Pentarrhinum insipidum</i> and <i>Asparagus larinus</i>. The geoxylic suffrutex <i>Ziziphus zeyheriana</i> was noted within the plant community.</p> <p>Medicinal plant species included <i>Hypoxis hemerocallidea</i> (Star flower) and <i>Boophone disticha</i> (Poison Bulb).</p>
CONFIRMED PLANTS OF CONSERVATION CONCERN	No plant SCC were noted within this plant community.
RATIONAL OF SENSITIVITY RATING	Due to the secondary nature of the plant community as well as low species richness this plant community was assigned a low sensitivity.
RECOMMENDATIONS RELATED TO PROPOSED TSF EXPANSION	No infrastructure is currently planned within the plant community. Alien invasive Management Plan should be developed and all AIS species should be removed or permitted as required per NEM:BA.

5.2.1. *Alien Invasive Plant Species*

Declared weeds and invader plant species have the tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition and function of these systems. Therefore, it is important that these plants are controlled and eradicated by means of an eradication and monitoring programme. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species.

The National Environmental Management: Biodiversity Act (NEMBA) is the most recent legislation pertaining to alien invasive plant species. A list of Alien Invasive Species was published in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (GN 864 of GG 40166, 26 July 2016). The Alien and Invasive Species Regulations were published in GN R598 in Government Gazette No. 37885, 1 August 2014. The legislation calls for the removal and / or control of alien invasive plant species (Category 1 species). In addition, unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring within proximity to a watercourse.

Below is a brief explanation of the three categories in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA):

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

Note that according to the regulations, a person who has under his or her control a category 1b listed invasive species must immediately:

- Notify the competent authority in writing
- Take steps to manage the listed invasive species in compliance with:
 - Section 75 of the Act;
 - The relevant invasive species management program developed in terms of regulation 4; and
 - Any directive issued in terms of section 73(3) of the Act.

The following category 1b species were observed during the site visits:

- *Argemone ochroleuca*;
- *Cirsium vulgare*;
- *Datura ferox*;
- *Datura stramonium*;
- *Eucalyptus camaldulensis* (Category 1b in riparian areas, or listed ecosystems or area of conservation in terms of bioregional conservation plans and grassland);
- *Malvastrum coromandelianum*;
- *Melia azedarach*;
- *Pennisetum clandestinum*;
- *Salsola kali*;
- *Solanum elaeagnifolium*;
- *Solanum nigrum*;
- *Solanum sisymbriifolium*; and
- *Verbena bonariensis*.

The following category 2 species were observed during the site visits

- *Eucalyptus camaldulensis*.

The following category 3 species were observed during the site visits

- *Morus alba*.

5.3. Vegetation Sensitivity

As per Table 18 below, the result of the sensitivity assessment indicated that the Dolomitic grassland, *Vachellia erioloba* savanna and wetlands were assigned a high sensitivity and the transformed and *Eucalyptus camaldulensis* woodland were assigned a low sensitivity (Figure 18). For wetland sensitivity as well as wetland buffer requirements please also consult the wetland report compiled by Limosella Consulting (2019).

Currently there are no recommended buffer areas for sensitivity mapping related to Red data plant species for the North West Province. However, to follow best practice the Gauteng Department of Agriculture and Rural

Development (GDARD) Minimum requirements for biodiversity assessments version 3 (GDARD, 2014) should be consulted. The Red data plant currently occurring within the study area is *Lithops lesliei* subsp. *lesliei*. Additionally, the species *Pearsonia bracteata* (Near Threatened B1ab) was previously found within the dolomitic grassland. A buffer zone of 300m is recommended for both of these species within a rural area (GDARD, 2014).

Table 18: Preliminary sensitivity scoring of vegetation communities within the study area

SITE	CONSERVATION STATUS OF REGIONAL VEGETATION UNIT	LISTED ECOSYSTEM OR STATE OF VEGETATION	LEVEL OF LEGISLATIVE PROTECTION	SUITABLE HABITAT FOR PLANTS OF CONSERVATION	ECOLOGICAL FUNCTION	ECOLOGICAL IMPORTANCE	TOTAL SCORE OUT OF MAX OF 18
<i>Asparagus laricinus</i> – <i>Vachellia karroo</i> floodplain thicket	2	1	3	0	1	1	7 Medium
Clay Grassland	2	1	3	2	1	1	9 Medium
Dolomitic Grassland	1	3	3	3	3	3	16 High
Doloritic Grassland	1	3	3	2	2	1	12 Medium
Sandy Grassland	2	3	3	2	2	1	12 Medium
Secondary Grassland	2	1*	3	2	1	0	8 Medium
<i>Vachellia karroo</i> savanna	2	2	3	2	1	1	10 Medium
<i>Vachellia erioloba</i> savanna	2	3	3	2	3	2	14 High
Wetlands	2	3	3	2	2	2	13 High
Transformed and <i>Eucalyptus camaldulensis</i> woodland	N/A	0*	0	0	1	1	2 Low

*Vegetation is secondary

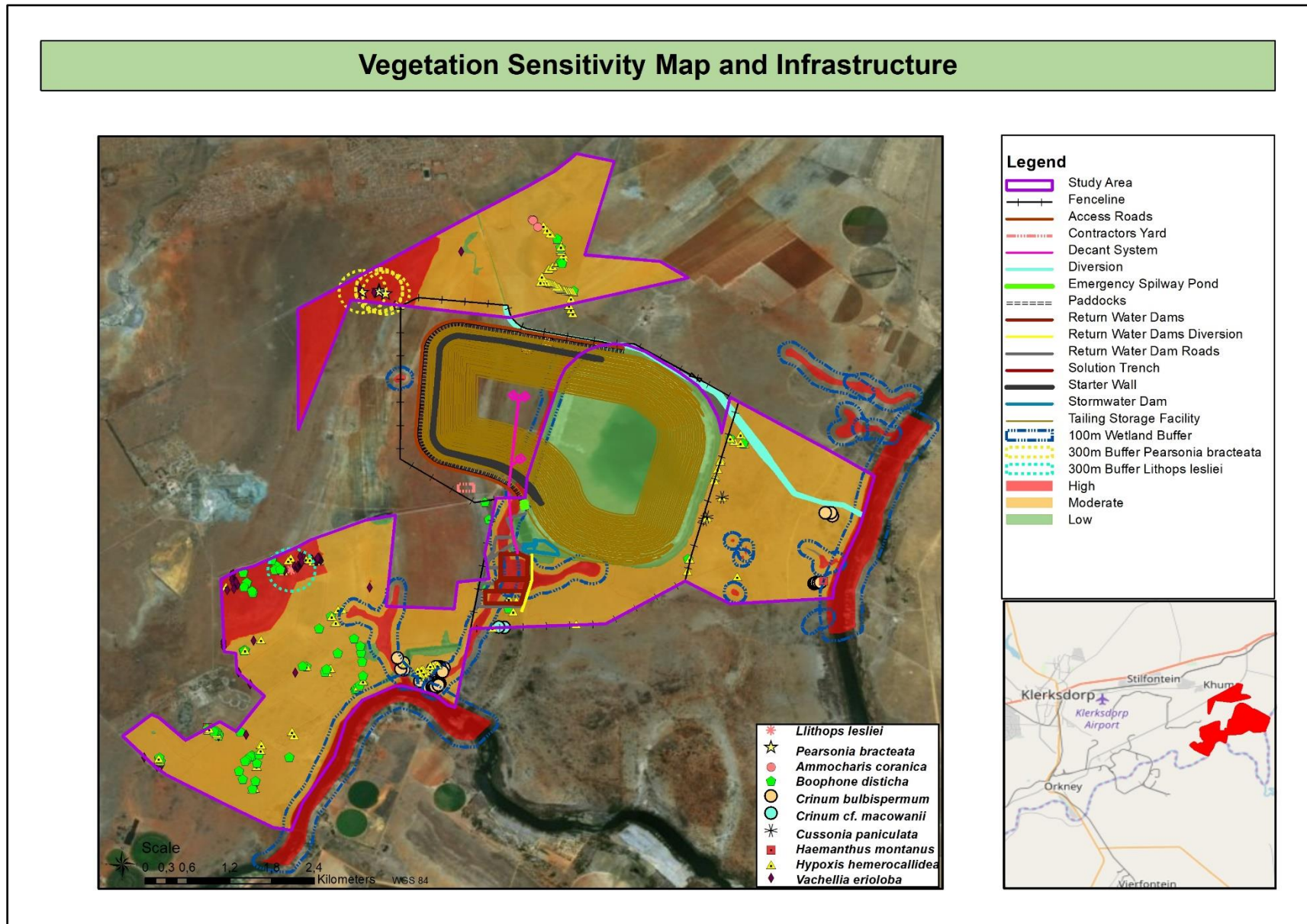


Figure 18: Vegetation sensitivity and infrastructure map

6. Impact Assessment and suggested mitigation measures

6.1. Impact Statement

Detailed impact assessments and management plans have been developed for the CBMAs and must be applied on site with regards to proposed future activities. This impact assessment focusses on the new activities relevant to the proposed expansion of infrastructure. The proposed activities are indicated in **Error! Reference source not found.**, Figure 13, Figure 14 and Figure 18. Please see accompanying excel spreadsheet for proposed impacts and their ratings. It is important to note that the impact assessment as per De Castro & Brits (2017) should also be taken into account for the area which did not form part of the study area in this report.

6.2. Impact Assessment Matrix

The following methodology was used to rank these impacts, as provided by GCS. Clearly defined rating and rankings scales were used to assess the impacts associated with the proposed activities. The impact assessment table is presented in Table 19.

Table 19: Impact Assessment Table

SPATIAL SCALE - HOW BIG IS THE AREA THAT THE ASPECT IS IMPACTING ON?	Area specific (at impact site)	1
	Whole site (entire surface right)	2
	Local (within 5km)	3
	Regional / neighbouring areas (5km to 50km)	4
	National	5
DURATION	One day to one month (immediate)	1
	One month to one year (short term)	2
	One year to 10 years (medium term)	3
	Life of the activity (long term)	4
	Beyond life of the activity (permanent)	5
SEVERITY	Insignificant / non-harmful	1
	Small / potentially harmful	2
	Significant / slightly harmful	3
	Great / harmful	4
	Disastrous / extremely harmful / within a regulated sensitive area	5
FREQUENCY OF THE ACTIVITY – HOW OFTEN DO YOU DO THE SPECIFIC ACTIVITY	Annually or less	1
	6 monthly	2
	Monthly	3
	Weekly	4

	Daily	5
FREQUENCY OF THE INCIDENT/IMPACT – HOW OFTEN DOES THE ACTIVITY IMPACT ON THE ENVIRONMENT?	Almost never / almost impossible / >20%	1
	Very seldom / Highly unlikely / >40%	2
	Infrequent / unlikely / seldom / >60%	3
	Often / regularly / likely/ possible/ >80%	4
	Daily / highly likely / definitely / >100%	5
LEGAL ISSUES	No legislation	1
	Fully covered by legislation	5
DETECTION – HOW QUICKLY/EASILY CAN THE IMPACTS/RISKS OF THE ACTIVITY BE DETECTED ON THE ENVIRONMENT, PEOPLE, AND PROPERTY	Immediately	1
	Without much effort	2
	Need some effort	3
	Remote and difficult to observe	4
	Covered	5

Each impact identified will be assessed in terms of scale (spatial scale), magnitude (severity) and duration (temporal scale) (Table 19). **Consequence** is then determined as follows:

$$\text{Consequence} = \text{Severity} + \text{Spatial Scale} + \text{Duration}$$

The **likelihood** of the activity is then calculated based on the frequency of the activity and impact, how easily it can be detected, and whether the activity is governed by legislation. Thus:

$$\text{Likelihood} = \text{Frequency of activity} + \text{Frequency of impact} + \text{legal issues} + \text{detection}$$

The **risk** is then based on the consequence and likelihood.

$$\text{Risk} = \text{Consequence} \times \text{likelihood}$$

Environmental effects will be rated as either of high, moderate, or low significance on the basis provided in Table 20 below:

Table 20: Impact ratings

RATING	CLASS
1 – 55	(L) Low Risk
56 – 169	(M) Moderate Risk
170 - 600	(H) High Risk

6.3. Assessment of Significance

The significance of the impacts on biodiversity prior to and post mitigation is summarised in Table 21 below. Please note the full calculations of the impacts are available upon request.

Table 21: Summary table of the impacts on biodiversity prior to and post mitigation

Impact description					Significance before mitigation	Significance after mitigation	Mitigation measures	Action plan	Responsible person		
No.	Phases	Activity	Aspect	Impact							
1	Construction & Operations	Site clearing / preparation	Destruction and fragmentation of flora and fauna habitats in CBMAs 1 and 3. Isolation between terrestrial and aquatic habitats. Loss of vegetation.	Destruction and fragmentation of flora and fauna habitats in CBMAs 1 and 3. Isolation between terrestrial and aquatic habitats. Loss of vegetation.	-	M	-	L	STOP: No activities are to commence within riverine (+100m buffer) and wetland areas until the necessary authorisations are obtained under the National Water Act (NWA) and NEMA. No activities are to commence within the dolomitic grassland or within 300m buffer areas of <i>Pearsonia bracteata</i> and <i>Lithops lesliei</i> subsp. <i>lesliei</i> . TOPS and provincially protected plant species should be conserved in site as far as possible. A suitably qualified person (e.g. botanist / horticulturist) should survey the final layout within the growing season of the plants (summer months, preferably between November and February), in order to confirm whether these plants occur within the development footprint. The layout should be flexible to avoid these species where recorded. No TOPS plant species or provincially protected plant species should be removed without the required permit. All contractors should be aware of the protected species present on site and should undergo training in how to identify and relocate the protected plant species. No open fires are permitted. The grasses can be removed as sods and re-established after construction is completed. MODIFY: Areas designated as having low and moderate sensitivity in terms of fauna and flora should be considered for all activities rather than areas designated as highly sensitive where possible. Maintain areas as ecological corridors to provide fauna means for escape from development area. Any plant SCC should remain conserved in situ where possible. Implement a Plant Rescue and Rehabilitation Plan: Where the plants of conservation concern are deemed to be under threat from the construction activities, the plants should be removed (if it could survive this process) by a suitably qualified specialist and replanted as part of vegetation rehabilitation after the construction (Note, these plants may only be removed with the permission of the provincial authority). Relocation of plants SCC to similar habitats unaffected by the proposed activities should be considered and a relocation plan should be developed and submitted to the relevant authorities. Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area. Remove only the vegetation where essential for construction and do not	Refer to Biodiversity management and monitoring plan (Section 6.4)	Environmental Officer with access to necessary biodiversity specialists.



Impact description					Significance before mitigation	Significance after mitigation	Mitigation measures	Action plan	Responsible person
No.	Phases	Activity	Aspect	Impact					
							<p>allow any disturbance to the adjoining natural vegetation cover. Protect all areas susceptible to erosion (especially the sloped rocky grassland) and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas. Colonisation of the disturbed areas by plants species from the surrounding natural vegetation must be monitored to ensure that vegetation cover is sufficient within one growing season. If not, then the areas need to be rehabilitated with a grass seed mix containing species that naturally occur within the study area. Ecological corridors with a minimum width of 700m should be maintained with Wildebeespan, the Vaal River and highly sensitive terrestrial habitats, which must also consider regional ecological connectivity. Plan and implement a proper storm-water management plan from the onset at all activity areas, which must allow for controlled storm-water diversion and silt traps to prevent impact to surrounding areas. Slopes of the diversion trench must be shallow enough for fauna to cross. Any fencing or linear structures erected in areas of high and moderate sensitivity must provide for animal migration and unimpeded movement. The infrastructure proposed south of the existing TSF will limit east-west movement of fauna between two sensitive habitats and provision should be made to connect these two sensitive areas to the sensitive habitat further south of the RWDs and eucalyptus plantation or an ecological corridor established south of the fence line.</p> <p>CONTROL: Peg out and demarcate areas for development and no-go areas before commencing with any activities to prevent disturbance to areas not targeted for development and maintain indigenous habitat in these areas. Maintain all areas of physical disturbance as small and compact as possible to limit the area of disturbance.</p> <p>REMEDY: Where areas not targeted for development are inadvertently impacted and damaged, clear any material dumped and rehabilitate the site as soon as possible. After construction is completed, rehabilitate all areas no longer required for operational phase to a state similar to the local indigenous character of the area and ensure animals can move through and around new infrastructure areas unencumbered. No additional activity / development should be allowed outside that approved in the EMPr. Area must be regularly monitored and rehabilitated as needed and ecological connectivity maintained at all times.</p>		



Impact description					Significance before mitigation	Significance after mitigation	Mitigation measures	Action plan	Responsible person
No	Phases	Activity	Aspect	Impact					
2	Residual	Site clearing / preparation	Fragmentation of habitat and loss of ecological corridors	Fragmentation of habitat and loss of ecological corridors	- M	- L	Mitigations as stipulated for Impact (1) above must be implemented.	See Action Plan for Impact(1)	Environmental Officer with access to necessary biodiversity specialists.
3	All	All	Increased presence of people on site	Increased presence of people on site	- M	- M	<p>GENERAL NOTE: Identified TOPS will leave the area upon disturbance if unimpeded.</p> <p>STOP: No domestic animals (other than local stock animals) will be allowed on site; where absolutely necessary domestic animals will be adequately restrained and not be allowed to run freely on the property. Only contractors that have completed environmental awareness training, including the details of this report, are allowed to conduct activities on site. No deliberate killing or trapping of indigenous fauna is allowed on site, unless trapping is done by a specialist to remove the specimen from the area.</p> <p>CONTROL: Ensure all drivers and staff on site are informed of the importance of TOP species through environmental awareness training. Maintain speed limits that will allow for adequate response time to any animals that may wonder onto the road. Current speed limits of 40km/hr are adequate, but consideration should be given to reducing speed limits to 30km/hr near pans, wetlands and rocky areas.</p> <p>REMEDY: Should any indigenous fauna be trapped or killed by staff, appropriate reprimand/fine must be implemented. This must be specified in contractual agreements.</p>	Implement a monitoring plan for all TOPS confirmed on site and with a high likelihood to occur on site. Should monitoring indicate that aspects of the development are posing a risk to these species, then management must be adapted to protect these species.	EO
4	Construction & Operations	All	Exposure to fauna of dangerous areas, excavations and hazardous substances	Exposure to fauna of dangerous areas, excavations and hazardous substances	- M	- L	<p>GENERAL NOTE: Identified TOPS will leave the area if unimpeded.</p> <p>STOP: Only contractors that have completed environmental awareness training, including the details of this report, are allowed to conduct activities on site. No poisons against fauna are to be brought on site; where this is not possible any substance that could be toxic to fauna will be stored and handled in a manner that will prevent exposure of the substance to the environment and animals.</p> <p>MODIFY: Plan activities outside the breeding season of TOPS that are likely to occur on site. No overhead-lines will be erected in highly sensitive areas and any overhead-lines in moderately sensitive areas will be fitted with bird flappers. All activities should proceed in a linear manner as far as possible to provide fauna the opportunity to escape the area, rather than conducting activities in a manner that may result in fauna getting trapped</p>	Implement a monitoring plan for all TOPS confirmed on site and with a high likelihood to occur on site. Should monitoring indicate that aspects of the	EO



Impact description					Significance before mitigation	Significance after mitigation	Mitigation measures	Action plan	Responsible person		
No	Phases	Activity	Aspect	Impact							
							within the development footprint. CONTROL: Ensure all drivers and staff on site are informed of the importance of TOP species through environmental awareness training. REMEDY: Should any indigenous fauna be trapped within development / activity areas, activities will cease, and the necessary qualified and permitted specialists will be brought to site to trap and relocate the species. Where areas not targeted for development are inadvertently impacted and damaged, clear any material dumped and rehabilitate the site as soon as possible. After construction is completed, rehabilitate all areas no longer required for operational phase to a state similar to the local indigenous character of the area and ensure animals can move through and around new infrastructure areas unencumbered. No additional activity / development should be allowed outside that approved in the EMP. Area must be regularly monitored and rehabilitated as needed and ecological connectivity maintained at all times.	development are posing a risk to these species, then management must be adapted to protect these species.			
5	Residual	All	Any destruction of TOPS	Any destruction of TOPS	-	H	-	M	See mitigations measures for Impacts (1) and (3).	See Action Plan for Impacts (1) and (3).	EO
6	All	All	Dust, noise, human activity and emissions	Dust, noise, human activity and emissions	-	M	-	L	MODIFY: Utilise quieter equipment where feasible. CONTROL: Ensure dust suppression, through water sprinkling, is applied at time of high dust generation. Vegetate exposed soils. Any noisy point-sources utilised on site should be enclosed, and all equipment / machinery fitted with silencers where applicable. All equipment / machinery will be serviced and maintained within operating specifications to prevent excessive noise. Monitor and maintain radiation, dust, emissions and noise within applicable national standards and manage as per specialists' recommendations. Ensure environmental awareness training informs staff, contractors and visitors of noise, dust and vibration impacts on fauna.	Ensure monitoring plans in terms of the various "emissions" are applied as per specialist recommendations and apply necessary actions if issues arise.	EO
7	All	All	Introduction of AIS / exacerbation of existing AIS	Introduction of AIS / exacerbation of existing AIS	-	H	-	L	MODIFY: Maintain the highly sensitive areas and connectivity on site as far as possible. Maintaining and improving local indigenous populations could assist in reducing alien species numbers on site through competition and predation. Ensure the necessary permits are obtain for the establishment of declared AIS plantation for the passive treatment area. CONTROL: Compile and implement and alien invasive management plan in line with the municipal management plan, which must include measures to prevent attracting additional alien avifauna and mammals to site. This	Compile and implement and alien invasive management plan. Apply for permit for AIS plantation.	EO



Impact description					Significance before mitigation	Significance after mitigation	Mitigation measures	Action plan	Responsible person
No .	Phases	Activity	Aspect	Impact					
							should include not feeding wild life and ensuring that all food and food waste, including domestic waste, is placed in sealed containers and not exposed on site. REMEDY: Inspect outside areas regularly and clear all domestic and food waste from site.		
8	Residual	All	Introduction of AIS / exacerbation of existing AIS	Introduction of AIS / exacerbation of existing AIS	- M	- M	See mitigations measures for Impact (7)	See Action Plan for Impact (7)	EO
9	Construction & Operations	Spills (chemical, tailings, dirty water)	Contamination of fauna habitat. Loss of the plant soil seed bank	Contamination of fauna habitat. Loss of the plant soil seed bank	- M	- L	STOP: Construction and operation of TSF and RWDs can only commence once the authorisations under NEMA and NWA are obtained. Tailings and contaminated water can only be disposed to the TSF expansion area and RWDs when these sites and related infrastructure have been prepared as per approved engineered designs. Storm-water and mine water separation, containment and treatment will be established in the areas before any potential contaminating activities commence. Ensure emergency response procedures for spills from the TSF and RWD are in place before any activities commence, and ensure any equipment required for emergency response is readily and quickly available on site. CONTROL: Monitor and audit and address all issues identified immediately. REMEDY: implement emergency response procedures immediately should spills and leaks be noted, which must focus initially on containment and prevention of spread. Once safe to do so, initiate and complete clean-up as soon as possible.	Regularly monitor and audit (annual internal audit and annual external audit), the development of the TSF and operation of the RWDs against the engineered designs and codes of practice and in accordance with the EA and IWULA requirements	EO with qualified engineer



Impact description					Significance before mitigation	Significance after mitigation	Mitigation measures	Action plan	Responsible person		
No.	Phases	Activity	Aspect	Impact							
10	Construction & Operations	Hydrocarbon spills	Contamination of fauna habitat. Loss of the plant soil seed bank	Contamination of fauna habitat. Loss of the plant soil seed bank	-	M	-	L	<p>STOP: Discontinue use of all faulty machinery / equipment on site until properly repaired. Ensure a waste management plan has been compiled in line with the National Environmental Management: Waste Act (NEM:WA) highlighting handling and storage of various wastes on site, including used hydrocarbons, in line with prescribed standards before any activities commence on site.</p> <p>MODIFY: Hydrocarbons and hydrocarbon drums/cans/bottles, all hazardous substances and cement must in no way be exposed to the environmental elements at any stage of the development and facilities for storage must be provided before any substances are brought to site.</p> <p>CONTROL: All equipment / machinery will be serviced and maintained within a designated workshop area with hydrocarbon management and collection system. All equipment / machinery will be serviced and maintained within operating specifications to prevent the risks of leak. New and used hydrocarbons must be properly stored and handled according to prescribed manner to prevent spills onto bare ground. Any machinery or equipment parked on site will either be parked on a concrete slab or have pans placed under them to collect all drips and potential leaks.</p> <p>REMEDY: All hydrocarbons spills on bare ground will be cleared immediately. This will include the lifting of the contaminated soil for bioremediation or disposal to a hazardous waste facility.</p>	Continue to measure and monitor leaks of any hydrocarbons as well as chemicals as per current ISO system schedule.	EO
11	Cumulative	Spills (hydrocarbon, chemical, tailings, dirty water) & dumping of waste	Contamination and complete degradation of fauna habitat without remedy	Contamination and complete degradation of fauna habitat without remedy	-	H	-	L	see mitigations measures for Impacts (9) and (10)	See action plan for Impacts (9) and (10)	EO
12	Residual	Spills (hydrocarbon, chemical, tailings, dirty water), dumping of waste & radiation	Contamination and complete degradation of fauna habitat without remedy	Contamination and complete degradation of fauna habitat without remedy	-	H	-	L	see mitigations measures for Impacts (9) and (10)	See action plan for Impacts (9) and (10)	EO



Impact description					Significance before mitigation	Significance after mitigation	Mitigation measures	Action plan	Responsible person
No	Phases	Activity	Aspect	Impact					
13	Construction & Operations	Waste generation	Contamination of fauna habitat	Contamination of fauna habitat	- M	- L	<p>STOP: Ensure a waste management plan has been compiled in line with the National Environmental Management: Waste Act (NEM:WA) highlighting handling and storage of various wastes on site, in line with prescribed standards before any activities commence on site. Train staff and contractors on the waste management plan before allowing persons on site.</p> <p>MODIFY: Hydrocarbons and hydrocarbon drums/cans/bottles, all hazardous substances and cement must in no way be exposed to the environmental elements at any stage of the development and facilities for storage must be provided before any substances are brought to site.</p> <p>CONTROL: All waste (domestic, hydrocarbon, hazardous) must be managed in line with the prescribed waste management plan. Refuse bins with properly secured lids will be placed around site to collect waste for separation, recycling and disposal. Waste (domestic, construction, hazardous) should be recycled as far as possible and sold/given to interested contractors. Recyclable waste should not be stored for excessive periods. Waste will be stored according to the Norms and Standards for Storage of Waste.</p> <p>REMEDY: Inspect and clear all litter and waste from the site and surrounds.</p>	Implement and audit the Waste Management plan	EO
14	Construction & Operations	Septic tank operation	Contamination of fauna habitat	Contamination of fauna habitat	- M	- L	<p>MODIFY: Provide for adequate portable toilets for the number of staff on site, provide for male and female staff and keep all facilities outside the riverine and wetland buffer zones.</p> <p>CONTROL: Keep toilet facilities operational, clean and hygienic. Toilets and associated plumbing and septic tanks will be properly managed to prevent overflow and leaks.</p> <p>REMEDY: Repair and clean any sewage leaks immediately.</p>	Toilets and general plumbing will be regularly checked for leaks which will be attended to immediately.	EO
15	Decommissioning and Closure	Revegetation	Poor plant selection and habitat creation	Poor plant selection and habitat creation	- M	- M	<p>Rehabilitation and revegetation must be done in line with an approved closure and rehabilitation plan, which must include a plot plan for proposed plant species to be used in revegetation. Only local indigenous flora must be utilised in rehabilitation and mixed species must be utilised with the aim of obtaining habitat characteristics similar to the current state.</p>	Compile, implement and monitor the closure and rehabilitation plan and attend to any issues immediately.	EO



Impact description					Significance before mitigation	Significance after mitigation	Mitigation measures	Action plan	Responsible person
No .	Phases	Activity	Aspect	Impact					
16	All	All	Introduction of AIS plant species	Introduction of AIS plant species	- M	- L	<p>STOP: Train staff and contractors on the identification of AIS. Prepare and implement an AIS management plan prior to any construction activities. Ensure that prior to any site clearing all listed plant AIS are cleared and removed from site.</p> <p>MODIFY: Alien invasive species, in particular category 1 species that were identified within the study area should be removed from the development footprint and immediate surrounds, prior to construction or soil disturbances. By removing these species, the spread of seeds will be prevented into disturbed soils which could thus have a positive impact on the surrounding natural vegetation</p> <p>CONTROL: All construction vehicles and equipment, as well as construction material should be free of plant material. Therefore, all equipment and vehicles should be thoroughly cleaned prior to access on to the construction areas. This should be verified by the ECO.</p> <p>REMEDY: All alien seedlings and saplings must be removed as they become evident for the duration of construction.</p>	Compile and implement and alien invasive management plan. Apply for permit for AIS plantation.	EO



6.4. Biodiversity Management and Monitoring Planning

The objectives of the management plan are as follows:

- To prevent the unnecessary destruction of natural habitat and biodiversity within the development area and to maintain ecological connectivity to neighbouring sites and, where possible, to regional ecological corridors.
- Not to unnecessarily or deliberately alienate or hinder the movement of flora or fauna in the area or to harm any indigenous animal life found on the property.
- To maintain or improve existing indigenous biodiversity and prevent the skewing or drastic alteration of floral and faunal communities as far as possible.

The mitigation measures stipulated in the accompanying excel spreadsheet form the biodiversity management plan.

The following is a general summary highlighting the more important management aspects:

- The proposed fence (Figure 13) should be moved to exclude the southern highly sensitive area as this will disconnect the sensitive site which is utilised by wild cats (as a cautionary approach, *F. nigripes*) (See section 4.2).
- Approximate locations of ecological corridors that must be maintained in at least the current natural state are indicated in Figure 14. Corridor mapping considered connectivity between existing sensitive areas, rocky habitats, grassland habitats and wetland/riverine habitats. Flexibility is allowed in determining the actual final areas to be established as ecological corridors, but the following should be adhered to:
 - Consider the flora and wetland sensitivity plans and incorporate these areas as far as possible.
- Many of the more severe impacts to fauna habitat can be mitigated through properly planned construction, good design, frequent monitoring/auditing, good house-keeping practices during operations and decommissioning and proper rehabilitation and revegetation of the affected site.
- Some impacts identified are related to contractor and staff activity on site. Human behaviour is not easy to manage, but providing the relevant information and motivation as stipulated in the mitigation measures through environmental awareness and re-iterating the information frequently should inform people active on site of the importance in conserving fauna on site.
- The specific mitigation measures within the accompanying excel spreadsheet should be incorporated into the final EMP.

The Biodiversity Management Plan (Clean Stream, 2015) also stipulates specific measures for CBMAs to maintain and improve biodiversity. Measures include:

- Allow grazing of the CBMAs at conservative stocking rates and develop and implement a controlled burning programme.



- Prevent the unauthorised and uncontrolled grazing of livestock that is currently occurring within the northern parts of CBMA 1.
- Implement an integrated alien plant control programme as per the recommendations of the Alien Plant report for the study area prepared by Clean Stream (De Castro & Brits, July 2015).
- Control access to the CBMAs in order to prevent illegal harvesting of medicinal and horticultural plants, the cutting of trees and shrubs for fuel wood and construction material, and the hunting, persecution and disturbance of animals.
- Implement annual monitoring for the two Near Threatened and four Declining plant species thus far recorded within the study area. The four recorded Declining plant species are all medicinal plants and are therefore considered good indicators of medicinal plant harvesting pressure in the study area (i.e. *Boophone disticha*, *Crinum bulbispermum*, *Eucomis autumnalis* and *Hypoxis hemerocallidea*).
- Prevent the establishment of roads, pipelines and other infrastructure within CBMA's without prior approval by the Biodiversity and Heritage section of the mines Environmental Department.
- Prevent the isolation of the CBMAs through use of fencing that does not constitute a barrier to the movement of small and medium mammals and reptiles. Razor wire security fencing should not be used.

A monitoring plan must be implemented in order to ensure mitigation measures are effective. With monitoring, an adaptive management approach must be applied. The benefits of monitoring and adaptive management include:

- Saving costs by discontinuation of non-effective measures.
- Higher success in environmental impact management through application of more effective management measures targeting specific identified impacts.

The monitoring plan is highlighted in Table 22.

It must be kept in mind that activities related to biodiversity may be further restricted under provincial legislation [North West biodiversity Management Act (Act No. 4 of 2016)] and these should be carefully consulted to ensure that necessary provincial permits are obtained to undertake necessary activities (trapping, catching, releasing fauna that may get trapped in the development area for example) where needed.

An Environmental Officer (EO) must be appointed to ensure activities are in line with EMP requirements, including the mitigation measures stipulated within this report. Inspection, records of issues and corrective measures and sign-off will form part of the EO's responsibilities.

6.4.1. *Invasive species*

Alien species are already present on site. The Alien and Invasive Species Regulations published under GNR598 of 2014 details the various categories for alien and invasive species, including:

- Category 1a Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of NEM:BA as species which must be eradicated.
- Category 1b Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of NEM:BA as species which must be controlled.
- Category 2 Listed Invasive Species are those species listed by notice in terms of section 70(1)(a) of NEM:BA as species which require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be. If there is no permit for these species then they are to be treated as Category 1 species.
- Category 3 Listed Invasive Species are species that are listed by notice in terms of section 70(1)(a) of NEM:BA, as species which are subject to exemptions (regarding possession of such species) in terms of section 71(3) and prohibitions (importing, transporting, handling, breeding, releasing) in terms of section 71A of Act, as specified in the Notice.

In terms of the findings of this study, only Category 3 alien invasive fauna species were identified on site (the Common Myna and House Sparrow). These specific bird species have extensive distributions in South Africa, are closely related to human settlements and no proper control programmes have been implemented in South Africa as yet (Picker & Griffiths, 2011). Extensive populations of these birds were not observed on site, but populations must be monitored and controlled in line with the Municipal Control Plan. Category 1b, 2 and 3 listed plant species were recorded within the study area as per section 5.2.1 these plants should be removed prior to any construction occurs to avoid further spread of these species.

Table 22: Monitoring plan

MONITORING ACTION	RESPONSIBLE PERSON	FREQUENCY
Ensure all proposed mitigation measures detailing proposed activity modifications have been fully considered and incorporated into the final design plan and operational procedures and sign off on final plans and procedures. This includes the final layout of proposed ecological corridors which will be maintained as no-go areas.	Environmental officer (EO)	Once-off
Ensure the following documents have been compiled prior to related activities commencing on site: 1) Emergency response procedures which must include the containment and prevention of spread of leaks from the TSF, RWDs and hydrocarbon storage areas. 2) Waste handling, storage and disposal in line with NEM:WA requirements.	EO	Once-off
Inspect servicing, maintenance and calibration (where needed) records of all vehicles, machinery and equipment on site to keep these up-to-date.	EO	Before brought to site and then every 3 months.
Inspect and sign-off on placement of demarcation pegs marking out activity areas and no-go areas.	EO	Once-off
Monitor construction activities to ensure they are within the designated areas.	EO	Weekly
Monitor construction activities to ensure they are outside of all buffer areas and do not affect any TOPS species or provincially protected plants unless permits have been obtained.	EO	Weekly
Monitor if dust fall out has an effect on the populations of sensitive species and the 300m buffer recommended for the populations of <i>Pearsonia bracteata</i> and <i>Lithops lesliei</i> subsp. <i>lesliei</i> sufficiently protects the species. Additionally, The TOPS listed <i>Vachellia erioloba</i> populations as well as any provincially protected plant species conserved in situ should be monitored. Fixed point photography points should be set up prior to construction and photographic records should be kept. If any deterioration is noted a botanist or SANBI should be contacted and the Provincial authorities should be notified.	EO	Weekly
Monitor and control the spread of Invasive species.	EO	Weekly
Monitor TSF and RWD development and operation to ensure these are to the specification of the approved engineered designs.	On-site engineer and EO	At least monthly.
The area should be visually monitored for the presence and extent of confirmed TOP species and those with a high likelihood of occurring on site and apply adaptive management as needed to reduce negative impact on these species.	EO	Daily
Inspect natural areas and CBMAs and areas around infrastructure areas and ensure these are in a natural state with no dumping, excavations, obstructions to fauna mobility.	EO	Weekly
Noise & dust should be maintained within national standards.	EO	As stipulated in authorisations
EO must ensure the following is managed in accordance with the EMPr and operational procedures: 1) Litter, waste, hydrocarbon spills, cement spills, sewage leaks on site and to the surrounding areas. 2) Food and food-waste handling. 3) Damage or disturbance to neighbouring areas not targeted for development. 4) State of portable toilets and ablution facilities on site. 5) Hydrocarbon storage and handling area. 6) Cement storage and handling practices on site. 7) Refuse bins and waste storage area.	EO to appoint on-site person	Daily, at close of day.
Apply monitoring and auditing requirements stipulated in NWA & NEMA authorisations as relevant.	EO	As stipulated in the authorisations
Audit the TSF and RWD operation in relation to approved engineer designs and operating procedures. It is highly recommended to complete an internal and external audit annually and complete these every 6 months.	EO	Annual internal audit & annual external audit

7. Conclusions and Recommendations

The project area is classified as a Critical Biodiversity Area 2, as well as Ecological Support Areas 1 and 2, based on the North West Biodiversity Sector Plan.

The type and extent of the proposed activities coupled with the overall status of the sites to be affected are not expected to have extremely detrimental effects on the overall ecological character as long as mitigation measures are implemented. Due to the high faunal assemblages in the area (albeit a game farm), and the variety of habitats and micro-habitats on site, the area is largely designated as highly sensitive in terms of terrestrial fauna. In terms of flora the largest sections of the study area are considered to be of moderate sensitivity, however three highly sensitive communities were identified. Two near threatened plant species were observed during the site visit the proposed footprint area does currently not affect the two species apart from the expected increase in dust as a result of construction activities as well as the larger surface area of the TSF during the operational phase. The management plan proposes recommendations to maintain a sample of sensitive habitats and connectivity between these habitats to retain and manage biodiversity on site. Where required, the necessary permits to relocate TOPS and provincially protected plants must be obtained prior to construction.

The management and monitoring plan outlined in this report must be implemented to ensure overall impact significance to terrestrial fauna stays low to moderate. All measures must be applied, but of particular importance are the following:

- The proposed fence (Figure 13) should be moved to exclude the southern highly sensitive area as this will disconnect the sensitive site which is utilised by wild cats (as a cautionary approach, *F. nigripes*) (See section 4.2).
- The proposed fence should also be re-aligned to exclude the sensitive dolomitic grassland community in the northern section of the study area.
- Where identified ecological corridors intersect the proposed operational areas / properties, consideration should be given to refrain from developing or fencing off these areas.
- Many of the more severe impacts to biodiversity can be mitigated through properly designed construction, frequent monitoring/auditing and associated good house-keeping practices during operations and decommissioning and proper rehabilitation and revegetation of the affected site.
- Some impacts identified are related to contractor and staff activity on site. Human behaviour is not as easy to manage, but providing the relevant information and motivation as stipulated in the

mitigation measures through environmental awareness and re-iterating the information frequently should inform people active on site of the importance in conserving fauna on site.

- The specific mitigation measures within the accompanying excel spreadsheet should be incorporated into the final EMPr.
- No activities are to commence within riverine and wetland areas (+100m buffer / 1:100 year flood-line) until the necessary authorisations are obtained under the National Water Act (NWA) and NEMA. This is of particular relevance to the RWDs.

All conditions in the Water Use License and Environmental Authorisations must be complied with and audited as required.

8. Professional opinion

A professional opinion is required as per the NEMA regulations with regards to the proposed development. The study area contains sensitive habitats as well as Red listed and TOP species. It is advised that the proposed expansion of the TSF as well as associated activities should be considered for approval with caution. It is imperative that this report together with the reports compiled by De Castro & Brits (2017), Deacon (2017) and Limosella (2019) should be collectively considered when making the decision of approving the proposed activities. Should the proposed activities be approved it is important that all mitigation measures as well as the monitoring and management plan should be applied. All contractors involved should receive a copy of the management and monitoring plans as well as impacts and mitigation measures prior to the commencement of any construction activities.

9. Limitations

The entire footprint area for the proposed TSF expansion and associated infrastructure was not surveyed in this report as a recent study by De Castro & Brits (2017) and Deacon (2017) covered the middle section of the proposed activities. It is therefore important to note that both this and the De Castro & Brits (2017) report should be used when determining the sensitivity of the area, impacts, associated mitigation and management measures.

Specialist studies are conducted to certain levels of confidence, and in all instances known and accepted methodologies have been used and confidence levels are generally high. This means that in most cases the



situation described in the report is accurate at high certainty levels, but there exists a low probability that some aspects have not been identified during the studies. Such situations cannot be avoided simply due to the nature of field work and have therefore not been further discussed below.

In situations where species sampling or sensitive site assessment is conducted (such as is completed for this fauna assessment), it must be understood that time limitation and conditions on site means that not all species can be identified / sites can be discovered during the surveys. Again, as accepted methodologies are used, this is not deemed to be a fatal flaw, but must be considered.

There are inherent errors in GPS and mapping programmes which must be considered with all mapping information presented.

Impact assessment is a predictive tool to identify aspects of a development that need to be prevented, altered or controlled in a manner to reduce the impact to the receiving environment, or determine where remediation activities will need to be incorporated into the overall development/activity plan. This does not mean that the impact will occur at the predicted significance, but provides guidance on the formulation of the management and monitoring requirements which need to be incorporated to prevent/reduce/manage the impact.

Citizen Science projects were used for bird (SABAP2) and animal (ADU) baseline data. When utilising data from Citizen Science projects, the following must be kept in mind:

- Public interest in sites may be fickle, and may wane and increase, which could have a direct effect on the number of records available and therefore the number of species recorded.
- Populated areas or popular tourist destinations may have more participants and therefore higher biodiversity data than less populated areas.
- Misidentification of species by the public cannot be excluded but is not seen as a major problem as this is likely to be a consistent issue from year to year, and a degree of vetting does take place.
- It must also be considered that animals observed in captivity may be recorded by citizens. Such animals should not be considered part of the natural biodiversity but as the data provided by citizen science sites do not make such distinctions, it cannot be separated from the biodiversity data presented in this report.

Specific limitations relevant to this study in terms of fauna are as follows:

- In general site conditions were good for fauna surveying. Other than some areas of very dense vegetation which limited fauna surveying, the only limitations were general field work limitations discussed above.



Vegetation studies should be conducted during the growing season of all plant species that may potentially occur. This may require more than one season's survey with two visits undertaken preferably during November and February. Plant species resprouting from storage tubers (geophytes) will take advantage of the first rains, stored reserves and low grass cover after the dry season to grow and flower during summer (December to March) and then die back. Herbs, forbs, and grasses first need adequate rainfall before being able to fully grow and flower between February and April. Most of the geophytes, forbs, succulents, and grasses can only be fully identified if they are actively growing and have either flowers or fruit. Rainfall prior to both the November as well as February site visit was limited. This could affect the species diversity especially in the grass – herb layer. Prior to the November site visit a fire event affected large sections of the vegetation.

Soil maps were not available to the specialist at the time of compiling this report. The soil properties were determined in field only by observation. Soil analysis is outside the field of expertise of the specialist.

The wetland communities were mapped and identified according to the wetland delineation conducted by Limosella Consulting (2019). Please consult the wetland report for more information related to wetlands within and around the study area (Limosella, 2019).

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. To obtain a comprehensive understanding of the dynamics of an ecosystem in an area, ecological assessments should always consider investigations at different time scales (across seasons/years) and through replication, as ecosystems are in constant change.

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10.2. Internet sources

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- <http://www.iucnredlist.org>: For the IUCN Red List status of species in 2016.
- <http://redlist.sanbi.org/>: For checking national conservation status of plants, common names and levels of endemism.
- <http://pza.sanbi.org/>: For identification of plant species.
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- Citations from the site includes:

Animal Demography Unit (2017). MammalMAP Virtual Museum. Accessed at <http://vmus.adu.org.za/?vm=MammalMAP> on 2018-10-31.

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Assumptions

- All information provided to ISS was accurate and up to date.
- The position of study site and proposed infrastructure was accurate and up to date.

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Annexure A: Expected Mammal Species



Animal Demography Unit
Virtual Museum

MammalMAP – Virtual Museum of African Mammals

46 species found for locus = 2626DD
Date filter: Year collected/observed >= 2007

Species code	Family	Scientific name	Common name	Red list category	Number of QDSs	Number of records	Last recorded
151470	Bathyergidae	Cryptomys hottentotus	Southern African Mole-rat	Least Concern (2016)	1	1	2013-05-1
211850	Bovidae	Aepyceros melampus	Impala	Least Concern	1	13	2017-01-0
211920	Bovidae	Alcelaphus buselaphus	Hartebeest		1	4	2013-05-2
211990	Bovidae	Alcelaphus buselaphus caama	Red Hartebeest	Least Concern ver 3.1, 2008	1	1	2013-05-2
212190	Bovidae	Antidorcas marsupialis	Springbok	Least Concern (2016)	1	5	2013-06-0
212040	Bovidae	Connochaetes taurinus taurinus		Least Concern (2016)	1	4	2013-06-0
212160	Bovidae	Damaliscus pygargus phillipsi	Blesbok	Least Concern (2016)	1	2	2013-05-0
212150	Bovidae	Damaliscus pygargus pygargus	Bontebok	Vulnerable (2016)	1	1	2016-05-1
216040	Bovidae	Kobus ellipsiprymnus	Waterbuck		1	2	2018-05-0
216050	Bovidae	Kobus ellipsiprymnus ellipsiprymnus		Least Concern (2016)	1	2	2013-05-3
216020	Bovidae	Oryx gazella	Gemsbok	Least Concern (2016)	1	4	2017-12-0
213320	Bovidae	Raphicerus campestris	Steenbok	Least Concern (2016)	1	7	2014-08-0
215700	Bovidae	Sylvicapra grimmia	Bush Duiker	Least Concern (2016)	1	5	2018-05-0
213760	Bovidae	Syncerus caffer	African Buffalo	Least Concern	1	4	2013-05-2
213850	Bovidae	Taurotragus oryx	Common Eland	Least Concern (2016)	1	5	2013-06-0
213930	Bovidae	Tragelaphus angasii	Nyala	Least Concern (2016)	1	1	2013-04-0
214120	Bovidae	Tragelaphus strepsiceros	Greater Kudu	Least Concern (2016)	1	4	2013-06-0
208510	Camelidae	Camelus dromedarius	One-humped Camel		1	1	2018-02-2
198600	Canidae	Canis mesomelas	Black-backed Jackal	Least Concern (2016)	1	11	2013-06-0
113300	Cercopithecidae	Chlorocebus pygerythrus	Vervet Monkey	Least Concern (2016)	1	9	2018-09-0
113310	Cercopithecidae	Chlorocebus pygerythrus pygerythrus	Vervet Monkey (subspecies pygerythrus)		1	2	2013-06-0
207010	Equidae	Equus quagga	Plains Zebra	Least Concern (2016)	1	4	2016-04-2
191810	Felidae	Felis catus	Domestic Cat	Introduced	1	1	2013-05-3
211780	Giraffidae	Giraffa camelopardalis camelopardalis	Nubian Giraffe	Least Concern	1	1	2013-04-3
195840	Herpestidae	Atilax paludinosus	Marsh Mongoose	Least Concern (2016)	1	1	2013-08-1
196100	Herpestidae	Cynictis penicillata	Yellow Mongoose	Least Concern (2016)	1	10	2018-08-2
196340	Herpestidae	Herpestes sanguineus	Slender Mongoose	Least Concern (2016)	1	6	2018-02-2
197700	Herpestidae	Suricata suricatta	Meerkat	Least Concern (2016)	1	1	2013-05-1
197770	Hyaenidae	Proteles cristata	Aardwolf	Least Concern (2016)	1	1	2013-05-1
151730	Hystriidae	Hystrix africaeaustralis	Cape Porcupine	Least Concern	1	7	2013-06-0
157259	Leporidae	Lepus sp.	Hares		1	8	2013-06-0
157560	Leporidae	Lepus capensis	Cape Hare	Least Concern	1	8	2013-05-3
158240	Leporidae	Lepus saxatilis	Scrub Hare	Least Concern	1	6	2013-05-3
106410	Macroscelididae	Elephantulus myurus	Eastern Rock Elephant Shrew	Least Concern (2016)	1	1	2013-04-2
217970	Muridae	Aethomys namaquensis	Namaqua Rock Mouse	Least Concern	1	2	2013-05-1
218030	Muridae	Gerbilliscus leucogaster	Bushveld Gerbil	Least Concern (2016)	1	3	2013-05-1
147479	Muridae	Mastomys sp.	Multimammate Mice		1	7	2013-05-1
150360	Muridae	Rhabdomys pumilio	Xeric Four-striped Grass Rat	Least Concern (2016)	1	1	2013-05-1
201180	Mustelidae	Aonyx capensis	African Clawless Otter	Near Threatened (2016)	1	2	2018-03-1
151320	Pedetidae	Pedetes capensis	South African Spring Hare	Least Concern (2016)	1	2	2013-05-1
107300	Procaviidae	Procavia capensis	Cape Rock Hyrax	Least Concern (2016)	1	2	2016-10-0
122610	Sciuridae	Xerus inauris	South African Ground Squirrel	Least Concern	1	10	2016-10-0
207690	Suidae	Phacochoerus africanus	Common Warthog	Least Concern (2016)	1	1	2013-05-1
217740	Viveridae	Genetta maculata	Common Large-spotted Genet	Least Concern	1	1	2013-05-2
195120	Viverridae	Genetta genetta	Common Genet	Least Concern (2016)	1	1	2016-02-0
195300	Viverridae	Genetta tigrina	Cape Genet	Least Concern (2016)	1	7	2013-08-0
Total					46	182	2013-06-0: 2013-05-30

* median date of last recorded date

** median date for all records identified to species or subspecies level

Red listing source:

Child MF, Roxburgh L, Do Linh San E, Raimondo D, Davies-Mostert HT, editors. 2016. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

NB: the following taxa have been omitted from the database query to produce the list above:

Rhinocerotidae: FAMILY Rhinocerotidae (Unidentified Rhinoceros),



Rhinocerotidae: *Diceros* sp. (Black Rhinoceros),

Rhinocerotidae: *Diceros bicornis minor* (Black Rhinoceros), Endangered (2016)

Rhinocerotidae: *Diceros bicornis bicornis* (Black Rhinoceros - arid ecotype), Endangered (2016)

Rhinocerotidae: *Diceros bicornis* (Black Rhinoceros), Critically Endangered

Rhinocerotidae: *Ceratotherium* sp. (),

Rhinocerotidae: *Ceratotherium simum* (White Rhinoceros), Near Threatened

Leporidae: FAMILY Leporidae (Unidentified Leporidae),

ID pending record(s) for this locus: 0

Citation: Animal Demography Unit (2018). MammalMAP Virtual Museum. Accessed at <http://vmus.adu.org.za/?vm=MammalMAP> on 2018-11-19

[Page served: November 19, 2018, 12:24 +0200]

Animal Demography Unit & FitzPatrick Institute of African Ornithology
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Annexure B: Expected Avifaunal Species

COMMON NAME	SCIENTIFIC NAME
Sparrowhawk, Black	<i>Accipiter melanoleucus</i>
Sparrowhawk, Little	<i>Accipiter minullus</i>
Sparrowhawk, Ovambo	<i>Accipiter ovampensis</i>
Myna, Common	<i>Acridotheres tristis</i>
Reed-warbler, Great	<i>Acrocephalus arundinaceus</i>
Reed-warbler, African	<i>Acrocephalus baeticatus</i>
Swamp-warbler, Lesser	<i>Acrocephalus gracilirostris</i>
Warbler, Marsh	<i>Acrocephalus palustris</i>
Warbler, Sedge	<i>Acrocephalus schoenobaenus</i>
Sandpiper, Common	<i>Actitis hypoleucos</i>
Jacana, African	<i>Actophilornis africanus</i>
Korhaan, Northern Black	<i>Afrotis afraoides</i>
Kingfisher, Malachite	<i>Alcedo cristata</i>
Goose, Egyptian	<i>Alopochen aegyptiacus</i>
Finch, Red-headed	<i>Amadina erythrocephala</i>
Waxbill, Orange-breasted	<i>Amandava subflava</i>
Crake, Black	<i>Amaurornis flavirostris</i>
Weaver, Thick-billed	<i>Amblyospiza albifrons</i>
Teal, Cape	<i>Anas capensis</i>
Teal, Red-billed	<i>Anas erythrorhyncha</i>
Teal, Hottentot	<i>Anas hottentota</i>
Duck, Mallard	<i>Anas platyrhynchos</i>
Shoveler, Cape	<i>Anas smithii</i>
Duck, African Black	<i>Anas sparsa</i>
Duck, Yellow-billed	<i>Anas undulata</i>
Darter, African	<i>Anhinga rufa</i>
Goose, Domestic	<i>Anser anser</i>
Pipit, African	<i>Anthus cinnamomeus</i>
Pipit, Plain-backed	<i>Anthus leucophrys</i>
Pipit, Long-billed	<i>Anthus similis</i>
Pipit, Buffy	<i>Anthus vaalensis</i>
Apalis, Bar-throated	<i>Apalis thoracica</i>
Swift, Little	<i>Apus affinis</i>
Swift, Common	<i>Apus apus</i>
Swift, African Black	<i>Apus barbatus</i>
Swift, White-rumped	<i>Apus caffer</i>
Swift, Horus	<i>Apus horus</i>
Eagle, Booted	<i>Aquila pennatus</i>
Heron, Grey	<i>Ardea cinerea</i>
Heron, Goliath	<i>Ardea goliath</i>
Heron, Black-headed	<i>Ardea melanocephala</i>
Heron, Purple	<i>Ardea purpurea</i>
Heron, Squacco	<i>Ardeola ralloides</i>
Owl, Marsh	<i>Asio capensis</i>
Hawk, African Cuckoo	<i>Aviceda cuculoides</i>
Batis, Chinspot	<i>Batis molitor</i>
Batis, Pririt	<i>Batis pririt</i>

COMMON NAME	SCIENTIFIC NAME
Ibis, Hadedda	<i>Bostrychia hagedash</i>
Flycatcher, Marico	<i>Bradornis mariquensis</i>
Rush-warbler, Little	<i>Bradypterus baboecala</i>
Eagle-owl, Spotted	<i>Bubo africanus</i>
Egret, Cattle	<i>Bubulcus ibis</i>
Oxpecker, Red-billed	<i>Buphagus erythrorhynchus</i>
Thick-knee, Spotted	<i>Burhinus capensis</i>
Buzzard, Steppe	<i>Buteo vulpinus</i>
Heron, Green-backed	<i>Butorides striata</i>
Lark, Red-capped	<i>Calandrella cinerea</i>
Lark, Sabota	<i>Calendulauda sabota</i>
Sandpiper, Curlew	<i>Calidris ferruginea</i>
Stint, Little	<i>Calidris minuta</i>
Woodpecker, Golden-tailed	<i>Campethera abingoni</i>
Coucal, Burchell's	<i>Centropus burchellii</i>
Chat, Familiar	<i>Cercomela familiaris</i>
Scrub-robin, White-browed	<i>Cercotrichas leucophrys</i>
Scrub-robin, Kalahari	<i>Cercotrichas paena</i>
Lark, Eastern Long-billed	<i>Certhilauda semitorquata</i>
Kingfisher, Pied	<i>Ceryle rudis</i>
Sunbird, Amethyst	<i>Chalcomitra amethystina</i>
Plover, Kittlitz's	<i>Charadrius pecuarius</i>
Plover, Three-banded	<i>Charadrius tricollaris</i>
Lark, Spike-heeled	<i>Chersomanes albofasciata</i>
Tern, Whiskered	<i>Chlidonias hybrida</i>
Tern, White-winged	<i>Chlidonias leucopterus</i>
Cuckoo, Diderick	<i>Chrysococcyx caprius</i>
Cuckoo, Klaas's	<i>Chrysococcyx klaas</i>
Stork, Abdim's	<i>Ciconia abdimii</i>
Sunbird, White-bellied	<i>Cinnyris talatala</i>
Marsh-harrier, African	<i>Circus ranivorus</i>
Cisticola, Desert	<i>Cisticola aridulus</i>
Cisticola, Wing-snapping	<i>Cisticola ayresii</i>
Cisticola, Rattling	<i>Cisticola chiniana</i>
Neddicky, Neddicky	<i>Cisticola fulvicapilla</i>
Cisticola, Zitting	<i>Cisticola juncidis</i>
Cisticola, Wailing	<i>Cisticola lais</i>
Cisticola, Cloud	<i>Cisticola textrix</i>
Cisticola, Levallant's	<i>Cisticola tinniens</i>
Cuckoo, Jacobin	<i>Clamator jacobinus</i>
Mousebird, White-backed	<i>Colius colius</i>
Mousebird, Speckled	<i>Colius striatus</i>
Pigeon, Speckled	<i>Columba guinea</i>
Dove, Rock	<i>Columba livia</i>
Roller, Lilac-breasted	<i>Coracias caudatus</i>
Roller, European	<i>Coracias garrulus</i>
Crow, Pied	<i>Corvus albus</i>
Go-away-bird, Grey	<i>Corythaixoides concolor</i>
Robin-chat, Cape	<i>Cossypha caffra</i>
Robin-chat, White-throated	<i>Cossypha humeralis</i>

COMMON NAME	SCIENTIFIC NAME
Quail, Common	<i>Coturnix coturnix</i>
Starling, Wattled	<i>Creatophora cinerea</i>
Crake, African	<i>Crecopsis egregia</i>
Canary, Black-throated	<i>Crithagra atrogularis</i>
Canary, Yellow	<i>Crithagra flaviventris</i>
Seedeater, Streaky-headed	<i>Crithagra gularis</i>
Canary, Yellow-fronted	<i>Crithagra mozambicus</i>
Cuckoo, Red-chested	<i>Cuculus solitarius</i>
Cursorer, Temminck's	<i>Cursorius temminckii</i>
Palm-swift, African	<i>Cypsiurus parvus</i>
House-martin, Common	<i>Delichon urbicum</i>
Duck, Fulvous	<i>Dendrocygna bicolor</i>
Duck, White-faced	<i>Dendrocygna viduata</i>
Woodpecker, Cardinal	<i>Dendropicos fuscescens</i>
Puffback, Black-backed	<i>Dryoscopus cubla</i>
Egret, Great	<i>Egretta alba</i>
Heron, Black	<i>Egretta ardesiaca</i>
Egret, Little	<i>Egretta garzetta</i>
Egret, Yellow-billed	<i>Egretta intermedia</i>
Kite, Black-shouldered	<i>Elanus caeruleus</i>
Bunting, Cape	<i>Emberiza capensis</i>
Bunting, Golden-breasted	<i>Emberiza flaviventris</i>
Bunting, Cinnamon-breasted	<i>Emberiza tahapisi</i>
Eremomela, Yellow-bellied	<i>Eremomela icteropygialis</i>
Sparrowlark, Chestnut-backed	<i>Eremopterix leucotis</i>
Sparrowlark, Grey-backed	<i>Eremopterix verticalis</i>
Waxbill, Common	<i>Estrilda astrild</i>
Waxbill, Black-faced	<i>Estrilda erythronotos</i>
Bishop, Yellow-crowned	<i>Euplectes afer</i>
Widowbird, White-winged	<i>Euplectes albonotatus</i>
Widowbird, Red-collared	<i>Euplectes ardens</i>
Bishop, Southern Red	<i>Euplectes orix</i>
Widowbird, Long-tailed	<i>Euplectes progne</i>
Falcon, Amur	<i>Falco amurensis</i>
Falcon, Lanner	<i>Falco biarmicus</i>
Kestrel, Lesser	<i>Falco naumanni</i>
Falcon, Peregrine	<i>Falco peregrinus</i>
Kestrel, Greater	<i>Falco rupicoloides</i>
Kestrel, Rock	<i>Falco rupicolus</i>
Coot, Red-knobbed	<i>Fulica cristata</i>
Snipe, African	<i>Gallinago nigripennis</i>
Moorhen, Common	<i>Gallinula chloropus</i>
Pratincole, Black-winged	<i>Glareola nordmanni</i>
Waxbill, Violet-eared	<i>Granatina granatina</i>
Kingfisher, Brown-hooded	<i>Halcyon albiventris</i>
Kingfisher, Woodland	<i>Halcyon senegalensis</i>
Fish-eagle, African	<i>Haliaeetus vocifer</i>
Stilt, Black-winged	<i>Himantopus himantopus</i>
Warbler, Icterine	<i>Hippolais icterina</i>
Swallow, Lesser Striped	<i>Hirundo abyssinica</i>

COMMON NAME	SCIENTIFIC NAME
Swallow, White-throated	<i>Hirundo albigularis</i>
Swallow, Greater Striped	<i>Hirundo cucullata</i>
Martin, Rock	<i>Hirundo fuligula</i>
Swallow, Barn	<i>Hirundo rustica</i>
Swallow, Red-breasted	<i>Hirundo semirufa</i>
Cliff-swallow, South African	<i>Hirundo spilodera</i>
Honeyguide, Greater	<i>Indicator indicator</i>
Honeyguide, Lesser	<i>Indicator minor</i>
Bittern, Little	<i>Ixobrychus minutus</i>
Wryneck, Red-throated	<i>Jynx ruficollis</i>
Firefinch, Jameson's	<i>Lagonosticta rhodopareia</i>
Firefinch, African	<i>Lagonosticta rubricata</i>
Firefinch, Red-billed	<i>Lagonosticta senegala</i>
Starling, Cape Glossy	<i>Lamprotornis nitens</i>
Shrike, Crimson-breasted	<i>Laniarius atrococcineus</i>
Fiscal, Common (Southern)	<i>Lanius collaris</i>
Shrike, Red-backed	<i>Lanius collurio</i>
Shrike, Lesser Grey	<i>Lanius minor</i>
Gull, Grey-headed	<i>Larus cirrocephalus</i>
Eagle, Long-crested	<i>Lophaetus occipitalis</i>
Barbet, Black-collared	<i>Lybius torquatus</i>
Longclaw, Cape	<i>Macronyx capensis</i>
Kingfisher, Giant	<i>Megaceryle maximus</i>
Goshawk, Southern Pale Chanting	<i>Melierax canorus</i>
Goshawk, Gabar	<i>Melierax gabar</i>
Bee-eater, European	<i>Merops apiaster</i>
Bee-eater, White-fronted	<i>Merops bullockoides</i>
Bee-eater, Swallow-tailed	<i>Merops hirundineus</i>
Bee-eater, Little	<i>Merops pusillus</i>
Kite, Yellow-billed	<i>Milvus aegyptius</i>
Lark, Rufous-naped	<i>Mirafra africana</i>
Lark, Melodious	<i>Mirafra cheniana</i>
Lark, Eastern Clapper	<i>Mirafra fasciolata</i>
Wagtail, African Pied	<i>Motacilla aguimp</i>
Wagtail, Cape	<i>Motacilla capensis</i>
Wagtail, Yellow	<i>Motacilla flava</i>
Flycatcher, Spotted	<i>Muscicapa striata</i>
Stork, Yellow-billed	<i>Mycteria ibis</i>
Chat, Anteating	<i>Myrmecocichla formicivora</i>
Sunbird, Malachite	<i>Nectarinia famosa</i>
Pochard, Southern	<i>Netta erythrophthalma</i>
Brubru, Brubru	<i>Nilaus afer</i>
Guineafowl, Helmeted	<i>Numida meleagris</i>
Night-Heron, Black-crowned	<i>Nycticorax nycticorax</i>
Dove, Namaqua	<i>Oena capensis</i>
Wheatear, Mountain	<i>Oenanthe monticola</i>
Wheatear, Capped	<i>Oenanthe pileata</i>
Quailfinch, African	<i>Ortygospiza atricollis</i>
Tit-babbler, Chestnut-vented	<i>Parisoma subcaeruleum</i>
Tit, Ashy	<i>Parus cinerascens</i>

COMMON NAME	SCIENTIFIC NAME
Sparrow, Southern Grey-headed	<i>Passer diffusus</i>
Sparrow, House	<i>Passer domesticus</i>
Sparrow, Cape	<i>Passer melanurus</i>
Peacock, Common	<i>Pavo cristatus</i>
Honey-buzzard, European	<i>Pernis apivorus</i>
Petronia, Yellow-throated	<i>Petronia superciliaris</i>
Cormorant, Reed	<i>Phalacrocorax africanus</i>
Cormorant, White-breasted	<i>Phalacrocorax carbo</i>
Ruff, Ruff	<i>Philomachus pugnax</i>
Flamingo, Lesser	<i>Phoenicopterus minor</i>
Wood-hoopoe, Green	<i>Phoeniculus purpureus</i>
Warbler, Willow	<i>Phylloscopus trochilus</i>
Spoonbill, African	<i>Platalea alba</i>
Goose, Spur-winged	<i>Plectropterus gambensis</i>
Ibis, Glossy	<i>Plegadis falcinellus</i>
Sparrow-weaver, White-browed	<i>Plocepasser mahali</i>
Masked-weaver, Southern	<i>Ploceus velatus</i>
Grebe, Great Crested	<i>Podiceps cristatus</i>
Grebe, Black-necked	<i>Podiceps nigricollis</i>
Eagle, Martial	<i>Polemaetus bellicosus</i>
Harrier-Hawk, African	<i>Polyboroides typus</i>
Swamphen, African Purple	<i>Porphyrio madagascariensis</i>
Prinia, Black-chested	<i>Prinia flavicans</i>
Prinia, Tawny-flanked	<i>Prinia subflava</i>
Honeybird, Brown-backed	<i>Prodotiscus regulus</i>
Thrush, Groundscraper	<i>Psophocichla litsipsirupa</i>
Spurfowl, Natal	<i>Pternistis natalensis</i>
Spurfowl, Swainson's	<i>Pternistis swainsonii</i>
Bulbul, African Red-eyed	<i>Pycnonotus nigricans</i>
Pytilia, Green-winged	<i>Pytilia melba</i>
Quelea, Red-billed	<i>Quelea quelea</i>
Rail, African	<i>Rallus caerulescens</i>
Avocet, Pied	<i>Recurvirostra avosetta</i>
Scimitarbill, Common	<i>Rhinopomastus cyanomelas</i>
Martin, Banded	<i>Riparia cincta</i>
Martin, Brown-throated	<i>Riparia paludicola</i>
Secretarybird, Secretarybird	<i>Sagittarius serpentarius</i>
Flufftail, Red-chested	<i>Sarothrura rufa</i>
Stonechat, African	<i>Saxicola torquatus</i>
Francolin, Orange River	<i>Scleroptila levaillantoides</i>
Hamerkop, Hamerkop	<i>Scopus umbretta</i>
Flycatcher, Fiscal	<i>Sigelus silens</i>
Mannikin, Bronze	<i>Spermestes cucullatus</i>
Lark, Pink-billed	<i>Spizocorys conirostris</i>
Finch, Scaly-feathered	<i>Sporopipes squamifrons</i>
Starling, Pied	<i>Spreo bicolor</i>
Flycatcher, Fairy	<i>Stenostira scita</i>
Tern, Caspian	<i>Sterna caspia</i>
Turtle-dove, Cape	<i>Streptopelia capicola</i>
Dove, Red-eyed	<i>Streptopelia semitorquata</i>

COMMON NAME	SCIENTIFIC NAME
Dove, Laughing	<i>Streptopelia senegalensis</i>
Ostrich, Common	<i>Struthio camelus</i>
Warbler, Garden	<i>Sylvia borin</i>
Whitethroat, Common	<i>Sylvia communis</i>
Crombec, Long-billed	<i>Sylvietta rufescens</i>
Grebe, Little	<i>Tachybaptus ruficollis</i>
Shelduck, South African	<i>Tadorna cana</i>
Tchagra, Brown-crowned	<i>Tchagra australis</i>
Bokmakierie, Bokmakierie	<i>Telophorus zeylonus</i>
Paradise-flycatcher, African	<i>Terpsiphone viridis</i>
Ibis, African Sacred	<i>Threskiornis aethiopicus</i>
Hornbill, Southern Yellow-billed	<i>Tockus leucomelas</i>
Barbet, Crested	<i>Trachyphonus vaillantii</i>
Barbet, Acacia Pied	<i>Tricholaema leucomelas</i>
Sandpiper, Wood	<i>Tringa glareola</i>
Greenshank, Common	<i>Tringa nebularia</i>
Sandpiper, Marsh	<i>Tringa stagnatilis</i>
Thrush, Karoo	<i>Turdus smithi</i>
Owl, Barn	<i>Tyto alba</i>
Hoopoe, African	<i>Upupa africana</i>
Waxbill, Blue	<i>Uraeginthus angolensis</i>
Mousebird, Red-faced	<i>Urocolius indicus</i>
Lapwing, Blacksmith	<i>Vanellus armatus</i>
Lapwing, Crowned	<i>Vanellus coronatus</i>
Lapwing, African Wattled	<i>Vanellus senegallus</i>
Indigobird, Village	<i>Vidua chalybeata</i>
Indigobird, Dusky	<i>Vidua funerea</i>
Whydah, Pin-tailed	<i>Vidua macroura</i>
Paradise-whydah, Long-tailed	<i>Vidua paradisaea</i>
Indigobird, Purple	<i>Vidua purpurascens</i>
Whydah, Shaft-tailed	<i>Vidua regia</i>
White-eye, Orange River	<i>Zosterops pallidus</i>
White-eye, Cape	<i>Zosterops virens</i>

Annexure C: Expected Reptiles



Animal Demography Unit
Virtual Museum

ReptileMAP — Reptile Atlas of Southern Africa

6 species found for locus = 2626DD
Date filter: Year collected/observed >= 2007

Species code	Family	Scientific name	Common name	Red list category	Number of QDSs	Number of records	Last recorded
1490	Agamidae	<i>Agama atra</i>	Southern Rock Agama	Least Concern (SARCA 2014)	1	1	2016-10-23
4560	Colubridae	<i>Crotaphopeltis hotamboeia</i>	Red-lipped Snake	Least Concern (SARCA 2014)	1	1	2013-10-31
5340	Elapidae	<i>Naja nivea</i>	Cape Cobra	Least Concern (SARCA 2014)	1	1	2012-11-19
2000	Scincidae	<i>Acontias gracilicauda</i>	Thin-tailed Legless Skink	Least Concern (SARCA 2014)	1	2	2013-03-08
2450	Scincidae	<i>Trachylepis punctatissima</i>	Speckled Rock Skink	Least Concern (SARCA 2014)	1	2	2016-05-12
1230	Varanidae	<i>Varanus niloticus</i>	Water Monitor	Least Concern (SARCA 2014)	1	1	2017-03-19
Total					6	8	2016-05-12* 2014-02-02**

* median date of last recorded date

** median date for all records identified to species or subspecies level

Red listing source:

Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. 2014. Edited by Michael F. Bates, William R. Branch, Aaron M. Bauer, Marius Burger, Johan Marais, Graham J. Alexander & Marianne S. de Villiers. SANBI, Pretoria.

NB: the following taxa have been omitted from the database query to produce the list above:

- Viperidae: *Bitis xeropaga* (Desert Mountain Adder), Least Concern (SARCA 2014)
- Viperidae: *Bitis schneideri* (Namaqua Dwarf Adder), Least Concern (SARCA 2014)
- Viperidae: *Bitis rubida* (Red Adder), Least Concern (SARCA 2014)
- Viperidae: *Bitis inornata* (Plain Mountain Adder), Endangered (SARCA 2014)
- Viperidae: *Bitis cornuta* (Many-horned Adder), Least Concern (SARCA 2014)
- Viperidae: *Bitis caudalis* (Horned Adder), Least Concern (SARCA 2014)
- Viperidae: *Bitis atropos* (Cape Berg Adder), Least Concern (SARCA 2014)
- Viperidae: *Bitis atropos* (Berg Adder),
- Viperidae: *Bitis atropos* (Drakensberg Adder),
- Viperidae: *Bitis atropos* (Zimbabwe Berg Adder),
- Viperidae: *Bitis armata* (Southern Adder), Vulnerable (SARCA 2014)
- Viperidae: *Bitis albanica* (Albany Adder), Critically Endangered (SARCA 2)
- Lamprophiidae: *Lamprophis fiskii* (Fisk's House Snake), Least Concern (SARCA 2014)
- Cordylidae: *Ouroborus cataphractus* (Armadillo Girdled Lizard), Least Concern (SARCA 2014)
- Chamaeleonidae: *Rhampholeon chapmanorum* (Chapman's Pygmy Chameleon),

ID pending record(s) for this locus: 0

Citation: Animal Demography Unit (2018). ReptileMAP Virtual Museum. Accessed at <http://vmus.adu.org.za/?vm=ReptileMAP> on 2018-11-19

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Annexure D: Expected Amphibians



Animal Demography Unit
Virtual Museum

FrogMAP — Frog Atlas of Southern Africa

4 species found for locus = 2626DD
Date filter: Year collected/observed >= 2007

Species code	Family	Scientific name	Common name	Red list category	Number of QDSs	Number of records	Last recorded
590	Hyperoliidae	<i>Hyperolius marmoratus</i>	Painted Reed Frog	Least Concern (IUCN ver 3.1, 2013)	1	1	2011-05-26
660	Hyperoliidae	<i>Kassina senegalensis</i>	Bubbling Kassina	Least Concern	1	1	2017-01-22
880	Pyxicephalidae	<i>Amietia delalandii</i>	Delalande's River Frog	Least Concern	1	1	2016-05-12
940	Pyxicephalidae	<i>Strongylopus fasciatus</i>	Striped Stream Frog	Least Concern	1	3	2016-05-12
Total					4	6	2016-05-12* 2016-05-12*

* median date of last recorded date

** median date for all records identified to species or subspecies level

Red listing source:

Minter LR, Burger M, Harrison JA, Braack HH, Bishop PJ & Kloepfer D (eds). 2004. Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland. SI/MAB Series no. 9. Smithsonian Institution, Washington, D.C.

ID pending record(s) for this locus: 3

Citation: Animal Demography Unit (2018). FrogMAP Virtual Museum. Accessed at <http://vmus.adu.org.za/?vm=FrogMAP> on 2018-11-19

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Annexure E.1: Expected Butterflies



Animal Demography Unit
Virtual Museum

LepiMAP — Atlas of African Lepidoptera

31 species found for locus = 2626DD
Date filter: Year collected/observed >= 2007

Species code	Family	Scientific name	Common name	Red list category	Number of QDSS	Number of records	Last recorded
634880	GEOMETRIDAE	Rhodometra sacraaria		Not Threatened (NT) [not an IUCN category]	1	1	2017-05-0
464690	LYCAENIDAE	Actizera lucida	Rayed blue	Least Concern (SABCA 2013)	1	2	2009-03-2
464800	LYCAENIDAE	Azanus jesous	Topaz babul blue	Least Concern (SABCA 2013)	1	2	2018-02-0
464820	LYCAENIDAE	Azanus moriqua	Black-bordered babul blue	Least Concern (SABCA 2013)	1	4	2018-03-1
464880	LYCAENIDAE	Azanus ubaldus	Velvet-spotted babul blue	Least Concern (SABCA 2013)	1	6	2018-10-1
466030	LYCAENIDAE	Chilades trochylus	Grass jewel	Least Concern (SABCA 2013)	1	2	2018-02-2
458270	LYCAENIDAE	Cigaritis natalensis	Natal bar	Least Concern (SABCA 2013)	1	1	2016-10-0
463120	LYCAENIDAE	Cupidopsis jobates jobates	Tailed meadow blue	Least Concern (SABCA 2013)	1	1	2018-02-0
465010	LYCAENIDAE	Eicochrysops messapus mahallakoaeana	Cupreous blue	Least Concern (SABCA 2013)	1	10	2018-04-1
463230	LYCAENIDAE	Lampides boeticus	Pea blue	Least Concern (SABCA 2013)	1	1	2010-02-1
463950	LYCAENIDAE	Leptotes sp.			1	1	2018-04-1
464050	LYCAENIDAE	Leptotes pirthous pirthous	Common zebra blue	Least Concern (SABCA 2013)	1	1	2009-03-2
464490	LYCAENIDAE	Tarucus sybaris sybaris	Dotted blue	Least Concern (SABCA 2013)	1	2	2017-01-2
464560	LYCAENIDAE	Zintha hintza hintza	Hintza pierrot	Least Concern (SABCA 2013)	1	2	2018-02-2
464605	LYCAENIDAE	Zizeeria knysna knysna	African grass blue	Least Concern (SABCA 2013)	1	5	2018-03-1
410760	NYMPHALIDAE	Acraea neobule neobule	Wandering donkey acraea	Least Concern (SABCA 2013)	1	1	2016-05-1
408530	NYMPHALIDAE	Byblia ilithyia	Spotted joker	Least Concern (SABCA 2013)	1	1	2009-03-2
439440	NYMPHALIDAE	Catacroptera cloanthe cloanthe	Pirate	Least Concern (SABCA 2013)	1	1	2009-03-2
409280	NYMPHALIDAE	Danaus chrysippus orientis	African monarch, Plain tiger	Least Concern (SABCA 2013)	1	10	2018-03-0
439300	NYMPHALIDAE	Hypolimnas misippus	Common diadem	Least Concern (SABCA 2013)	1	1	2010-02-1
438280	NYMPHALIDAE	Junonia hierta cebrene	Yellow pansy	Least Concern (SABCA 2013)	1	7	2018-04-1
438380	NYMPHALIDAE	Junonia orithya madagascariensis	Eyed pansy	Least Concern (SABCA 2013)	1	3	2017-01-2
438810	NYMPHALIDAE	Precis archesia archesia	Garden commodore	Least Concern (SABCA 2013)	1	1	2013-02-0
414160	NYMPHALIDAE	Telchinia rahira rahira	Marsh acraea	Least Concern (SABCA 2013)	1	2	2018-03-1
413770	NYMPHALIDAE	Telchinia serena	Dancing acraea	Least Concern (SABCA 2013)	1	3	2010-02-1
438050	NYMPHALIDAE	Vanessa cardui	Painted lady	Least Concern (SABCA 2013)	1	2	2018-09-0
400530	PAPILIONIDAE	Papilio demodocus demodocus	Citrus swallowtail	Least Concern (SABCA 2013)	1	2	2016-12-2
407450	PIERIDAE	Belenois aurota	Brown-veined white	Least Concern (SABCA 2013)	1	9	2018-01-3
403120	PIERIDAE	Catopsilia florella	African migrant	Least Concern (SABCA 2013)	1	3	2016-09-2
402930	PIERIDAE	Eurema brigitta brigitta	Broad-bordered grass yellow	Least Concern (SABCA 2013)	1	21	2018-02-2
405610	PIERIDAE	Pontia helice helice	Common meadow white	Least Concern (SABCA 2013)	1	7	2018-09-0
Total					31	115	2018-02-0 2016-05-1:

* median date of *last recorded date*

** median date for all records identified to species or subspecies level

Red listing source:

Mecenero, S., J.B. Ball, D.A. Edge, M.L. Hamer, G.A. Hening, M. Krüger, E.L. Pringle, R.F. Terblanche & M.C. Williams (eds). 2013. Conservation assessment of butterflies of South Africa, Lesotho and Swaziland: Red List and atlas. Saftronics (Pty) Ltd., Johannesburg and Animal Demography Unit, Cape Town.

ID pending record(s) for this locus: 5

Citation: Animal Demography Unit (2018). LepiMAP Virtual Museum. Accessed at <http://vmus.adu.org.za/?vm=LepiMAP> on 2018-11-19

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Annexure E.2: Expected Odonata



Animal Demography Unit
Virtual Museum

OdonataMAP — Odonata Atlas of Africa

12 species found for locus = 2626DD
Date filter: Year collected/observed >= 2007

Species code	Family	Scientific name	Common name	Red list category	Number of QDSs	Number of records	Last recorded
664070	Aeshnidae	Anaciaeschna triangulifera	Evening Hawker	LC	1	2	2017-05-07
664120	Aeshnidae	Anax ephippiger	Vagrant Emperor	LC	1	1	2016-12-28
662330	Coenagrionidae	Africallagma glaucum	Swamp Bluet	LC	1	2	2018-10-28
667030	Libellulidae	Brachythemis leucosticta	Southern Banded Groundling	LC	1	23	2018-05-03
667130	Libellulidae	Crocothemis erythraea	Broad Scarlet	LC	1	4	2018-10-28
667140	Libellulidae	Crocothemis sanguinolenta	Little Scarlet	LC	1	1	2011-03-10
667860	Libellulidae	Orthetrum caffrum	Two-striped Skimmer	LC	1	1	2018-10-28
668120	Libellulidae	Orthetrum trinacria	Long Skimmer	LC	1	1	2017-06-04
668230	Libellulidae	Pantala flavescens	Wandering Glider	LC	1	1	2017-12-23
668420	Libellulidae	Sympetrum fonscolombii	Red-veined Darter or Nomad	LC	1	4	2018-11-04
668660	Libellulidae	Trithemis annulata	Violet Dropwing	LC	1	1	2017-01-03
668670	Libellulidae	Trithemis arteriosa	Red-veined Dropwing	LC	1	1	2018-01-05
Total					12	42	2018-01-05* 2018-03-05**

* median date of last recorded date

** median date for all records identified to species or subspecies level

Red listing source:

Samways, M.J. & Simaika, J.P. 2016. Manual of Freshwater Assessment for South Africa: Dragonfly Biotic Index. Suricata 2. South African National Biodiversity Institute, Pretoria.

ID pending record(s) for this locus: 0

Citation: Animal Demography Unit (2018). OdonataMAP Virtual Museum. Accessed at <http://vmus.adu.org.za/?vm=OdonataMAP> on 2018-11-19

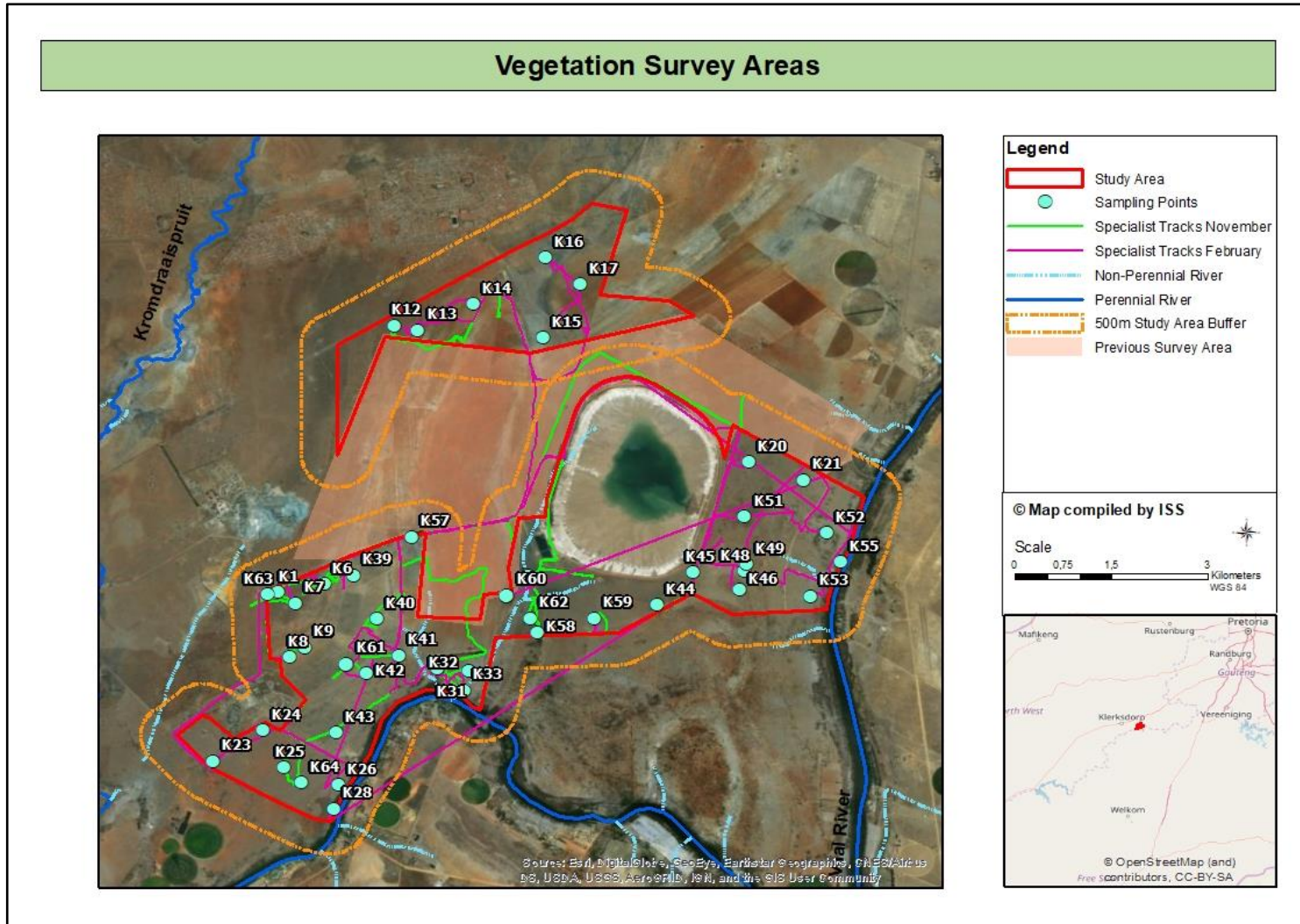
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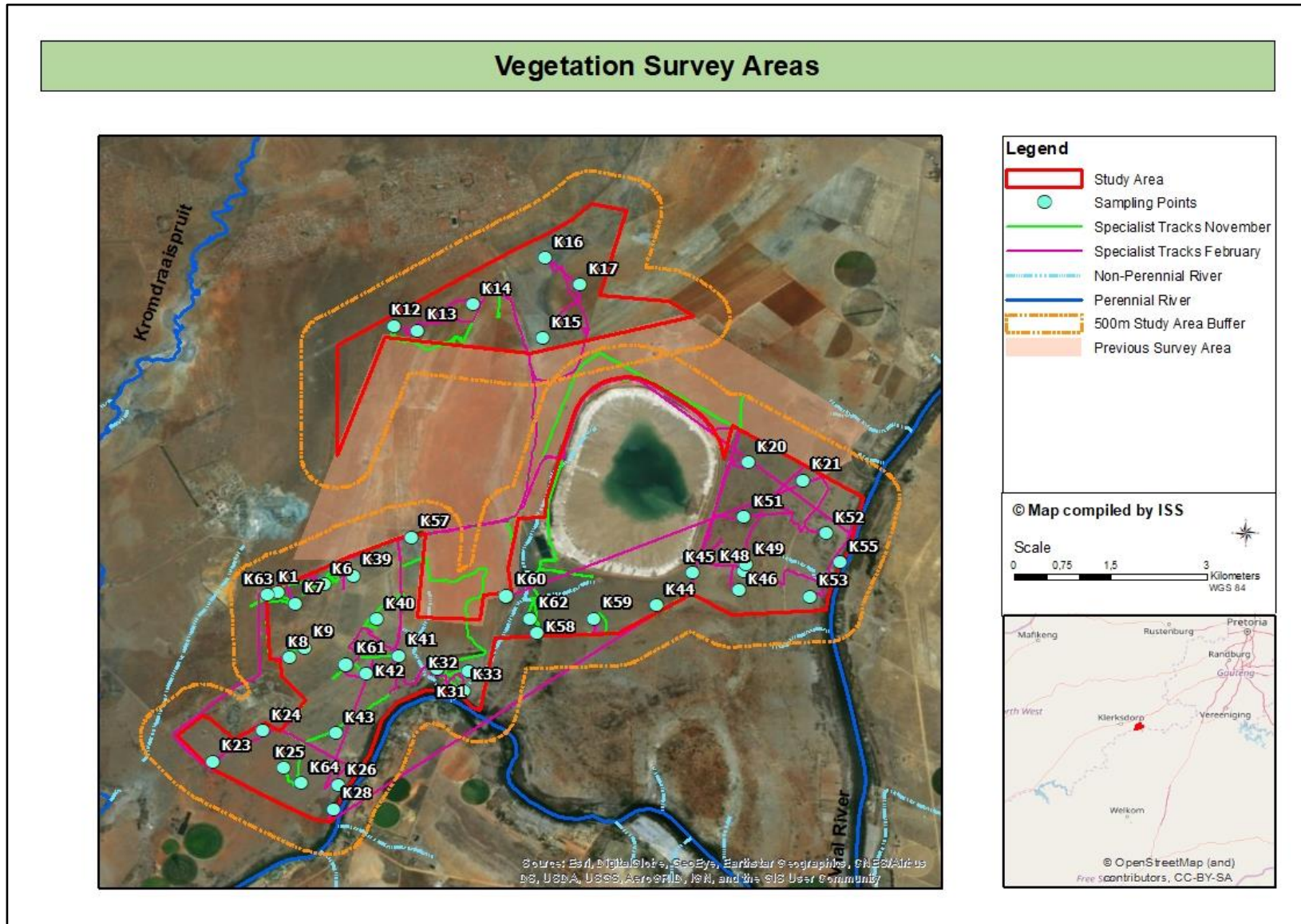
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Annexure F: Vegetation Sample Plots and Specialist tracks

64 sample points were planned for the November – February site visits 26 sample plots were surveyed during the November site visit. The sample plots were: K57, K39; K6; K42; K43; K61; K41; K62; K58; K59; K40; K32; K35; K44; K45; K14; K12; K1; K25; K63; K64; K7; K9; K8; K33 and K65. February site visits 31 sample plots were surveyed during the February site visit. The sample plots were: K6, K7, K8, K12, K13, K15, K16, K17, K20, K21, K23, K24, K26, K28, K31, K32, K33, K39, K40, K42, K43, K44, K45, K46, K49, K51, K52, K53, K55, K58, K59 and K60.. This can be confirmed by the specialist tracks



64 sample points were planned for the November – February site visits 31 sample plots were surveyed during the February site visit. The sample plots were: K6, K7, K8, K12, K13, K15, K16, K17, K20, K21, K23, K24, K26, K28, K31, K32, K33, K39, K40, K42, K43, K44, K45, K46, K49, K51, K52, K53, K55, K58, K59 and K60.. This can be confirmed by the specialist tracks



Annexure G: Observed Localities of Plant Species of Conservation Concern

SPECIES	NUMBER OF INDIVIDUALS	COORDINATES
<i>Hypoxis hemerocallidea</i>	1	26.886178,-26.870174
<i>Hypoxis hemerocallidea</i>	1	26.885917,-26.869736
<i>Hypoxis hemerocallidea</i>	1	26.88571,-26.869202
<i>Hypoxis hemerocallidea</i>	1	26.885956,-26.868294
<i>Hypoxis hemerocallidea</i>	1	26.886201,-26.867498
<i>Boophone disticha</i>	2	26.886284,-26.867327
<i>Hypoxis hemerocallidea</i>	1	26.886125,-26.867394
<i>Hypoxis hemerocallidea</i>	5	26.885872,-26.867392
<i>Hypoxis hemerocallidea</i>	18	26.885629,-26.867351
<i>Hypoxis hemerocallidea</i>	5	26.885358,-26.867306
<i>Hypoxis hemerocallidea</i>	8	26.885319,-26.867279
<i>Hypoxis hemerocallidea</i>	12	26.885084,-26.867193
<i>Hypoxis hemerocallidea</i>	50	26.885023,-26.867193
<i>Hypoxis hemerocallidea</i>	20	26.884752,-26.867152
<i>Hypoxis hemerocallidea</i>	25	26.884677,-26.867096
<i>Hypoxis hemerocallidea</i>	20	26.884535,-26.86704
<i>Hypoxis hemerocallidea</i>	15	26.884457,-26.866902
<i>Hypoxis hemerocallidea</i>	50	26.884354,-26.866843
<i>Hypoxis hemerocallidea</i>	100	26.884076,-26.866751
<i>Hypoxis hemerocallidea</i>	200	26.883776,-26.866539
<i>Hypoxis hemerocallidea</i>	20	26.883516,-26.866433
<i>Hypoxis hemerocallidea</i>	20	26.883325,-26.866384
<i>Hypoxis hemerocallidea</i>	20	26.883165,-26.866319
<i>Hypoxis hemerocallidea</i>	20	26.882995,-26.866296
<i>Hypoxis hemerocallidea</i>	2	26.882774,-26.866262
<i>Hypoxis hemerocallidea</i>	12	26.882423,-26.866233
<i>Hypoxis hemerocallidea</i>	10	26.882049,-26.866181
<i>Hypoxis hemerocallidea</i>	2	26.882217,-26.865461
<i>Hypoxis hemerocallidea</i>	2	26.88292,-26.864623
<i>Hypoxis hemerocallidea</i>	1	26.883001,-26.864579
<i>Hypoxis hemerocallidea</i>	30	26.883151,-26.864488
<i>Hypoxis hemerocallidea</i>	20	26.883524,-26.864244
<i>Hypoxis hemerocallidea</i>	20	26.883627,-26.864171
<i>Hypoxis hemerocallidea</i>	5	26.884089,-26.863872
<i>Hypoxis hemerocallidea</i>	30	26.884186,-26.863781
<i>Hypoxis hemerocallidea</i>	50	26.884272,-26.86373
<i>Hypoxis hemerocallidea</i>	50	26.884424,-26.863688
<i>Boophone disticha</i>	1	26.884662,-26.863648
<i>Hypoxis hemerocallidea</i>	50	26.884775,-26.86364
<i>Hypoxis hemerocallidea</i>	50	26.884997,-26.863116
<i>Hypoxis hemerocallidea</i>	2	26.884972,-26.86265
<i>Hypoxis hemerocallidea</i>	2	26.884699,-26.862299
<i>Hypoxis hemerocallidea</i>	5	26.884629,-26.862073
<i>Hypoxis hemerocallidea</i>	30	26.884602,-26.862002
<i>Boophone disticha</i>	1	26.884596,-26.861812
<i>Hypoxis hemerocallidea</i>	100	26.884629,-26.86168

SPECIES	NUMBER OF INDIVIDUALS	COORDINATES
<i>Hypoxis hemerocallidea</i>	50	26.88426,-26.860768
<i>Boophone disticha</i>	1	26.88417,-26.860688
<i>Hypoxis hemerocallidea</i>	5	26.883439,-26.860083
<i>Hypoxis hemerocallidea</i>	15	26.883288,-26.85998
<i>Hypoxis hemerocallidea</i>	1	26.882874,-26.859536
<i>Hypoxis hemerocallidea</i>	1	26.882409,-26.859014
<i>Ammocharis coranica</i>	1	26.881079,-26.858275
<i>Ammocharis coranica</i>	3	26.880979,-26.858253
<i>Ammocharis coranica</i>	1	26.881094,-26.858348
<i>Ammocharis coranica</i>	3	26.881082,-26.858337
<i>Ammocharis coranica</i>	2	26.88172,-26.85919
<i>Boophone disticha</i>	1	26.884812,-26.863823
<i>Crinum bulbispermum</i>	1	26.88295,-26.873985
<i>Crinum bulbispermum</i>	1	26.880374,-26.874687
<i>Pearsonia bracteata</i>	1	26.861422,-26.867193
<i>Pearsonia bracteata</i>	1	26.861386,-26.867183
<i>Pearsonia bracteata</i>	1	26.861397,-26.867367
<i>Pearsonia bracteata</i>	2	26.861417,-26.867373
<i>Pearsonia bracteata</i>	1	26.861443,-26.867386
<i>Vachellia erioloba</i>	1	26.860781,-26.867557
<i>Pearsonia bracteata</i>	1	26.859291,-26.867413
<i>Pearsonia bracteata</i>	1	26.862261,-26.867608
<i>Hypoxis hemerocallidea</i>	5	26.886625,-26.909974
<i>Crinum cf. macowanii</i>	1	26.877399,-26.910382
<i>Crinum cf. macowanii</i>	1	26.876707,-26.910321
<i>Hypoxis hemerocallidea</i>	15	26.875874,-26.910429
<i>Boophone disticha</i>	1	26.858347,-26.918444
<i>Boophone disticha</i>	6	26.85844,-26.918283
<i>Boophone disticha</i>	2	26.858526,-26.918182
<i>Boophone disticha</i>	2	26.858733,-26.917962
<i>Hypoxis hemerocallidea</i>	55	26.858744,-26.917945
<i>Boophone disticha</i>	2	26.858942,-26.917751
<i>Hypoxis hemerocallidea</i>	50	26.859335,-26.917231
<i>Boophone disticha</i>	2	26.85936,-26.916595
<i>Crinum bulbispermum</i>	2	26.864596,-26.915816
<i>Crinum bulbispermum</i>	1	26.866599,-26.917295
<i>Crinum bulbispermum</i>	3	26.867818,-26.918099
<i>Crinum bulbispermum</i>	1	26.868194,-26.91802
<i>Crinum bulbispermum</i>	5	26.868301,-26.917979
<i>Crinum bulbispermum</i>	4	26.868429,-26.918162
<i>Crinum bulbispermum</i>	1	26.868508,-26.918151
<i>Crinum bulbispermum</i>	2	26.868695,-26.917875
<i>Crinum bulbispermum</i>	5	26.868914,-26.917738
<i>Crinum bulbispermum</i>	2	26.869034,-26.917615
<i>Crinum bulbispermum</i>	6	26.86918,-26.917575
<i>Crinum bulbispermum</i>	2	26.869085,-26.917579

SPECIES	NUMBER OF INDIVIDUALS	COORDINATES
<i>Crinum bulbispermum</i>	1	26.869001,-26.917703
<i>Crinum bulbispermum</i>	1	26.868946,-26.917734
<i>Crinum bulbispermum</i>	1	26.868838,-26.917867
<i>Crinum bulbispermum</i>	2	26.868965,-26.917853
<i>Hypoxis hemerocallidea</i>	2	26.86872,-26.916593
<i>Hypoxis hemerocallidea</i>	5	26.868723,-26.916434
<i>Crinum bulbispermum</i>	10	26.868574,-26.916281
<i>Hypoxis hemerocallidea</i>	5	26.868526,-26.916165
<i>Crinum bulbispermum</i>	1	26.868522,-26.916153
<i>Hypoxis hemerocallidea</i>	20	26.868541,-26.916087
<i>Boophone disticha</i>	1	26.868448,-26.916099
<i>Crinum bulbispermum</i>	5	26.868394,-26.915976
<i>Hypoxis hemerocallidea</i>	50	26.868371,-26.915965
<i>Crinum bulbispermum</i>	2	26.868277,-26.915937
<i>Crinum bulbispermum</i>	1	26.868277,-26.915731
<i>Crinum bulbispermum</i>	1	26.868766,-26.915611
<i>Crinum bulbispermum</i>	1	26.868887,-26.915716
<i>Hypoxis hemerocallidea</i>	5	26.86941,-26.915363
<i>Crinum bulbispermum</i>	1	26.869714,-26.91556
<i>Crinum bulbispermum</i>	1	26.869202,-26.915452
<i>Hypoxis hemerocallidea</i>	1	26.869063,-26.915447
<i>Crinum bulbispermum</i>	3	26.868923,-26.91545
<i>Crinum bulbispermum</i>	3	26.868653,-26.915451
<i>Hypoxis hemerocallidea</i>	1	26.868397,-26.915509
<i>Hypoxis hemerocallidea</i>	50	26.868248,-26.915554
<i>Hypoxis hemerocallidea</i>	200	26.867887,-26.915713
<i>Hypoxis hemerocallidea</i>	100	26.867372,-26.916009
<i>Hypoxis hemerocallidea</i>	100	26.867072,-26.916254
<i>Hypoxis hemerocallidea</i>	30	26.866776,-26.916501
<i>Hypoxis hemerocallidea</i>	100	26.866667,-26.916725
<i>Crinum bulbispermum</i>	2	26.864202,-26.915718
<i>Crinum bulbispermum</i>	1	26.864508,-26.914897
<i>Hypoxis hemerocallidea</i>	1	26.864791,-26.914956
<i>Crinum bulbispermum</i>	3	26.863756,-26.91428
<i>Boophone disticha</i>	1	26.859261,-26.914783
<i>Boophone disticha</i>	1	26.859085,-26.913618
<i>Boophone disticha</i>	1	26.859018,-26.91276
<i>Hypoxis hemerocallidea</i>	5	26.852459,-26.901727
<i>Vachellia erioloba</i>	30	26.852714,-26.901715
<i>Hypoxis hemerocallidea</i>	1	26.853452,-26.901787
<i>Hypoxis hemerocallidea</i>	1	26.853623,-26.901808
<i>Hypoxis hemerocallidea</i>	1	26.853776,-26.901826
<i>Hypoxis hemerocallidea</i>	1	26.853593,-26.90194
<i>Hypoxis hemerocallidea</i>	5	26.852898,-26.901951
<i>Vachellia erioloba</i>	1	26.847701,-26.901795
<i>Hypoxis hemerocallidea</i>	1	26.848857,-26.902837

SPECIES	NUMBER OF INDIVIDUALS	COORDINATES
<i>Boophone disticha</i>	1	26.848553,-26.902674
<i>Boophone disticha</i>	1	26.84833,-26.902544
<i>Boophone disticha</i>	1	26.8477,-26.90177
<i>Boophone disticha</i>	1	26.843993,-26.90329
<i>Boophone disticha</i>	1	26.844039,-26.903346
<i>Boophone disticha</i>	1	26.845247,-26.905974
<i>Boophone disticha</i>	3	26.845171,-26.905714
<i>Boophone disticha</i>	1	26.844509,-26.904629
<i>Boophone disticha</i>	1	26.844071,-26.913344
<i>Boophone disticha</i>	1	26.844276,-26.91329
<i>Boophone disticha</i>	2	26.844182,-26.913396
<i>Hypoxis hemerocallidea</i>	1	26.844245,-26.913272
<i>Haemanthus montanus</i>	1	26.839436,-26.923281
<i>Boophone disticha</i>	1	26.83944,-26.923357
<i>Hypoxis hemerocallidea</i>	10	26.839494,-26.92347
<i>Hypoxis hemerocallidea</i>	1	26.839557,-26.92356
<i>Hypoxis hemerocallidea</i>	1	26.839674,-26.923542
<i>Hypoxis hemerocallidea</i>	1	26.84029,-26.92352
<i>Hypoxis hemerocallidea</i>	1	26.840542,-26.92363
<i>Boophone disticha</i>	1	26.840681,-26.923834
<i>Boophone disticha</i>	2	26.840682,-26.923926
<i>Boophone disticha</i>	1	26.840895,-26.924118
<i>Boophone disticha</i>	1	26.840888,-26.924287
<i>Vachellia erioloba</i>	1	26.840866,-26.924312
<i>Hypoxis hemerocallidea</i>	1	26.840725,-26.924098
<i>Hypoxis hemerocallidea</i>	20	26.840664,-26.923966
<i>Boophone disticha</i>	1	26.84059,-26.923666
<i>Boophone disticha</i>	1	26.840393,-26.923688
<i>Boophone disticha</i>	1	26.840269,-26.923694
<i>Hypoxis hemerocallidea</i>	1	26.839687,-26.923389
<i>Vachellia erioloba</i>	5	26.831364,-26.927037
<i>Vachellia erioloba</i>	2	26.833048,-26.928237
<i>Vachellia erioloba</i>	10	26.833623,-26.928011
<i>Boophone disticha</i>	1	26.833441,-26.927542
<i>Hypoxis hemerocallidea</i>	5	26.833346,-26.927421
<i>Hypoxis hemerocallidea</i>	1	26.83326,-26.927293
<i>Boophone disticha</i>	1	26.833268,-26.927128
<i>Boophone disticha</i>	1	26.833304,-26.92706
<i>Hypoxis hemerocallidea</i>	1	26.833226,-26.927137
<i>Boophone disticha</i>	4	26.843595,-26.923676
<i>Boophone disticha</i>	5	26.843625,-26.92372
<i>Boophone disticha</i>	1	26.849915,-26.927001
<i>Boophone disticha</i>	1	26.856126,-26.913692
<i>Hypoxis hemerocallidea</i>	1	26.854777,-26.916148
<i>Hypoxis hemerocallidea</i>	1	26.855057,-26.915666
<i>Hypoxis hemerocallidea</i>	1	26.855221,-26.915614

SPECIES	NUMBER OF INDIVIDUALS	COORDINATES
<i>Boophone disticha</i>	1	26.854491,-26.916124
<i>Boophone disticha</i>	1	26.852091,-26.915408
<i>Hypoxis hemerocallidea</i>	50	26.852097,-26.915403
<i>Hypoxis hemerocallidea</i>	50	26.855815,-26.909725
<i>Hypoxis hemerocallidea</i>	1	26.855714,-26.909752
<i>Hypoxis hemerocallidea</i>	20	26.855847,-26.909743
<i>Boophone disticha</i>	1	26.858188,-26.911839
<i>Haemanthus montanus</i>	1	26.917673,-26.904481
<i>Crinum bulbispermum</i>	1	26.917058,-26.904755
<i>Crinum bulbispermum</i>	1	26.917137,-26.904731
<i>Crinum bulbispermum</i>	1	26.917142,-26.904749
<i>Crinum bulbispermum</i>	1	26.917209,-26.904729
<i>Crinum bulbispermum</i>	2	26.917244,-26.904708
<i>Crinum bulbispermum</i>	1	26.917361,-26.904615
<i>Haemanthus montanus</i>	1	26.917627,-26.90466
<i>Crinum bulbispermum</i>	3	26.917636,-26.904674
<i>Crinum bulbispermum</i>	1	26.917877,-26.904629
<i>Haemanthus montanus</i>	1	26.918219,-26.904504
<i>Hypoxis hemerocallidea</i>	2	26.907215,-26.903855
<i>Cussonia paniculata</i>	1	26.903042,-26.896592
<i>Hypoxis hemerocallidea</i>	1	26.903226,-26.896382
<i>Hypoxis hemerocallidea</i>	1	26.903346,-26.896319
<i>Cussonia paniculata</i>	1	26.903346,-26.896247
<i>Hypoxis hemerocallidea</i>	1	26.907641,-26.885712
<i>Hypoxis hemerocallidea</i>	1	26.908048,-26.886399
<i>Boophone disticha</i>	1	26.90799,-26.886879
<i>Hypoxis hemerocallidea</i>	1	26.90809,-26.886872
<i>Boophone disticha</i>	1	26.908001,-26.88683
<i>Hypoxis hemerocallidea</i>	1	26.907628,-26.886787
<i>Hypoxis hemerocallidea</i>	1	26.906845,-26.886558
<i>Hypoxis hemerocallidea</i>	1	26.906415,-26.886273
<i>Boophone disticha</i>	1	26.906323,-26.886211
<i>Hypoxis hemerocallidea</i>	1	26.906281,-26.886196
<i>Hypoxis hemerocallidea</i>	1	26.905257,-26.893739
<i>Cussonia paniculata</i>	2	26.905279,-26.893745
<i>Crinum bulbispermum</i>	1	26.919059,-26.895883
<i>Crinum bulbispermum</i>	1	26.919372,-26.896122
<i>Crinum bulbispermum</i>	1	26.919217,-26.895717
<i>Crinum bulbispermum</i>	1	26.918483,-26.895747
<i>Boophone disticha</i>	1	26.874557,-26.90492

Annexure H: Photographs of Near Threatened Plant Species



Pearsonia bracteata recorded in February 2019 a) View from top of plant b) Side view of flower, c) Scale of flower relative to a pencil d) Frontal view of flower.



Lithops lesliei subsp. *lesliei* recorded November 2018 a) scale of the species relative to a pencil b) close up of species between rocks.

Annexure I: Specialist Curriculum Vitae



Lorainmari den Boogert

Resume Summary

Contact: +27 722 006244
Email: lorain@iggdrasilscientific.com
Languages: English, Afrikaans, Dutch

Career Highlights

DIRECTOR, ECOLOGIST

Iggdrasil Scientific Services

Jan 2012 – Present

A medium sized enterprise specialising in ecological assessments, covering fauna, flora, wetland and aquatic ecosystems.

PLANT ECOLOGIST

GEM – Science, South Africa

Oct 2010 – Jan 2012

A medium sized enterprise providing comprehensive geological and environmental consulting service for the mining industry.

JUNIOR ENVIRONMENTAL CONSULTANT

Bokamoso Environmental Consultants, SA

Jan 2010 – Oct 2010

PROJECT RESEARCH ASSISTANT

Abiotic Research Group, Alterra, Wageningen, The Netherlands

Jan 2009 – Jun 2009

BOTANY DEMONSTRATOR

University of Pretoria, Plant Sciences, SA

Jul 2008 – Nov 2008

FIELD ASSISTANT

University of Pretoria, Zoology, SA

Nov 2007 – Feb 2007



PROJECT RESEARCH ASSISTANT

University of Pretoria, Zoology, SA

Jan 2006 – Aug 2006

Education and Training

Degrees

- **Master of Science in Geohydrology, in progress: expected completion** December 2019
University of the Free State, Bloemfontein, SA
- **Master of Science Plant Science** 2010
Wageningen University, The Netherlands and University of Pretoria, SA
- **Bachelor of Science (Honours) Plant Science (Cum Laude)** 2008
University of Pretoria, SA
- **Bachelor of Science Ecology** 2007
University of Pretoria, SA

Certificates and Accreditations

- **SASS5 Accreditation (freshwater Aquatic Zoology)** 2017, 2014, 2011
Department of Water Affairs, SA
- **Dutch as a professional language** 2011
CNaTV, Belgium

Additional Courses

- Asteraceae ID course, by Paul Herman from SANBI's National Herbarium at the University of Pretoria, Department of Plant and Soil Sciences. 2018
- MIRAI (Macro invertebrate Response Assessment Index), Department of Water and Sanitation 2016
- Invasive Species and Herbicide Training, South African Green Industries Council (SAGIC) 2016
- A rapid method for water quality assessment, Nepid Consultants, Sabie 2011
- EIA water use authorisation and waste management activity licences, CBSS, Pretoria 2011
- Tools for wetland assessment, Rhodes University, Grahamstown 2011
- Inventory and survey methods for invasive plants, Online Course, Department of land resource of environmental Sciences, Montana State University, Bozeman, Montana. 2009

Conference Presentations

- **Course Presenter: Riparian Vegetation Assessment Methods for DWS** 2017
Department of Water and Sanitation, DWS, Roodeplaat
- **Conservation Planning in Urban Open Spaces** 2016
Botanical Society, Pretoria
- **The Vegetation ecology of Seringveld Conservancy, Cullinan South Africa** 2010
South African Association of Botanist's Annual Conference, Potchefstroom
- **A comparison between Ellenberg and Wamelink Biological indicator values** 2009



Wageningen Abiotic Research Group, Alterra Annual Conference, Wageningen, The Netherlands

- **The effect of the higher energy flow in the Ash River System, Bethlehem, SA** 2003
Stockholm International Youth Science Seminar, Sweden
- **The youth of South Africa would like to see underground water pollution addresses in light of the international summit for sustainable development** 2003
Water institute of South Africa, Annual Conference, Durban

Achievements

- Board member of the South African Botanical Society Pretoria Branch
- Selected for an exchange program to the University of Wageningen as part of my MSc studies.
- Overall Winner and gold medalist of the Eskom Expo for Young Scientist, representing south Africa in the Stockholm Sweden at the Stockholm international youth seminar
- Winner of the South Africa youth water prize of the department of water affairs and represented South Africa at the international youth water prize during world water week in Stockholm Sweden.

Membership & Associations

- South African Council of Natural Scientific Professions - Registered Professional Scientist (Pr.Sci.Nat: 400003/13),
- South African Association for Botanists,
- South African Botanical Society,
- South African Society for Aquatic Scientist,
- Department of Water and Sanitation SASS5 practitioners.

Dr Barbara Kasl

Resume Summary

Contact: +27 71 988 6773

Email: bk.zoology@gmail.com

Qualifications: PhD (Animal, Plant and Environmental Sciences)

Career Highlights

FAUNA SPECIALIST & ENVIRONMENTAL CONSULTANT

Feb 2017 – Present

Work involving fauna impact assessments and management and monitoring plans for various developments requiring NEMA authorisation, as well as terrestrial alien invasive fauna management plans. Working closely with ecologists on a variety of projects requiring specialist's terrestrial fauna input - Gauteng & North West Provincial Biodiversity Outlook Reports – Terrestrial Fauna input. Generic environmental management plans for the Working for Ecosystems and Land care projects (ongoing). Consulting on projects requiring Environmental Authorisation, including Mineral Authorisations, as well as the review of various environmental documentation.

ENVIRONMENTAL SCIENTIST/PRINCIPAL CONSULTANT

Cabanga Concepts, South Africa

Jan 2008 – Feb 2017

Cabanga works on a strategic level advising, consulting and overseeing environmental projects for construction, industry, mining and related businesses. Requested to join the company as an environmental consultant specialising in all environmental authorisation processes and related documents. I am one of three principal members/shareholders of Cabanga Concepts.

UNIT MANAGER / ACTING DEPARTMENT HEAD: BIOPHYSICAL DEPARTMENT

Digby Wells & Associates (now Digby Wells Environmental), SA

Sept 2004 – Nov 2007

Digby Wells Environmental's multidisciplinary team of integrated in-house specialists provides comprehensive environmental and social solutions for the Mineral Resources, Oil and Gas, Energy and Infrastructure sectors in Africa.



VARIOUS UNIVERSITY AND TEMP RESEARCH JOBS IN ENTOMOLOGY**University of Witwatersrand****2001 – 2003****PRIVATE TUTOR****University of Witwatersrand****2001**

Education and Training

Degrees

- **PhD in Animal, Plant and Environmental Sciences** **2002 - 2004**
University of Witwatersrand, Johannesburg, SA
- **Master of Science in Animal, Plant and Environmental Sciences (upgraded to PhD)** **1999 - 2001**
University of Witwatersrand, Johannesburg, SA
- **Bachelor of Science (Honours) Zoology and Entomology** **1998**
University of Witwatersrand, Johannesburg, SA
- **Bachelor of Science Zoology and Botany** **1995**
- **1998**
University of Pretoria, SA

Professional Memberships and Affiliations

- **2011 – current:** Registered Professional Environmental And Ecological Scientist
- **2015 – 2017:** EAPSA Certified Environmental Assessment Practitioner
- **1999, 2001 & 2008 – current:** Entomological Society of South Africa
- **2008-2011:** International Association for Impact Assessment
- **1998:** Zoological Society of Southern Africa

Additional Courses

- Alien invasive species identification and management course in KZN organised through Kay Montgomery 2017
- NEM: Air Quality Act course through IMBEWU Sustainability Legal Specialists (Pty) Ltd 2010
- NEMA and NEMWA course through ECOLAW 2009
- Environmental Impact Assessment Training 2007
- Project Management for Non-Project Managers Course through Astro Tech 2007
- Unilever Introduction to Managing Environmental Water Quality - Practical, Theoretical and Policy; through Institute for Water Research – RHODES University 2006
- Non-credited course in River health and SASS5 rapid methodology of water quality assessment presented by NEPID Consultants 2005
- Snake Identification and Snakebite Treatment Course 2005

*Project list and references available on request



