Appendix D3
Mine Waste Solutions – Kareerand Extension Storage Facility Extension Project, Terrestrial Fauna: Impact Assessment Report
-Dr A Deacon, 2017

ANGLO GOLD ASHANTI

MINE WASTE SOLUTIONS – KAREERAND EXTENSION STORAGE FACILITY EXTENSION PROJECT

TERRESTRIAL FAUNA: IMPACT ASSESSMENT REPORT.

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Status: DRAFT V3

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Table 1:	Specialist reports and reports on specialist processes Checklist	STATUS
	NEMA Regs (2014) – Appendix 6	Reference to section of specialist report or justification for not meeting requirement
1	A specialist report prepared in terms of these Regulations must contain—	
(a) i	the person who prepared the report; and	Title page
(a) ii	the expertise of that person to carry out the specialist study or specialised process;	Included in Appendix 1
(b)	a declaration that the person is independent in a form as may be specified by the competent authority;	Included in Appendix 2
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	1.1 Terms of Reference
(d)	the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Sections 2.2.2 and 2.2.4
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process;	2. Methodology
(f)	the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	5.1 Sensitivity mapping
(g)	an identification of any areas to be avoided, including buffers;	5.2 Assessment of impacts
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	3.2.3 Biodiversity Sector Plan and Threatened Ecosystems
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	2.2.4 Limitations
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	5.2 Assessment of impacts
(k)	any mitigation measures for inclusion in the EMPr	5.2 Assessment of impacts
(l)	any conditions for inclusion in the environmental authorisation	5.3 Conditions for inclusion in the environmental authorization
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation	5.4 Monitoring requirements
(n)	a reasoned opinion -	
.i	as to whether the proposed activity or portions thereof should be authorised and	5.5.1 Reasoned opinion
.ii	if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	5.5.1 Reasoned opinion
(o)	a description of any consultation process that was undertaken during the course of carrying out the study;	5.5.2 Consultation process

Table 1:	Specialist reports and reports on specialist processes Checklist	STATUS
(p)	a summary and copies if any comments that were received during any consultation process, and -	-
(q)	any other information requested by the competent authority.	-

Table of Contents

Abbreviations

ADU	Animal Demographic Unit
AGA	AngloGold Ashanti
BGIS	Biodiversity Geographic Information System
BMP	Biodiversity Management Plan
BSP	Biodiversity Sector Plan
CBA	Critical Biodiversity Areas
CSBS	Clean Stream Biological Services
°C	Degrees Celsius
E	East
e.g.	For example
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Area
GIS	Geographic Information System
GPS	Global Positioning System
Ha	Hectares
IUCN	International Union for Conservation of Nature
km	Kilometre
LUDS	Land-Use Decision Support Tool
m	Meter
MWS	Mine Waste Solutions
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMBA	National Environmental Management & Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWBSP	North West Biodiversity Sector Plan
ONA	Other Natural Areas
READ	North West Department of Rural, Environment and Agricultural Development
RR	Reporting rates
RSA	Republic of South Africa
S	South
SANBI	South African National Biodiversity Institute
SARCA	South African Reptile Conservation Assessment
TOPS	Threatened or Protected Species
TOR	Terms of Reference
TSF	Tailings Storage facility

List of Tables

List of Figures

1. Introduction and Project Description

This specialist ecological study was requested as part of the Environmental Impact Assessment (EIA) process for the proposed extension to the existing Kareerand Tailings Storage Facility (TSF). Mine Waste Solutions (MWS) is a tailing dam reclamation operation situated in the North West Province of RSA, with tailings dams in the Klerksdorp, Orkney, Stilfontein and Hartbeesfontein area being processed. MWS is a subsidiary of AngloGold Ashanti (AGA). Currently tailings from the MWS plant are sent to the Kareerand Tailings Storage facility (TSF).

The survey and impact assessment on the footprint of the infrastructure components will form part of the proposed Mine Waste Solutions Kareerand Tailings Storage Facility (TSF) Extension Project, which will require additional Environmental Authorisation. The proposed infrastructure footprints are included in a study area of 1 495.5ha situated directly adjacent to the northern boundary of the current Mine Waste Solutions (MWS) surface rights area (Figure 1) on portions of the farms Buffelsfontein 443 IP, Hartebeestfontein 442 IP, Megadam 574 IP, Kareerand 444 IP and Kromdraai 420 IP.

The motivation behind the development of the TSF project comes from concerns that the Kareerand TSF will constrain WMS operation capacity as from the beginning of 2021 as production demands increase. To keep within the projected rate of rise the tonnage deposited on the TSF will need to be reduced if the problem is not addressed. In order to maintain operations, additional TSF capacity is needed. The proposed developments will thus provide additional tailings storage capacity for Mine Waste Solutions' (MWS) operation. This will be achieved by increasing both the height of the existing footprint as well as the TSF area. Extension of the TSF is proposed to the west and north of the existing footprint. Due to the increase surface area of the extended TSF there will also be additional storm water collection dams (Figure 1) to control run off from the dam.

Mine Waste Solutions (MWS) is a tailings dam reclamation operation is a subsidiary of AngloGold Ashanti (AGA). Tailings dams in the Klerksdorp-Orkney – Stilfontein – Hartbeesfontein area are being processed at this facility. Currently tailings from the MWS plant are also sent to the Kareerand Tailings Storage facility (TSF). The proposed developments are also indicated in Figure 1, including the three borrow pits (1 to 3), the TSF extension and return water dams.

The following proposed infrastructure features were evaluated within the demarcated study area (Figure 1):

- TSF Extension - The proposed combined size of the extended Kareerand TSF will then be 946.6 ha, of which 382.6 ha will be added onto the exiting footprint and extend into the study area.
- Burrow pits - Three separate burrow pits with a combined surface area of 666.3 ha.
    - Borrow Area 1, or the western borrow area (180.0ha in extent)
    - Borrow Area 2, or the central borrow area (299.8ha in extent)
    - Borrow Area 3, or the eastern borrow area (186.5ha in extent)
- Return water dams – Four return water dams with a combined size of 43.2 ha.

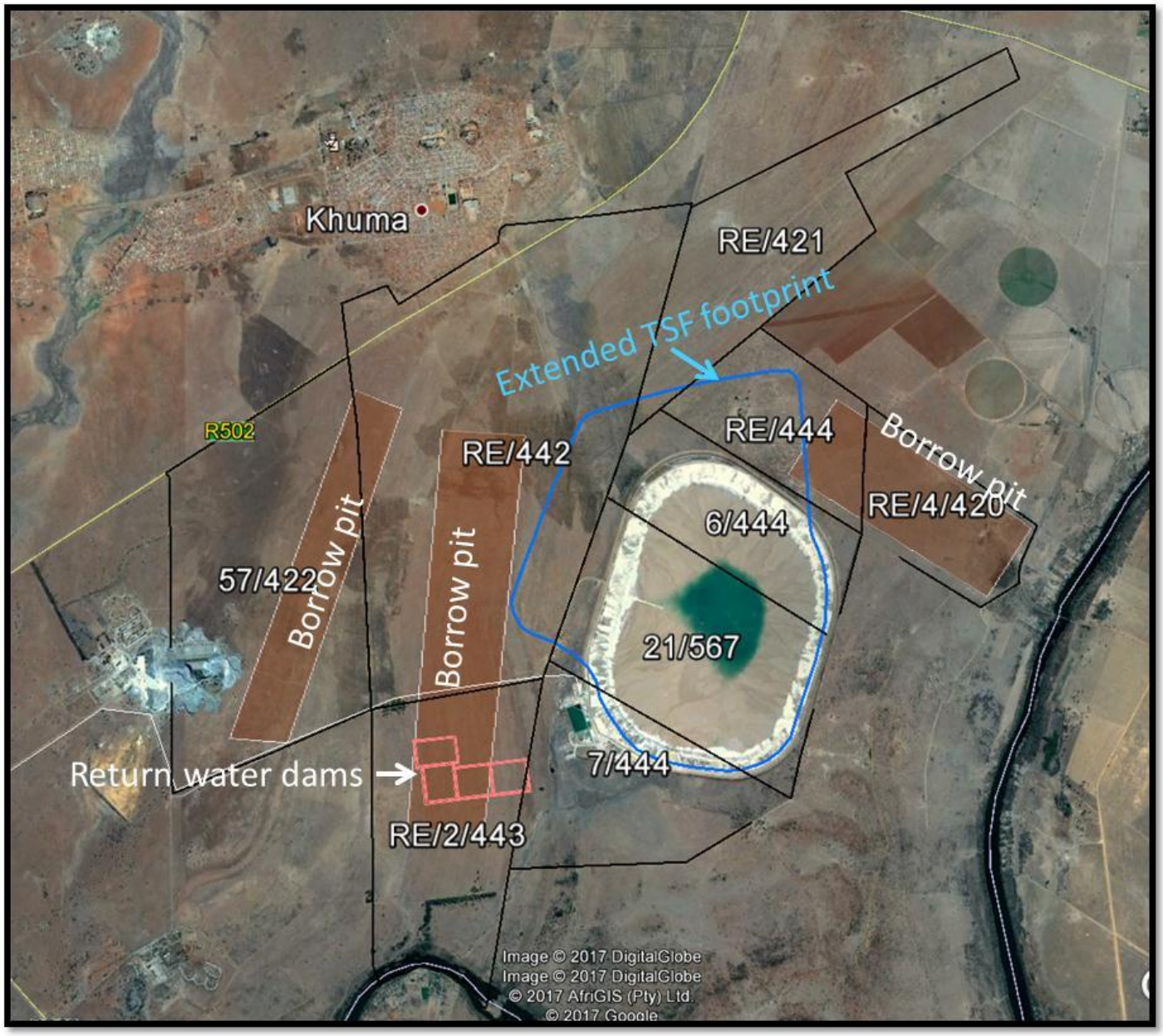

Figure 1: The proposed layout of the extended Kareerand TSF.

Table 2: Areas affected by the proposed Kareerand TSF development (Figure 1).

Farm name	ID	Proposed development
Hartebeestfontein 442 IP	57/422	Borrow pit 1
	RE/442	Borrow pit 2
Buffelsfontein 443 IP	RE/2/443	Return water dams
Kareerand 444 IP	RE/444	Extended TSF footprint Borrow pit 3
	7/444	Extended TSFF footprint
Kromdraai 420 IP	RE/4/420	Borrow pit 3
Megadam 574 IP	6/444	Extended TSFF footprint
	21/567	Extended TSFF footprint

Before the TSF extension can begin, various permits and EMPr approval must be applied for. To support these applications, specialist studies are completed to determine the impacts of the proposed development. The proposed development includes (information supplied by developer):

Additional borrow pits: Three potential areas for borrow pits have been identified, whether these will be used will be confirmed after the soil studies are complete. These sites will be used to reclaim topsoil as follows:

- Soil will be removed by excavator and dump truck.
- The borrow pits are expected to be maximum 2 m depth, which again depends on soil studies.

Slimes dam extension:

- The slimes dam will be constructed by creating a starter wall and drains around the perimeter, using material borrowed from the floor of the dam. Wall construction is by cycloning the slimes to generate a coarse fraction to build the wall with the fine slimes deposited inside the basin so created.
- The dam will be built over several years (about 7 years) as deposition starts from the low point and will take time to reach the high point of the area.
- The wetland to the west, adjacent to the existing TSF footprint, will be covered by slimes; the wetland south of the TSF will be disturbed by building return water dams and seepage interception dams. North of the TSF the valley-bottom wetland will be diverted east and west around the footprint to prevent clean water being impacted by the dam.
- The dam will be built with trenches, storm water diversions etc. to keep dirty water within the footprint for returning to the process and preventing clean water from getting on to the footprint. The mine is doing geohydrological studies to determine how to prevent underground seepage escaping from the perimeter, again it will be captured and return to the process.

1.1 Terms of Reference

The proposal for the faunal specialist study was to assess the footprint of the following infrastructure components proposed as part of the Mine Waste Solutions Kareerand TSF Extension Project. In accordance with the accepted proposal for this faunal study, the following aspects were to be included in this specialist report:

- A determination of the potential faunal habitat in the study area, based on the Vegetation Types demarcated by De Castro (2018) and habitat surveys.
- Identification of all vertebrate species (birds, herpetofauna and mammals) to be present in the study area, making use of existing distribution data and atlases. This will be verified by faunal surveys in the identified Vegetation Types.
- Identification of certain invertebrate groups (butterflies, dragonflies, spiders and scorpions) to be present in the study area, making use of existing distribution data and atlases. This will be verified by surveys of certain invertebrate taxa in the identified Vegetation Types.
- Identification of all Red Data species expected to be present according to desktop studies of all relevant animal groups, namely birds, herpetofauna (amphibians and reptiles), mammals, butterflies, dragonflies, spiders and scorpions. This will be verified by faunal surveys in the identified Vegetation Types.
- An assessment of envisaged impacts to the fauna associated with the proposed development will also be provided, as will appropriate preliminary mitigation measures for any identified 'species of conservation concern', protected faunal species and sensitive habitats.

It was proposed by the client that the report should comply with the National Environmental Management Act (107/1998): Amendment of the Environmental Impact Assessment Regulations Listing Notice 1 of 2014, (checklist inserted directly after the title page of this report). This has been done and the completed feedback appears in "Specialist reports and reports on specialist processes Checklist" at the beginning of this report.

1.2 Assumptions & Exclusions

Assumptions and exclusions associated with this study include the following: The assumption has been made that:

- The lists of fauna for the site are based on those observed at the site as well as those likely to occur in the area based on their distribution and habitat preferences.

- The assumption has been made that all vegetation and topsoil on the proposed Borrow pit footprints will be permanently removed from the project footprint during the construction phase of the development and that Species of Special Concern will be rescued and relocated where feasible to a suitable protected habitat.

- Spatial GIS shape files received from the client that demarcate the proposed infrastructure development footprints are accurate.

- The details regarding the actions that will be taken during closure/decommissioning and rehabilitation is not available at this early stage of the proposed development and therefore falls outside the scope of the current report. This should be further addressed as part of the closure and rehabilitation plans for the mine.

1.3 Legislative requirements

According to the client brief and in terms of Government Notices R 983 and R 984, an EIA is required for the following activities (Table 3):

Table 3: List of 'trigger' activities in terms of the NEMA:

NAME OF ACTIVITY (All activities including activities not listed) (E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc.)	**Aerial extent of the Activity Ha or m²**	**APPLICABLE LISTING NOTICE (GNR 983, GNR 984 or GNR 985 as amended by As amended by GNR 324, GNR 326 and GNR 327 of 7 April 2017)**
Return Water Dam	518,810 m^2	Activity 12 of GNR 983
Return Water Dam	518,810 m^2	Activity 13 of GNR 983
Return Water Dam	518,810 m^2	Activity 16 of GNR 984
Vegetation clearance for footprint preparation	10,294,224 m^2	Activity 15 of GNR 984
Tailings Storage Facility (TSF) and borrow pits	15,166,039 m^2	Activity 19 of GNR 983
Borrow pits		Activity 21 of GNR 983
Tailings Storage Facility (TSF)	10,513,253 m^2	Activity 48 of GNR 983
Tailings Storage Facility (TSF)	10,513,253 m^2	Activity 4 of GNR 984
Expansion of the current TSF and associated infrastructure	16,818,021 m^2	Activity 34 of GNR 983
Slurry and Process water pipelines, storm water diversion channels	245,062 m^2	Activity 9 of GNR 983
Slurry and Process water pipelines	245,062 m^2	Activity 10 of GNR 983
Slurry and Process water pipelines	245,062 m^2	Activity 45 of GNR 983
Slurry and Process water pipelines	245,062 m^2	Activity 46 of GNR 983
Slurry and Process water pipelines	245,062 m^2	Activity 7 of GNR 984
Access and Haul Roads	207,740 m^2	Activity 24 of GNR 983
Reclamation of Tailings and depositing of reclaimed tailings.	33,613,253 m^2	Activity 6 of GNR 984
Reclamation of Tailings and depositing of reclaimed tailings	33,613,253 m^2	Category B (4) of NEMWA

2. Methodology

2.1 Methods and approach

Information assembled during previous biodiversity studies of the Kareerand TSF (Deacon, 2015) and studies relevant to the area (all the Clean Stream Biological Services Biodiversity Management Plans and Biodiversity Assessments from 2005 to 2015) was reviewed and used in this study. These projects included faunal studies of the Mine Waste Solutions surface rights area as well as the Vaal Reefs Mine Complex surface rights situated to the west of the study area:

> The Faunal diversity and Associated Ecological Aspects of the Anglo Ashanti Vaal River Mine Lease Area (Deacon, 2005).
>
> The Faunal diversity and Associated Ecological Aspects of the Anglo Gold Ashanti Vaal River section (Deacon, 2007).
>
> Biodiversity assessment for Anglo Gold Ashanti Vaal River. Specialist study: Monitoring local fauna, with an emphasis on threatened species (Deacon, 2013).
>
> Biodiversity assessment for AngloGold Ashanti Mine Waste Solutions: Specialist study: Local fauna, with emphasis on threatened species (Deacon, 2015).

Information on the broad-scale biodiversity conservation value of the study area and its surrounds was obtained from the North West Biodiversity Sector Plan (NWBSP), which is available on the SANBI Biodiversity Global Information System (BGIS) website. The NBWSP provided updated guidelines for the assessment of the biodiversity value of the entire province.

In order to meet the project scheduling requirements of MWS, all fieldwork was done during a single site visit between the 5th and 10th of November 2017. The field survey included the entire 1495.5ha study area but concentrated on the proposed infrastructure footprints.

Clean Stream Biological Services (CSBS) completed a comprehensive biodiversity assessment of the AngloGold Ashanti's (AGA) Mine Waste Solutions (MWS) area during 2015.

The primary deliverable of the 2015 study was the compilation of a Biodiversity Management Plan (BMP) for the MWS section (CSBS, 2015a). As part of this study, various detailed specialist studies (vegetation, terrestrial fauna, aquatic fauna, and biodiversity risk assessment) were performed which provided the foundation for the BMP.

Firstly, data collected during this study by Clean Stream Biological Services is updated. This includes a reassessment of available pre-development (baseline) faunal habitat and expected biota and the valuation of possible project site related effects. To do this effectively the following tasks were completed:

2.2 Specialist assessment of terrestrial fauna for the Kareerand Extension Project

The areas evaluated include the TSF extension area and potential borrow pit sites (for extraction of soils for rehabilitation of the TSF). Additional surveys were conducted in areas surrounding the development site, specifically those juxtaposed to the project area. The assessment includes a review of all relevant literature, completion of field surveys, production of specialist reports and development of management recommendations.

2.2.1 Desktop studies and literature review:

A detailed desktop study on all faunal species recorded in the past was completed and includes a description of red data and protected status according to IUCN red data list and the National Environmental Management Biodiversity Act (TOPS List). All applicable literature was reviewed and extensive background studies regarding species distributions, habitat preferences and species status were updated accordingly. The potential occurrence of threatened species is also evaluated from historical records, available literature, habitat availability and personal experience. The fauna species lists thus represent the majority of species occurring in the study area and provide a solid basis from which the mine can continue to develop a comprehensive species list using their own personnel with specialist input, where necessary. The following detailed desktop studies and baseline animal assessment were conducted:

- Identification of all animal species expected to be present according to desktop studies of all relevant animal groups, namely birds; herpetofauna (amphibians and reptiles); and mammals. Invertebrates, which were restricted to butterflies, dragonflies, spiders and scorpions, were included, but due to the great number species, only Red Data species were noted in these expected lists where available.
- Identification and compilation of known distribution records of all animal groups recorded during a detailed faunal assessment (wet season assessment) and from relevant literature
- Identification of all red data, protected and conservation important species per animal group and the compilation of distribution maps and GPS coordinates where recorded
- design management and monitoring programs to successfully monitor and manage all red data and protected and / or conservation important species.

2.2.2 Field surveys and habitat evaluation:

The current status of the faunal environment and an evaluation of the extent of site-related effects were determined using selected ecological indicators. At the same time all rare and endangered species, protected species, sensitive species and endemic species (conservation important faunal species) were identified and used to update and supplement existing studies. Ideally faunal surveys should cover the summer season, stretching from October to February. Due to the urgency of the project, surveys were conducted during November 2017 and the report made available mid-December 2017. These surveys included the following faunal groups:

Terrestrial invertebrate surveys

Terrestrial invertebrate survey - Invertebrates, which included butterflies, dragonflies, spiders and scorpions, were surveyed in pre-selected units. Emphasis is on invertebrates with high conservation value and their probability of occurrence in the unit.

- **Scorpions and spiders**

Survey methods included meticulous searches on fixed transects in all the representative biotopes, as well as pitfall traps for scorpions and spiders.

- **Dragonfly surveys**

Visual encounter and collecting species during surveys are appropriate techniques for both inventory and monitoring of dragonfly species. Taking photographs of dragonflies were useful to verify species identification.

- **Butterfly surveys**

Visual encounters and collecting species during surveys were appropriate techniques for both inventorising and monitoring butterfly species. Taking photographs of butterflies were useful to verify species identification.

Terrestrial vertebrate survey

Amphibians, reptiles, birds and mammals were surveyed in pre-selected units. Emphasis was placed on fauna with high conservation value and their probability of occurrence in the unit. These include meticulous searches on fixed transects in all the representative biotopes to assess the presence/absence of amphibians, reptiles, birds and mammals species. Where necessary, special methods were implemented to augment the chances of finding species, including traps, nocturnal spotlight searches and identifying tracks and scats. Special emphasis is placed on finding threatened species.

- **Amphibian surveys**

Visual encounter surveys and audio monitoring are appropriate techniques for both inventory and monitoring of amphibian species. Both visual and auditory surveys were conducted along all transects, in plots, along streams and around ponds. Most amphibians are detectable in this manner. To ensure a comprehensive inventory, all possible microhabitats were also searched, namely: soil, water, tree trunks, and beneath rocks, during both the day and at night.

- **Reptile surveys**

The most practical way to monitor reptiles, over large areas, is to sample along transects and systematically search encountered refuge areas. Transects were surveyed in different habitats and all cover objects within a specified distance of the line turned over and checked. One particular strength of such transect monitoring is that it can be used to relate reptile abundance to habitat variables, such as vegetation and cover. The main objective of the survey is not to find as many reptiles as possible, but to get a reliable estimate of available habitat and quality of shelter, and to compare these with expected reptiles and their required suite of habitat types.

- **Bird surveys**

Transects are probably the most widely used method of estimating the number of bird species in terrestrial habitats. Traditionally, observers will move along a fixed route undertaking surveys and recording the birds they see on either side of the route. For small birds, which are usually relatively numerous, a transect width of 10m on either side of the route (or 20-30m in open habitats) was found to be suitable for this study. Transects were placed in such a way that all dominant soil and associated habitat types were adequately covered. Birds outside the transect band or those flying over were noted. Surveys always commenced at first light when avian activity was at its peak. Bird calls are equally important in bird surveys and especially important during point counts in rugged terrain and dense bush where visual observations are limited. Point surveys can also be used within wide open areas where birds can be spotted from a distance, for example pans and grassland flats.

- **Mammal surveys**

The same line-transects were surveyed on foot to monitor diurnal mammal species. Each sighting as well as the related vegetation features was recorded to establish habitat preferences. All major habitat types were assessed. For smaller mammals such as rodents and insectivores, Sherman traps were put out near the tansect lines, while pitfall traps for collecting vertebrates was discontinued due to the time consuming effort and low success rates. Visual sightings, as well as all signs of mammal presence (tracks and scats) were used as indicators of presence for some species.

Habitat surveys

Representative habitats transects within study area were surveyed. Macro- and micro-habitat surveys are executed to assess the quality of habitat and its potential to support various faunal species.

In assessing the habitat profiles in conjunction with the distribution data per species, accurate information on the probability of the species occurring in the relevant biotopes was obtained. Thus a list of expected species for the different biotopes in the survey area was compiled and compared with the fauna observed during monitoring surveys. The information obtained from the micro-habitat surveys were used to enhance the prediction abilities of the process. To this end, quality and quantity of habitat aspects give an indication of species abundance, while presence or absence of habitat aspects indicates the probability of species occurrence. Habitat quality classifications could be a useful indication of resource utilization (especially in adjacent areas).

2.2.3 Impact Assessment

Habitat sensitivity assessment

The purpose of producing a habitat sensitivity map is to provide information on the location of potentially sensitive biodiversity features in the study area, including areas of natural vegetation, habitats supporting important biodiversity features or high diversity, areas supporting important ecological processes and habitat suitable for any species of conservation concern.

An explanation of the different sensitivity classes is given in Table 4. Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity.

Table 4: Explanation of sensitivity ratings.

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
VERY HIGH	Indigenous natural areas that are highly positive for any of the following: • presence of threatened species (Critically Endangered, Endangered, Vulnerable) and/or habitat critical for the survival of populations of threatened species. • High conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk). • Protected habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act) And may also be positive for the following: • High intrinsic biodiversity value (high species richness and/or turnover, unique ecosystems) • High value ecological goods & services (e.g. water supply, erosion control, soil formation, • carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value) • Low ability to respond to disturbance (low resilience, dominant species very old).	• CBA areas. • Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered or Vulnerable. • Protected forest patches. • Confirmed presence of populations of threatened species.
HIGH	Indigenous natural areas that are positive for any of the following: • High intrinsic biodiversity value (moderate/high species richness and/or turnover). presence of habitat highly suitable for threatened species (Critically Endangered, Endangered, Vulnerable species). • Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age). • Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). • Moderate to high value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). And may also be positive for the following: Protected habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated	• Habitat where a threatened species could potentially occur (habitat is suitable, but no confirmed records). • Confirmed habitat for species of lower threat status (near threatened, rare). • Habitat containing individuals of extreme age. • Habitat with low ability to recover from disturbance. • Habitat with exceptionally high diversity (richness or turnover). • Habitat with unique species composition and narrow distribution. • Ecosystem providing high value ecosystem goods and services.

	Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act).	
MEDIUM-HIGH	Indigenous natural areas that are positive for one or two of the factors listed above, but not a combination of factors.	• Corridor areas. • Habitat with high diversity (richness or turnover). • Habitat where a species of lower threat status (e.g. (near threatened, rare) could potentially occur (habitat is suitable, but no confirmed records).
MEDIUM	Other indigenous natural areas in which factors listed above are of no particular concern. May also include natural buffers around ecologically sensitive areas and natural links or corridors in which natural habitat is still ecologically functional.	
MEDIUM-LOW	Degraded, secondary or disturbed indigenous natural vegetation.	
LOW	No natural habitat remaining.	

The potential impacts or risks associated with the proposed development were assessed based on the following criteria:

- **Applicable phase: Construction, Operational, (Decommissioning)**
- **Nature of impact:** Provides a description of the expected impacts
- **Extent of impact:**
  - Site: Effect limited to site and its immediate surrounds
  - Local: Effect limited to 3 to 5km of the site
  - Regional: Effect will have an impact on a regional scale.
- **Duration of impact:**
  - Short: Effect lasts for a period of 0 to 5 years
  - Medium: Effect continues for a period between 5 and 10 years
  - Long: Effect will cease after operational life of the activity either because of natural process or by human intervention
  - Permanent: Where mitigation either by natural process or human intervention will not occur in such a way or in such a time span that the impact can be considered transient.
- **Intensity of impact:**
  - Low: The impact affects the environment in such a way that natural, cultural and social functions and processes are not affected
  - Medium: Where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way
  - High: Where the natural, cultural or social functions or processes are altered to the extent that it will temporarily or permanently cease
- **Probability:**
  - Improbable: Less than 33% chance of occurrence
  - Probable: Between 33 and 66% chance of occurrence.
  - Highly probable: Greater than 66% chance of occurrence
  - Definite: Will occur regardless of any prevention measures
- **Significance:**
  - Low: Where the impact will have a relatively small effect on the environment and will not have an influence on the decision
  - Medium: Where the impact can have an influence on the environment and the decision and should be mitigated

    - High: Where the impact definitely has an impact on the environment and decision regardless of any possible mitigation
- **Status**:
    - Positive: Impact will be beneficial to the environment
    - Negative: Impact will not be beneficial to the environment
    - Neutral: Positive and negative impact
- **Confidence:**
    - Low: It is uncertain whether the impact will occur
    - Medium: It is likely that the impact will occur
    - High: It is relatively certain that the impact will occur

Mitigation: Provides recommendations for mitigation measures
Significance post mitigation: Describes the significance after mitigation.

2.2.4 Limitations

The most significant limitations for the faunal study were as follows:

- Due to the nature and habits of most faunal taxa it is unlikely that all species would have been observed during a site assessment of limited duration. Therefore, site observations are compared with literature studies where necessary.

- In order to meet the clients' project scheduling requirements, all fieldwork was done during a single site visit in early November. The study area experienced low rainfall in the early summer season prior to the field survey and was very dry at the time of the field survey.

- The study area experienced low rainfall in the early spring season prior to the field survey and was very dry (end of the 2017 drought period) and heavily grazed at the time of the field survey.

    - Invertebrates: Due to these circumstances very low catch success rates were obtained with pitfall traps for invertebrates. Despite searching actively for scorpions and special spiders (baboon spiders), sightings were very rare which resulted in a lack of proper species data.

    - Vertebrates: Due to these circumstances very low catch success rates were obtained with pitfall traps for vertebrates. Active searches for frogs and reptiles were more successful and improved the quality of the species data.

    - Rodents: Due to these circumstances low catch success rates were obtained with Sherman traps (2 species).

- Although butterflies and dragonflies were present, they were also low in numbers.

- Due to the crime in the area (illegal miners and close proximity of a township), nocturnal searches were discouraged.

- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records, due to the naturally low density of such species, that makes it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be unexpectedly located in an area.

- No detail was available at this phase of the project regarding the exact processes that will be followed during closure/decommissioning. No detailed impact assessment can therefore be completed.

3. Description of the study area

3.1 Present Ecological State of the study area

The study area is situated in the North-West Province some 8.5km southwest of Stilfontein and, comprising parts of the farms Hartebeestfontein, Buffelsfontein, Kareerand, Kromdraai and Megadam. These farms are subdivided into smaller portions and these portions are illustrated in Figure 1 and listed in Table 1. The entire study area is situated within the quarter degree grid 2626DD.

The areas which include the vegetation types Vaal Reefs Dolomite Sinkhole Woodland and Rand Highveld Grassland, have been transformed significantly due to human impact. Specifically, large areas of land have been transformed by anthropogenic impacts such as cultivation (ploughing of soils), mining infrastructure (e.g. slimes dams, discard dumps, plants and offices), introductions of alien invasive trees and construction of transport infrastructure (roads and railway lines). Although classified as untransformed, much of the remaining indigenous vegetation has also been degraded by anthropogenic impacts such as heavy grazing (or in some cases exclusion of grazing by ungulates), altered fire regimes (usually in the form of reduced fire frequency), alterations to hydrological patterns and water quality, along with various edge effects emanating from surrounding transformed areas. The areas studied herein are depicted in Figure 1 and the TSF extension indicated with a blue outline.

The MWS study area includes a large tailings storage facility on the Farm Megadam 574 IP. The remainder of the southern portion of the study area comprises mostly untransformed grassland with smaller areas of woodland and secondary grassland historically cultivated (including disused centre pivot areas on the farm Kromdraai 420 IP). The central and eastern portions of the farm Buffelsfontein 433 IP are fenced with game proof fencing and leased as a game farm. The Vaal River makes up the southern boundary of the game farm. Figures 2 and 3 illustrate the present ecological state of the project area and the area surrounding it.

The topography of the study area is generally flat to slightly undulating and gently slopes from north to south. The vegetation map for South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006) describes the vegetation of the farms Buffelsfontein 443 IP, Megadam 574 IP and Kromdraai 420 IP as Vaal Reefs Dolomite Sinkhole Woodland (west) and the eastern half as Rand Highveld Grassland. Vaal Reefs Dolomite Sinkhole Woodland forms part of the Dry Highveld Grassland Bioregion of the Grassland Biome (Mucina & Rutherford, 2006). While the Rand Highveld Grassland forms part of the Mesic Highveld Grassland Bioregion of the Grassland Biome (Mucina & Rutherford, 2006).

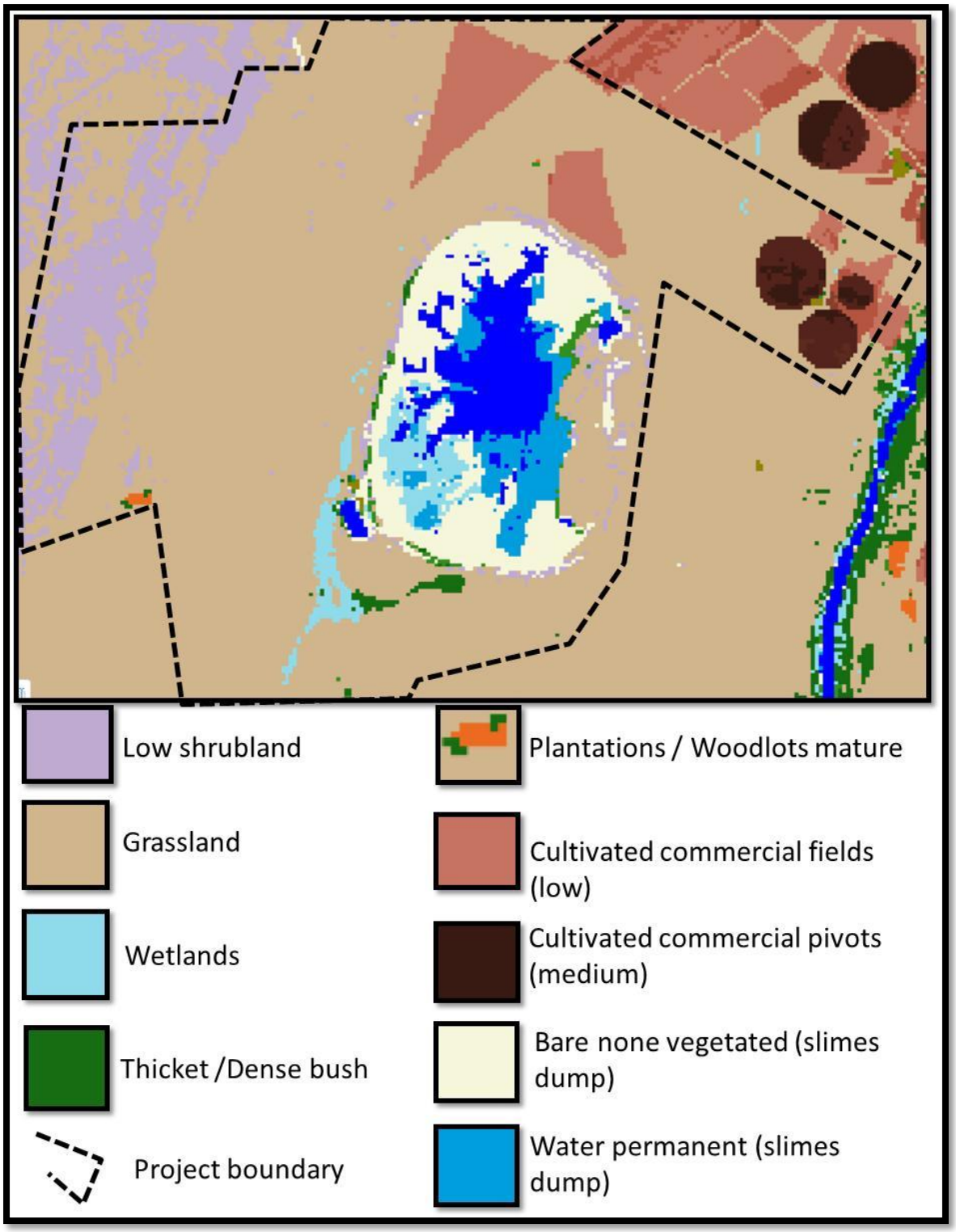

Figure 2: The land cover for the MWS Kareerand TSF expansion project area as illustrated by the 'Land Cover' GIS shape-file (land cover category of the property - natural, degraded, irreversibly modified etc.) obtained from the LUDS maps (BGIS, 2015).

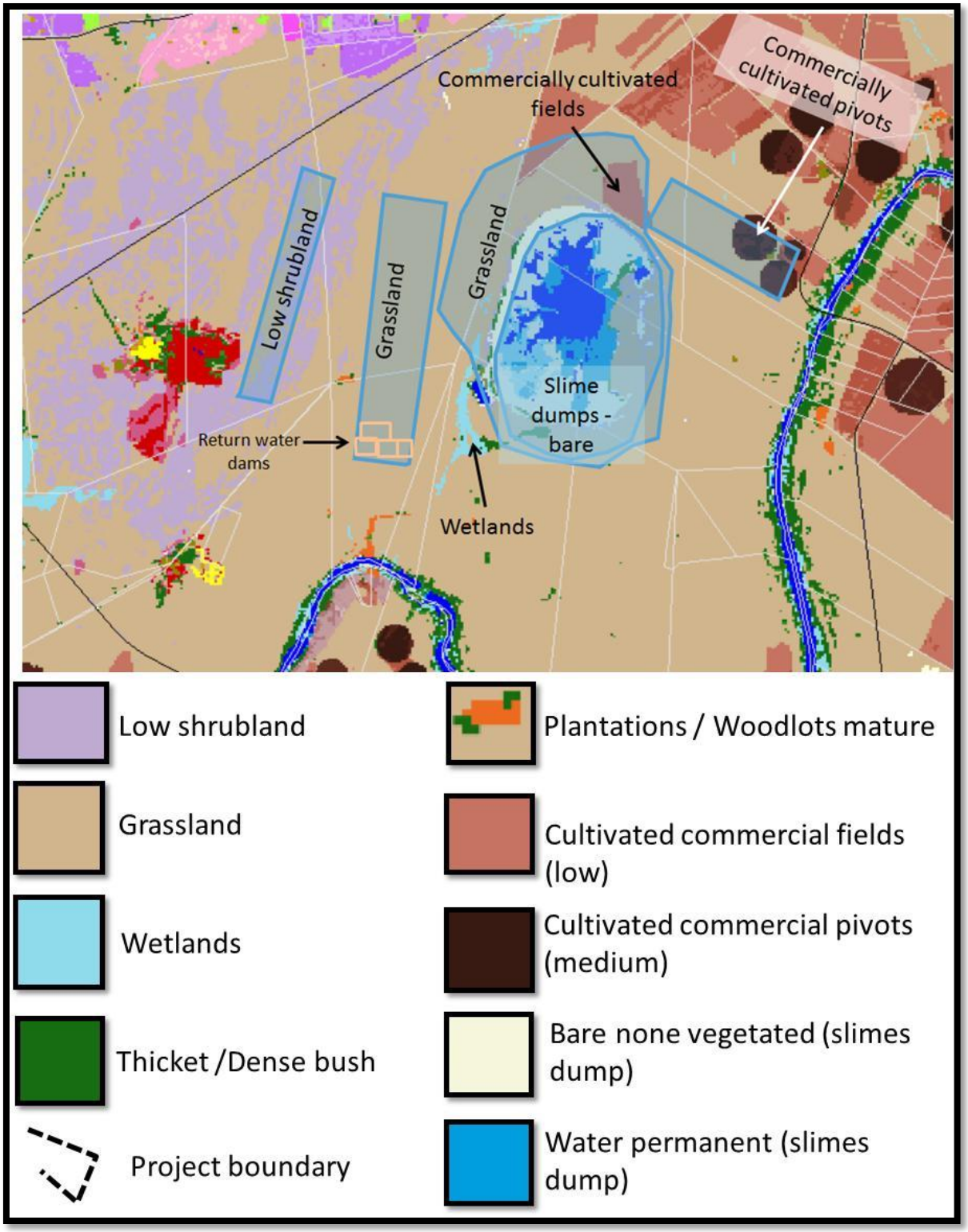

Figure 3: The land cover categories of the project area with the positions of the proposed project developments area as illustrated by the 'Land Cover' GIS shapefile (land cover category of the property - natural, degraded, irreversibly modified etc.) obtained from the LUDS maps (BGIS, 2015).

3.2 Physiography of the study area

The study area is situated in the Grassland Biome, covering a Grassland vegetation type (Rand Highveld Grassland) and a Woodland vegetation (Vaal Reefs Dolomite Sinkhole Woodland) type (Mucina & Rutherford, 2006), with a flat to gently undulating terrain near the town of Stilfontein.

Rand Highveld Grassland [Gm 11], failing in the eastern part of the study area, this is 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. There is a high diversity of herbs on the plains, while the rocky hills and ridges carry sparse savanna woodlands. The main features geological features are quartzite ridges and soils of various qualities, including shallow soils on the rocky ridges. The region receives summer-rainfall whiling experiences high summer temperatures but severe winter frost. Its conservation status is “Endangered” with a target of 24%. It is poorly conserved (only 1%) in small patches in statutorily reserves and private conservation areas. Almost half has been transformed by cultivation, plantations, urbanization or the building of dams.

Vaal Reefs Dolomite Sinkhole Woodland [Gh 12] is described as a grassland-woodland vegetation complex and occupies a small area in and around Stilfontein and Orkney (Vaal Reefs). The Vaal River forms the southern distribution limit of this vegetation unit. The terrain is slightly undulating and dissected by prominent rocky chert ridges. The most typical vegetation feature is the woodland, which occurs naturally in clumps around sinkholes, especially in places of dolomite outcrops. The area occurs almost exclusively on the dolomites where underground dissolution of the rock causes sinkholes. As a result more than 50% of the main soil types are relatively shallow and rocky. Erosion is generally very low. The climate is also typically warm-temperate with summer-rainfall, high summer temperatures and severe winter frost. Its conservation status is “Vulnerable” with a target of 24% and only a small patch currently conserved. Almost a quarter has been transformed already – mainly by mining, cultivation, urban sprawl and road-building. This region in general contains possibly the highest concentration of mines of any vegetation type in South Africa.

3.2.1 Vegetation units and land cover types within the study area

The following table (Table 5) summarizes the vegetation units and land cover types within the study area and was obtained from the Botanical Biodiversity Impact Assessment Report by De Castro (De Castro, 2018) for this project. It is important to have a thorough understanding of the vegetation types and the structure of these components, because together with the physiography of the area it provides the template for potential faunal habitat. Wetlands are important for life cycle of amphibians and therefore some understanding of the wetlands and potential habitat provided should also be recognized.

Table 5: The vegetation units and land cover types of the MWS Kareerand TSF extension project (Figure 4).

Vegetation unit and landcover type	**Description**	**Position in the study area**
1. Pan wetland	Includes the marsh vegetation and hygrophilous grassland of a single, small ephemeral endorheic pan	Situated in the north-western parts of the study area adjacent to Borrow Pit 2.
2. Valley-bottom wetland - including associated hillslope seeps	Includes marsh vegetation, dominated by hygrophilous grassland and sedges, in valley-bottom wetlands and associated hillslope seeps.	On the farms Megadam, Kromdraai and Kareerand.
3. *Acacia karoo* Woodland	Closed to Open Woodland in which *A. karoo* is dominant and few other species of trees and shrubs contribute significantly to woody cover.	Occurs mainly on red-brown clay loam soils overlying diabase.
4. *Acacia erioloba* Woodland	*Acacia erioloba* dominated Short Open/Closed Woodland situate in sinkholes overlying dolomite, on red brown sandy clay loams.	Occurs only in two small patches on the farm Hartebeestfontein.
5. Clay Grassland	Comprises species rich Closed Grassland, predominately on moderately deep red-brown to brown clay loams, overlying diabase and andesitic lava. This unit also includes species rich Grassland with occasional bushclumps, on low outcrops of diabase boulders.	This is the identified unit with the greatest extent within the study area. Low outcrops of diabase boulders on the farms Kromdraai and Megadam.
6. Dolomite Grassland	Comprises predominantly of Closed Grassland and Sparse Woodland on shallow and rocky (chert) brown clay loams with surface rock cover usually between 15% and 30%.	Confined to a low chert ridge running the length of the eastern boundary of the study area.
7. Sandy Grassland	Grassland on moderately deep to shallow, light brown sandy loams or sandy clay loams overlying mostly quartzite but also shale and siltstone. Occurs on a low, linear, rocky (quartzitic) outcrop in the south central parts of the study area.	Occurs in the south central parts of the study area at the juncture of boundaries of the farms Megadam, Hartebeestfontein and Buffelsfontein.
8. Secondary Grassland	Secondary grassland of historically cultivated areas.	Cultivation varies from approximately six years (i.e. centre pivot fields on the farm Kromdraai) to more than 15 years.
9. Artificial wetland	Secondary wetland vegetation of areas of clay soils that were once representative of Clay Grassland, that have been degraded by contaminated seepage and runoff from the existing TSF.	Comprises a thin strip of secondary (ca. 10m to 30m in width) along the western foot of the retaining wall of the existing TSF.
10. Alien trees	Small *Eucalyptus* plantations.	A few stands of alien trees around the abandoned homesteads in the north-eastern parts of the study

		area on the farms Kareerand and Kromdraai.
11. Infrastructure	Includes existing all mine infrastructure and two abandoned farm homesteads.	In the north-eastern parts of the study area on the farms Kareerand and Kromdraai.

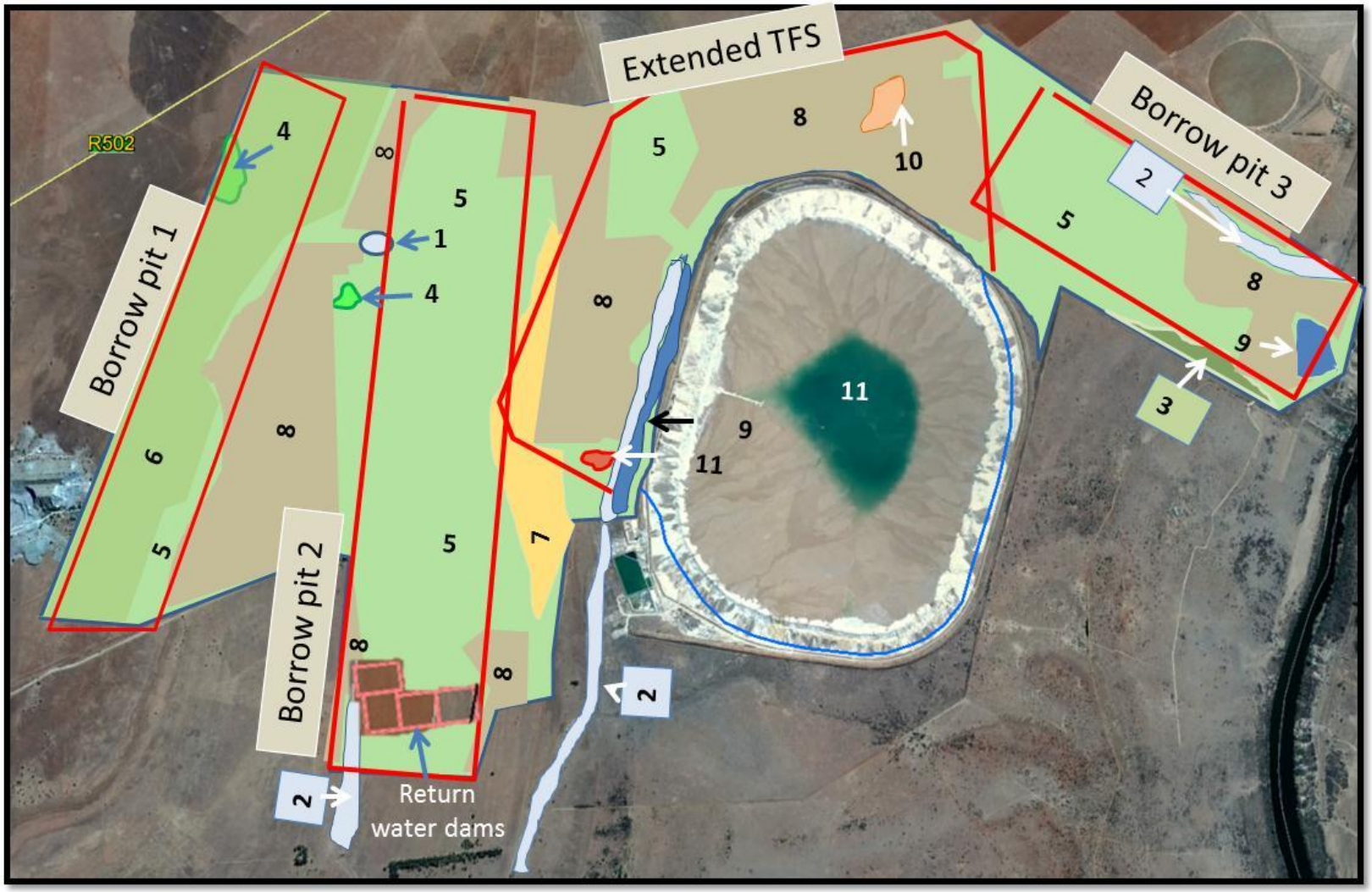

Figure 4: The study area showing all the vegetation/land cover types and the proposed development options. Vegetation/land cover types categories: **1** Pan wetland; **2** Valley-bottom wetlands; **3** *Acacia karoo* Woodland; **4** *Acacia erioloba* Woodland; **5** Clay Grassland; **6** Dolomite Grassland; **7** Sandy Grassland; **8** Secondary Grassland; **9** Artificial Wetland; **10** Alien trees; **11** Existing Infrastructure.

3.2.2 Vegetation and land cover types identified for the faunal surveys

Pan Wetland

One Pan Wetland is located in Clay Grassland between the two proposed western borrow pit areas within a flat landscape or shallow depressions and support zoned systems of aquatic and hygrophilous vegetation. Although it has already been heavily by a windmill and reservoir, it is the only Pan Wetland in the area and is thus of special interest. At the time of the survey it was unfortunately dry and therefore the full habitat potential could not be established.

Figure 5: The Pan Wetland in the Clay Grassland with a patch indigenous shrubs and the reservoir.

Valley-bottom wetlands

This vegetation unit supports seasonal marsh vegetation, dominated by hygrophilous grassland and sedges, of 'valley-bottom wetlands' that are either unchanneled or have poorly incised channels. These wetlands are found on the farms Megadam and Kromdraai. The soils are dark-brown to black hydromorphic clays, clay loams or sandy clay loams. There is strong lateral zonation of vegetation as a result of variations in key habitat parameters, such as flood frequency and duration, speed of floodwater, and topography and soil characteristics. The dense marsh vegetation is dominated by helophytic and hygrophytic grasses and, to a lesser extent, sedges.

Figure 6: The valley-bottom wetlands below the slimes dump.	**Figure 7:** A dry drainage line.

Figure 8: The valley-bottom wetlands with emerging and marginal hydrophilic plants.	**Figure 9:** The dammed part of the wetland with islands of emerging bulrushes and reeds.

Table 6: Aspects of Drainage lines (Wet season)

Habitat	Aspect of habitat	% of total habitat
Surface water	Shallow open water column and backwaters	15%
Herbaceous vegetation	Emergent hygrophytic grass and sedges	42%
	Floating aquatic vegetation	3%
	Inundated aquatic vegetation	15%
	Hygrophytic grass and sedges on land	15%
Bare ground	Wetted soil	5%
	Inundated mud & sand	5%

***Acacia karoo* Woodland**

This vegetation type consists of closed to open woodland in which the sweet thorn *(Acacia karoo)* dominates with few other tree or shrub species contributing significantly to woody cover. The woodland occurs mainly on brown alluvial sandy clay loams, and on red-brown clay loam soils overlying diabase, where species richness is far higher. In many cases, this

vegetation appears to have developed as a result of the exclusion of fire for the purposes of protecting grazing, or as a result of soil disturbance (e.g. scouring and trampling).


Figures 10 and 11: *Acacia karroo* Woodland habitat.

Within the study area and its immediate surroundings, the *Acacia karoo* Woodlands provide a unique habitat structure necessary for a wide diversity of animals.

Table 7: Aspects of *Acacia karroo* Woodland habitat (Wet season)

Habitat	Aspect of habitat	% of total habitat
Woody vegetation	Tall woodland	70%
	Shrubs	16%
	Logs - prostrate	Fraction
	Dead trees with loose bark or holes	Fraction
Ground cover	Stones and rocks	2%
Herbaceous vegetation	Tall, rank grass cover	2%
	Short grazing lawns	5%
	Forbs	2%
	Vegetable debris	Fraction
Bare ground	Loamy soil	3%
	Holes in ground (burrows)	Fraction
	Moribund termitaria	Fraction

Acacia erioloba **Woodland**

The camel thorn *(Acacia erioloba)* dominates this Short Open/Closed Woodland on red brown clay loams overlying dolomite. This vegetation unit occurs only on the farm Buffelsfontein and is representative of Vaal Reefs Dolomite Sinkhole Woodland, a Vulnerable vegetation type (Mucina & Rutherford, 2007).

The vegetation that characterises these areas is situated on slightly undulating landscape dissected by prominent rocky chert ridges and supporting a grassland-woodland vegetation complex. The most typical vegetation feature is the woodland, which occurs naturally in clumps around sinkholes, especially in places of dolomite outcrops.

The diverse floristic composition of the study area is a reflection of the high diversity of species that is generally encountered in the Grassland Biome, particularly natural grassland regions. It also reflects the presence of diverse habitat types such as natural grasslands, rocky outcrops, moist grassland areas and woodland habitat as well as areas that were subjected to transformation and degradation. Within the study area and its immediate surroundings, the

Acacia karoo Woodlands provides a unique habitat structure necessary for a wide diversity of animals.

Figure 12 and 13: The camel thorn *(Acacia erioloba)* clumps occurs naturally around sinkholes on red brown clay loams overlying dolomite.

Table 8: Aspects of *Acacia erioloba* Woodland habitat (Wet season)

Habitat	Aspect of habitat	% of total habitat
Woody vegetation	Tall woodland	20%
	Shrubs	15%
	Logs - prostrate	Fraction
	Dead trees with loose bark or holes	Fraction
Ground cover	Stones and rocks	2%
Herbaceous vegetation	Tall, rank grass cover	2%
	Short grazing lawns	30%
	Forbs	5%
	Vegetable debris	Fraction
Bare ground	Loamy soil	24%
	Holes in ground (burrows)	1%
	Moribund termitaria	1%

Clay Grassland

This vegetation unit comprises different components:

- a species-rich closed grassland, predominately on red-brown to brown clay loams overlying diabase and andesitic lava;
- a species-rich grassland with bush clumps on low outcrops of diabase boulders on the farms Kromdraai and Megadam;
- patches of grassland, distinct in terms of species composition, on grey to brown heavy clay soils, mostly overlying andesitic lava;
- moist terrestrial grassland, on clay soils which may experience temporary soils saturation on the margins of the wetland habitats of various valley-bottom wetlands.

The vegetation of this unit is representative of Rand Highveld Grassland, an “Endangered” vegetation type (Mucina & Rutherford, 2007).


Figure 14 and 15: The Clay Grassland vegetation unit is representative of the Rand Highveld Grassland.

Within the study area and its immediate surroundings, the Clay Grasslands provide a unique habitat structure necessary for a wide diversity of animals.

Table 9: Aspects of Clay Grasslands habitat (Wet season)

Habitat	Aspect of habitat	% of total habitat
Herbaceous vegetation	Tall, rank grass cover	20%
	Lightly grazed sparse short grass	38%
	Forbs	10%
Woody vegetation	Bush cover	10%
	Logs	Fraction
Bare ground	Clay loam soils	19%
	Holes in ground (burrows)	Fraction
	Rocks and stones	2%
	Moribund termitaria	1%

Dolomite Grassland – overlying dolomite

This unit makes up the majority of the study area and consists predominantly of Closed Grassland and Sparse Woodland on shallow to moderately deep, red- brown clay loam soils overlying dolomite which is frequently exposed on the surface. The vegetation of this unit is representative of Vaal Reefs Dolomite Sinkhole Woodland, a “Vulnerable” vegetation type (Mucina & Rutherford, 2007). Small groves of trees and patches of *Rhus lancea* represent Closed Woodland to Short/Tall Forest vegetation types and are included in this unit.


Figure 16 and 17: Dolomite Grassland also includes small groves of trees - sparse Woodland on shallow to moderately deep, red- brown clay loam soils overlying dolomite which is frequently exposed on the surface.

Within the study area and its immediate surroundings, the Dolomite Grasslands provide a unique habitat structure necessary for a wide diversity of animals.

Table 10: Aspects of Dolomite Grassland habitat (Wet season)

Habitat	Aspect of habitat	% of total habitat
Herbaceous vegetation	Tall, rank grass cover	10%
	Lightly grazed sparse short grass	40%
	Forbs	10%
Woody vegetation	Bush cover	10%
	Logs	Fraction
Bare ground	Clay loam soils	19%
	Holes in ground (burrows)	Fraction
	Rocks and stones	10%
	Moribund termitaria	1%

Sandy Grassland – including quartzite outcrops

Sandy Grassland occurs on moderately deep to shallow, light coloured, brown to yellow-brown sandy loams overlying quartzites. This vegetation unit is situated on low, linear, rocky (quartzite) ridges adjacent to a valley-bottom wetland on the farm Megadam. It comprises the most species rich plant communities found within the study area; the grassland on the rocky quartzite ridges at Kareedam is particularly species rich. The vegetation of this unit is representative of Eastern Highveld Grassland, an Endangered vegetation type (Mucina & Rutherford, 2007), but also displays floristic and structural elements of Rand Highveld Grassland.

Figure 18 and 19: The species-rich grassland is situated on low, linear, rocky (quartzite) ridges adjacent to a valley-bottom wetland on the farm Megadam.

Within the study area and its immediate surroundings, the Sandy Grasslands provide a unique habitat structure necessary for a wide diversity of animals.

Table 11: Aspects of Sandy Grassland habitat (Wet season)

Habitat	Aspect of habitat	% of total habitat
Herbaceous vegetation	Tall, rank grass cover	15%
	Lightly grazed sparse short grass	35%

	Forbs	10%
Woody vegetation	Bush cover	10%
	Logs	Fraction
Bare ground	Clay loam soils	19%
	Holes in ground (burrows)	Fraction
	Rocks and stones	10%
	Moribund termitaria	1%

Transformed Vegetation/Habitat Types:

Secondary Grassland

Secondary grassland is an area that has been cultivated historically. Time elapsed since termination of cultivation varies from approximately three years (i.e. centre pivot lands on the farm Kromdraai) to more than 15 years. Vegetation structure and species composition varies in accordance with the stage of succession and soil type.

Figure 20 and 21: Two areas of secondary grassland in the study area - structure and species composition varies in accordance with the stage of succession and soil type.

Table 12: Aspects of Secondary Grassland habitat (Wet season)

Habitat	Aspect of habitat	% of total habitat
Herbaceous vegetation	Tall, rank grass cover	15%
	Lightly grazed sparse short grass	40%
	Forbs	15%
Woody vegetation	Bush cover	5%
	Logs	Fraction
Bare ground	Open ground	25%
	Holes in ground (burrows)	Fraction
	Rocks and stones	Fraction
	Moribund termitaria	Fraction

Secondary Wetland

Unchannelled valley-bottom wetlands alongside the current TFS are located on the farms Megadam and Buffelsfontein and have been degraded by contaminated seepage and runoff from the tailings storage facilities. The valley-bottom wetland includes marsh vegetation, dominated by hygrophilous grassland and sedges. The vegetation includes mostly dense *Phragmites* reed beds surrounded by seasonally inundated or saturated soils vegetated by facultative or obligate halophytes such as *Cynodondactylon* and *Juncus* cf. *rigidus* and various

alien invasive plant species. The soils in these wetland areas are dark-brown to black hydromorphic clays, clay loams or sandy clay loams.


Figure 22 and 23: Extensive growth of dense *Phragmites* reed beds around the tailings storage facility.

Alien trees

This transformed vegetation type includes plantations, windbreaks and stands of *Eucalyptus* species and other alien trees.

Figure 24: A stand of an exotic *Eucalyptus* species in the study area.

Infrastructure

This management unit includes the TFS infrastructure, comprised predominantly of the operational tailings storage facilities and associated infrastructure.

Figure 25: The operational tailings storage facility.

3.2.3 North West Province Biodiversity Sector Plan (NWBSP) and Threatened Ecosystems

The North West Province Biodiversity Sector Plan (NWBSP) (North West Department of Rural, Environment and Agricultural Development, 2015), provides a map of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) for the entire province, which is referred to as the CBA Map in the NWBSP.

Critical Biodiversity Area (CBA) maps and their associated land-use guidelines are used to determine the biodiversity context of a proposed land-use site, ahead of making the first site visit. Although the CBA maps supply crucial guidelines for the assessment, additional background information is needed to develop a broader understanding of the study area. A number of resources and tools are therefore used to establish how important the proposed development site is for meeting biodiversity targets. Specifically, the Land-Use Decision Support Tool (LUDS) and the North West Province Biodiversity Sector Plan (NWBSP) are extensively used to compile reports (BGIS, 2015). LUDS was developed to facilitate and support biodiversity planning and land-use decision-making at a national and provincial level.

Its primary objective is to serve as a guide for biodiversity planning but should not replace specialist ecological assessments. Critical Biodiversity Areas (CBAs) are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. If these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. To maintain an area in a ‘natural’ state, a variety of biodiversity-compatible land uses and resource uses should be followed.

Categories used in the CBA map are as follow:

- Protected Areas - protected areas recognized in the Protected Areas Act including South African National Parks and North West Provincial Parks;
- Conservation Areas - areas not recognized in the Protected Areas Act (e.g. conservancies and private nature reserves or game farms where there is no legal agreement);

- CBA – terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services, areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services;
- ESA - are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration;
- Other Natural Areas – that are all remaining natural areas not included in the above CBA or ESA categories. Degraded areas falling with the CBA and ESA categories should be earmarked for rehabilitation to an acceptable ecological state;
- No Natural Habitat Remaining - these are areas that have been transformed and do not contribute significantly to maintaining biodiversity pattern or ecological processes and include urban and rural settlements; crop lands; mines and mined areas; and, forest plantations.

The key results of the Biodiversity Geographic Information System (BGIS) maps and LUDS Report is summarized in Table 13. The information is extracted for the area from national datasets available from BGIS for the North West Province.

Table 13: The key results of the LUDS Report as extracted for the Kareerand project area from national datasets available from BGIS.

National Data Set	**Aspect**	**Present**
National terrestrial information: North West		
South African municipal boundaries	**Municipality name:** Matlosana Local Municipality	NW403
Quarter-degree grid square		2626DD
Terrestrial CBAs		
Bioregion	**National vegetation map**	**Status**
Dry Highveld Grassland Bioregion	Vaal Reefs Dolomite Sinkhole Woodland	Endemic; Threatened ecosystem: Vulnerable
Infrastructure	**CBA Category**	**Project area**
Borrow Pit 1 on Farm 57/422	Ecological support Area (ESA 1)	Hills & Ridges
Bioregion	**National vegetation map**	**Status**
Mesic Highveld Grassland Bioregion	Rand Highveld Grassland (GM11)	Threatened ecosystem: Vulnerable
Infrastructure	**CBA Category**	**Project area**
Borrow Pit 2 Farms RE/442 and RE443	Ecological support Area (ESA 1) Critical biodiversity Area (CBA2)	Corridor Corridor Nodes
Borrow Pit 3 Farm RE/4/420 & Farm RE/444	Ecological support Area (ESA 1) Critical biodiversity Area (CBA2) Ecological support Area (ESA 2) Ecological support Area (ESA 2)	Corridor Corridor Nodes Corridor Corridor - Cultivated Areas
Extended TSF footprint	Ecological support Area (ESA 1) Critical biodiversity Area (CBA2) Ecological support Area (ESA 2) Ecological support Area (ESA 2)	Corridor Corridor Nodes Corridor - Cultivated Areas Critical Corridor Linkages
Project area to the east (Figure 3)	Terrestrial CBA 1	CBA 1

Project area to the west (Figure 3)	Terrestrial CBA 2	CBA 2
National aquatic information: Middle Vaal Catchment		
Ecoregion 1	11 Highveld	
Ecoregion 2	11.01	
River quaternary	C24B	
Wetland ecosystem type	Mesic Highveld Grassland Group 4	Channelled valley-bottom wetland
Aquatic Critical Biodiversity Areas		
Project area to the west	Aquatic CBA 1	CBA 1
Freshwater CBAs and ESAs	CBA_W2 Channelled valley-bottom wetland	ESA1
River FEPA		Not a river FEPA
Fish FEPA		None
Fish Corridor		None
FEPA Catchment		None
NFEPA Water Management Area		None

Figure 26 defines the area in which the project development will take place. The locations of these zones are listed below and land modifications according to the CBA maps, are compared with the proposed planning of the project. The main development activities are proposed to take place in these areas as follow:

Critical Biodiversity Area and development in the Kareerand project area (Figure 26):

Activities in Terrestrial CBA 2

i. Proposed Project Area: Borrow Pit 1 on Hartebeestfontein 57/422
ESA 1: Hills & Ridges

ii. Proposed Project Area: Borrow Pit 2 on Hartebeestfontein RE/442
ESA 1: Corridor

iii. Proposed Project Area: Borrow Pit 2 and Return water dams on Buffelsfontein RE/443
ESA 1: Corridor
CBA2: Corridor nodes

iv. Proposed Project Area: Extended TSF footprint on Megadam 574, Hartebeestfontein RE/442
ESA 1: Corridor
ESA 2: Corridor cultivated areas
CBA 2: Corridor nodes

Activities in Terrestrial CBA 1

v. Proposed Project Area: Extended TSF footprint on Kareerand RE/444
ESA 2: Corridor
ESA 2: Corridor cultivated areas
ESA 2: Critical corridor linkages

vi. Proposed Project Area: Borrow Pit 3 on Kareerand RE/444, & Kromdraai 4/420
ESA 1: Corridor
ESA 2: Corridor cultivated areas
ESA 2: Critical corridor linkages
CBA 2: Corridor nodes

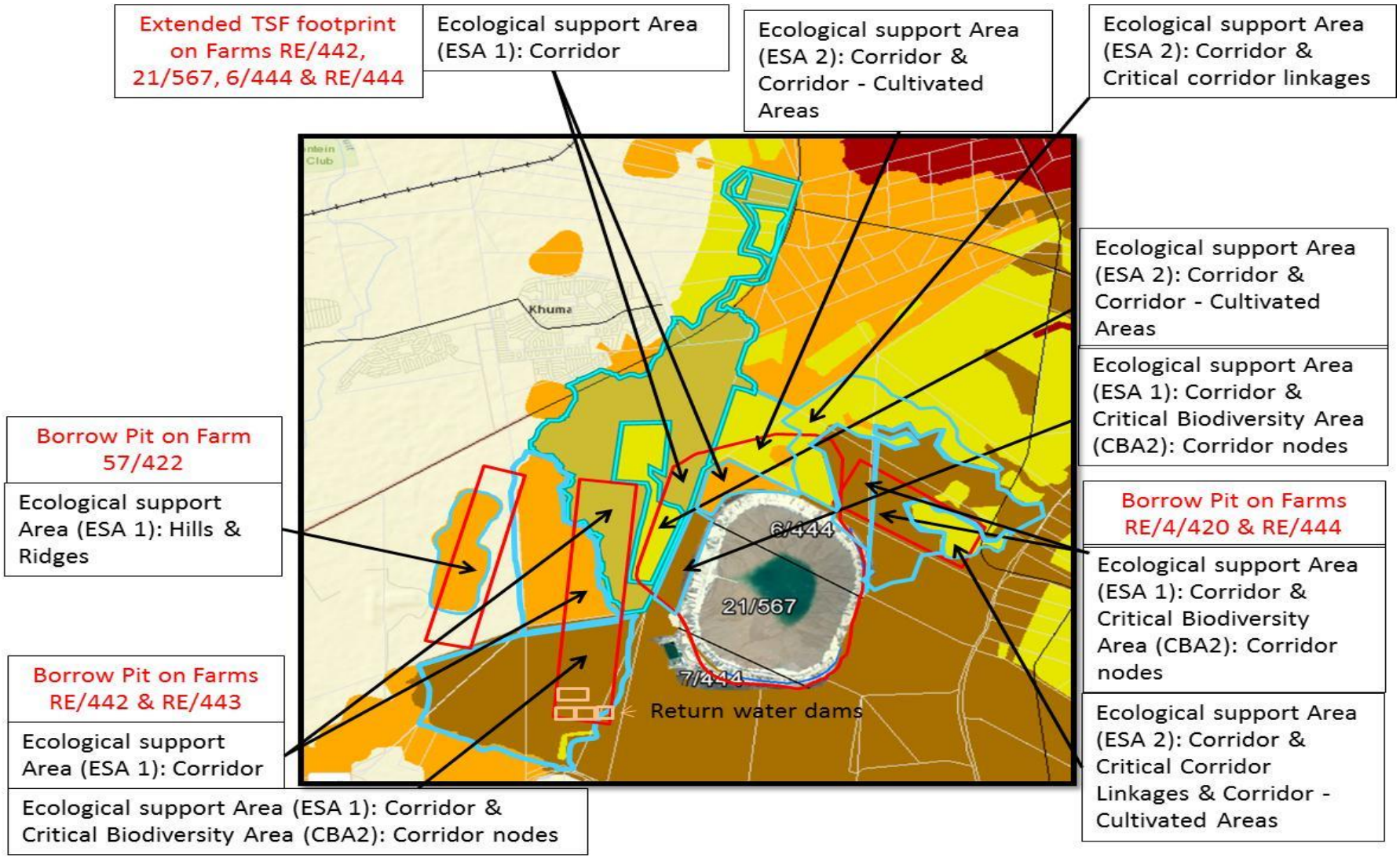

Figure 26: Detail regarding the category of the study area which includes CBA, ESA, ONA and/or No Natural Habitat Remaining.

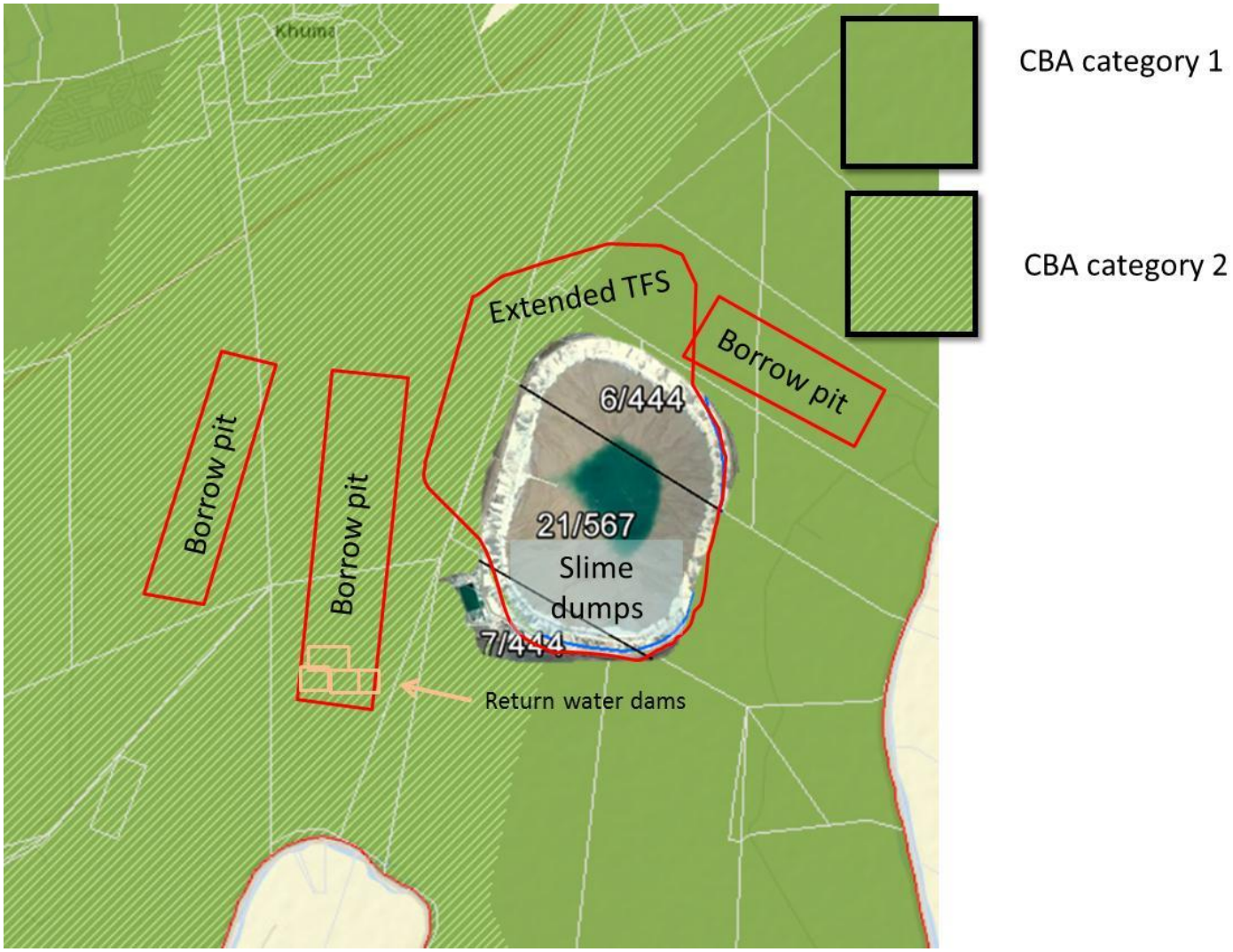

Figure 27: Terrestrial Critical Biodiversity Areas (CBAs) (North West Province Biodiversity Conservation Assessment) and the proposed positioning of the project development.

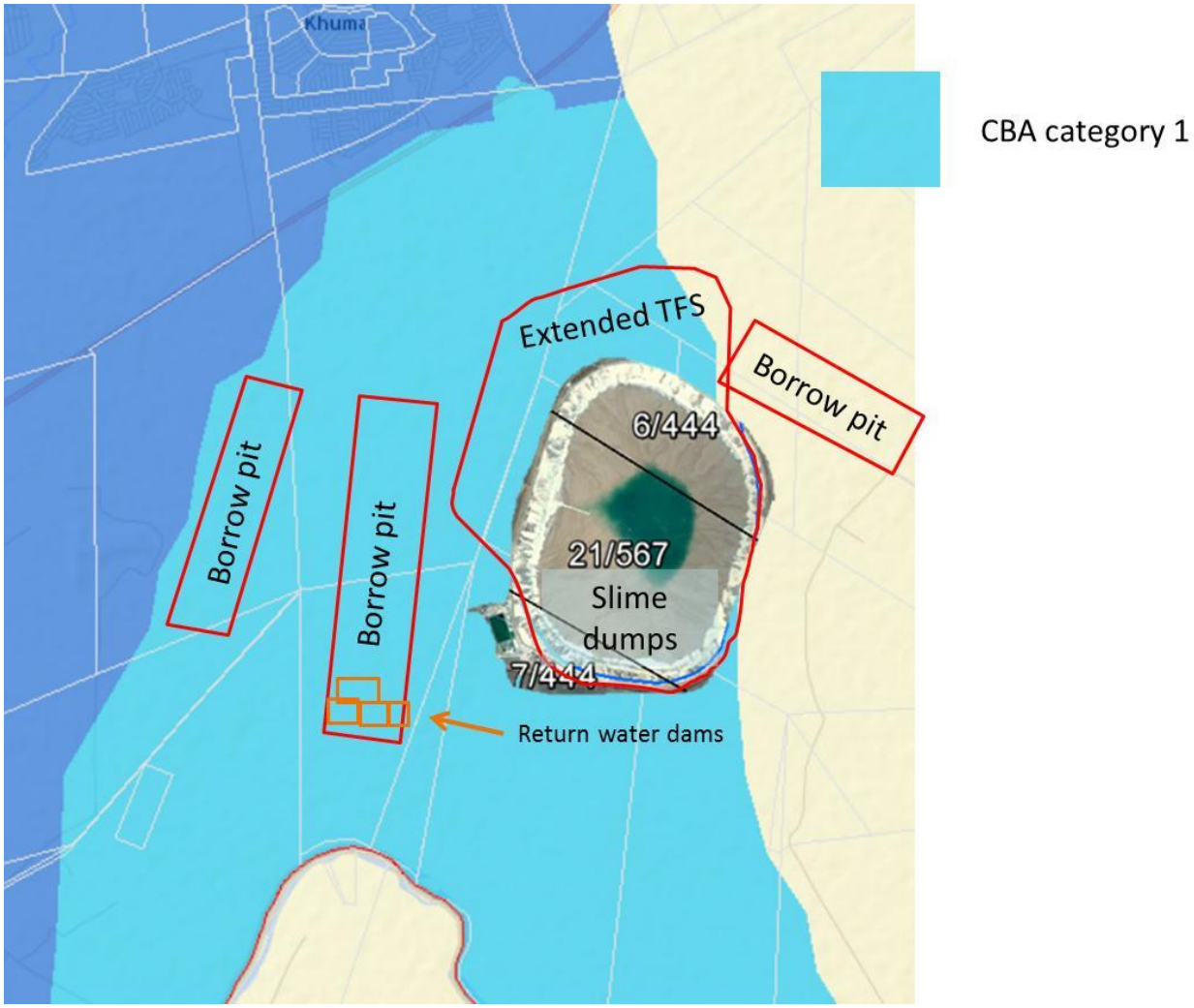

Figure 28: Aquatic Critical Biodiversity Areas (CBAs) (North West Province Biodiversity Conservation Assessment) and the proposed positioning of the project development.

The drainage system of the valley-bottom wetlands situated on the farms Megadam and Buffelsfontein is not recognized as a FEPA river or catchment. The status of the wetlands is important due to the situation where a part of the amphibian life cycle is completed in the aquatic environment.

Based on the importance values of the North West Province's requirements regarding the area, the entire study area falls within the CBA - Category 1 or CBA - Category 2 (Figure 26).

READ recommends Limits of Acceptable Change for the different land use categories. This refers to the maximum amount of transformed vegetation is permitted in that land use category. The recommended limit for Category 1 CBA's is that not more that 10% of a land parcel (i.e. development site or area), meaning that more than 90% of original natural vegetation of site or amount of 'natural resource' must remain intact after development. The recommended limit for Category 2 CBA's is between 10 and 40%, meaning that 60 to 90% of original natural vegetation of site must remain untransformed after development.

Maintaining biodiversity patterns, ecological processes and the ecosystem services derived from these, requires integrated management over large areas of land. The landscape approach to conservation is a system wide one where protected areas are embedded in a matrix of land-uses that strives for biodiversity compatibility. The following section categorizes

the CBA Map and the associated Land Management Objective according to the North West BSP in Part D of the "Guidelines for Land Use and Decision-Making". All of the categories are relevant to the project development (Table 14).

Table 14: The CBA Map categories and the associated Land Management Objectives according to the North West Biodiversity Sector Plan.

CBA MAP CATEGORY	LAND MANAGEMENT OBJECTIVE
Critical Biodiversity Area 1 (CBA 1)	Maintain in a natural or near-natural state that maximises the retention of biodiversity pattern and ecological process: • Ecosystems and species fully or largely intact and undisturbed. • These are areas with high irreplaceability or low flexibility in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost then targets will not be met. • These are biodiversity features that are at, or beyond, their limits of acceptable change.
Critical Biodiversity Area 2 (CBA 2)	Maintain in a natural or near-natural state that maximises the retention of biodiversity pattern and ecological process: • Ecosystems and species fully or largely intact and undisturbed. • Areas with intermediate irreplaceability or some flexibility in terms of meeting biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising the ability to achieve biodiversity targets, although loss of these sites would require alternative sites to be added to the portfolio of CBAs. • These are biodiversity features that are approaching but have not passed their limits of acceptable change.
Ecological Support Area 1 (ESA 1)	Maintain in at least a semi-natural state as ecologically functional landscapes that retain basic natural attributes: • Ecosystem still in a natural, near-natural state or semi-natural state, and has not been previously developed. • Ecosystems moderately to significantly disturbed but still able to maintain basic functionality. • Individual species or other biodiversity indicators may be severely disturbed or reduced. • These are areas with low irreplaceability with respect to biodiversity pattern targets only.
Ecological Support Area 2 (ESA 2)	Maintain as much ecological functionality as possible (generally these areas have been substantially modified): • Maintain current land use or restore area to a natural state. • Ecosystem NOT in a natural or near-natural state, and has been previously developed (e.g. ploughed). • Ecosystems significantly disturbed but still able to maintain some ecological functionality. • Individual species or other biodiversity indicators are severely disturbed or reduced and these are areas that

	have low irreplaceability with respect to biodiversity pattern targets only. • These are areas with low irreplaceability with respect to biodiversity pattern targets only. These areas are required to maintain ecological processes especially landscape connectivity.
Other Natural Areas and No Natural Habitat Remaining	Production landscapes: • Manage land to optimise sustainable utilisation of natural areas.

Table 15: A matrix of recommended land use zones and associated activities in relation to the CBA Map categories.

Land use zone	Associated land use activities	CBA1	CBA2	ESA1	ESA2	ONA
Quarrying and mining	Quarrying and open cast mining (includes surface mining, dumping and dredging).	N	N	N	N	R

Notes:
1. Guidelines apply only to natural or near natural land with natural vegetation cover within each category (on site).
2. Y = YES, permitted and actively encouraged activity;
3. N = NO, not permitted, actively discouraged activity;
4. R = RESTRICTED to compulsory, site-specific and controls when unavoidable, not usually permitted.

4. Results

4.1 Faunal survey transects in the MWS Kareerand project area.

A major component of this study is the characterization of habitats and associated fauna (obtained from regional distribution records) of the available landscape/environment. This information is used as a basis for predicting the potential impacts of the proposed mining, and other human-induced activities, on the composition of threatened fauna in the study area. Representative survey sites were selected in all prominent vegetation types of the study area. Extensive transects (400-3000m) were then surveyed for potential habitat and all associated fauna. GPS readings provide fixed locations of these transects for future monitoring (Table 16; Figure 29).

Table 16: Description of transects or point counts conducted for habitat, micro-habitat, influences and impacts, birds, mammal signs and herpetofauna (November 2017).

Habitat	**COORDINATES**		**Length (m)**	**Total (m)**
	Start	**End**		
Wetlands				
Pan wetland				
Transect 1 (8 = 4/pan)	S26^{0}52.904 E26^{0}51.773	Polygon	868	
			Total	**868m**
Valley-bottom wetlands				
Transect 2 (4 = 2	S26^{0}54.251 E26^{0}51.774	S26^{0}54.533 E26^{0}51.708	559	
Transect 3 (17 = 2	S26^{0}53.921 E26^{0}52.537	S26^{0}54.126 E26^{0}52.607	411	
Transect 4 (6 = 2	S26^{0}54.623 E26^{0}52.442	S26^{0}54.543 E26^{0}52.490	169	
			Total	**1139m**
Woodlands				
Acacia karoo Woodland				
Transect 5 (11 = 3	S26^{0}52.611 E26^{0}52.991	Polygon	576	
Transect 6 (2 = 3	S26^{0}52.902 E26^{0}54.389	S26^{0}53.237 E26^{0}54.292	623	
			Total	**1199m**
Acacia erioloba Woodland				
Transect 7 (8 = 4/pan)	S26^{0}52.904 E26^{0}51.773	Polygon	868	
			Total	**868m**
Grasslands				
Clay Grassland – Diabase and Andesitic lava				
Transect 8 (5 = 5	S26^{0}54.101 E26^{0}52.013	S26^{0}54.008 E26^{0}51.973	190	
Transect 9 (13 = 5	S26^{0}52.849 E26^{0}54.466	Polygon	2424	

Transect 10 (14 = 5	S26^{0}52.429 E26^{0}53.061	Polygon	959	
Transect 11 (15 = 5	S26^{0}54.320 E26^{0}52.110	Polygon	2292	
Transect 12 (19 = 5	S26^{0}53.614 E26^{0}52.280	S26^{0}53.630 E26^{0}51.926	588	
			Total	**6453m**
Dolomite and Chert Grassland				
Transect 13 (12 = 6	S26^{0}53.653 E26^{0}51.036	Polygon	1480	
Transect 14 (18 (7) = 6	S26^{0}53.679 E26^{0}51.031	S26^{0}53.801 E26^{0}50.946	274	
			Total	**1754m**
Sandy Grassland				
Transect 15	S26^{0}53.086 E26^{0}52.709	S26^{0}52.908 E26^{0}52.772	355	
			Total	**355m**
Transformed Vegetation / Habitat types				
Secondary Grassland				
Transect 16 (1 = 8	S26^{0}52.972 E26^{0}55.256	S26^{0}52.934 E26^{0}54.937	543	
Transect 17 (3 = 8	S26^{0}52.414 E26^{0}53.528	S26^{0}52.293 E26^{0}53.268	489	
Transect 18 (7 = 8	S26^{0}53.680 E26^{0}51.765	Polygon	1360	
Transect 19 (9 = 8	S26^{0}53.680 E26^{0}51.765	S26^{0}52.904 E26^{0}51.773	1596	
Transect 20 (10 = 8	S26^{0}52.904 E26^{0}51.773	S26^{0}51.687 E26^{0}51.456	1971	
			Total	**5959m**
Secondary Wetland				
Transect 21 (16 = 9	S26^{0}53.652 E26^{0}52.747	S26^{0}53.347 E26^{0}52.840	590	
			Total	**590m**

GPS coordinates, acquired in the field (Table 15), were added to Google Earth to illustrate and demarcate the study area and survey transects. Twenty-one transects were completed to assess resident fauna and their associated habitats. Specific habitat features were identified to provide an indication of available habitat for different animals favouring a specific biotope (specifically medium-sized fauna across all vertebrate groups).

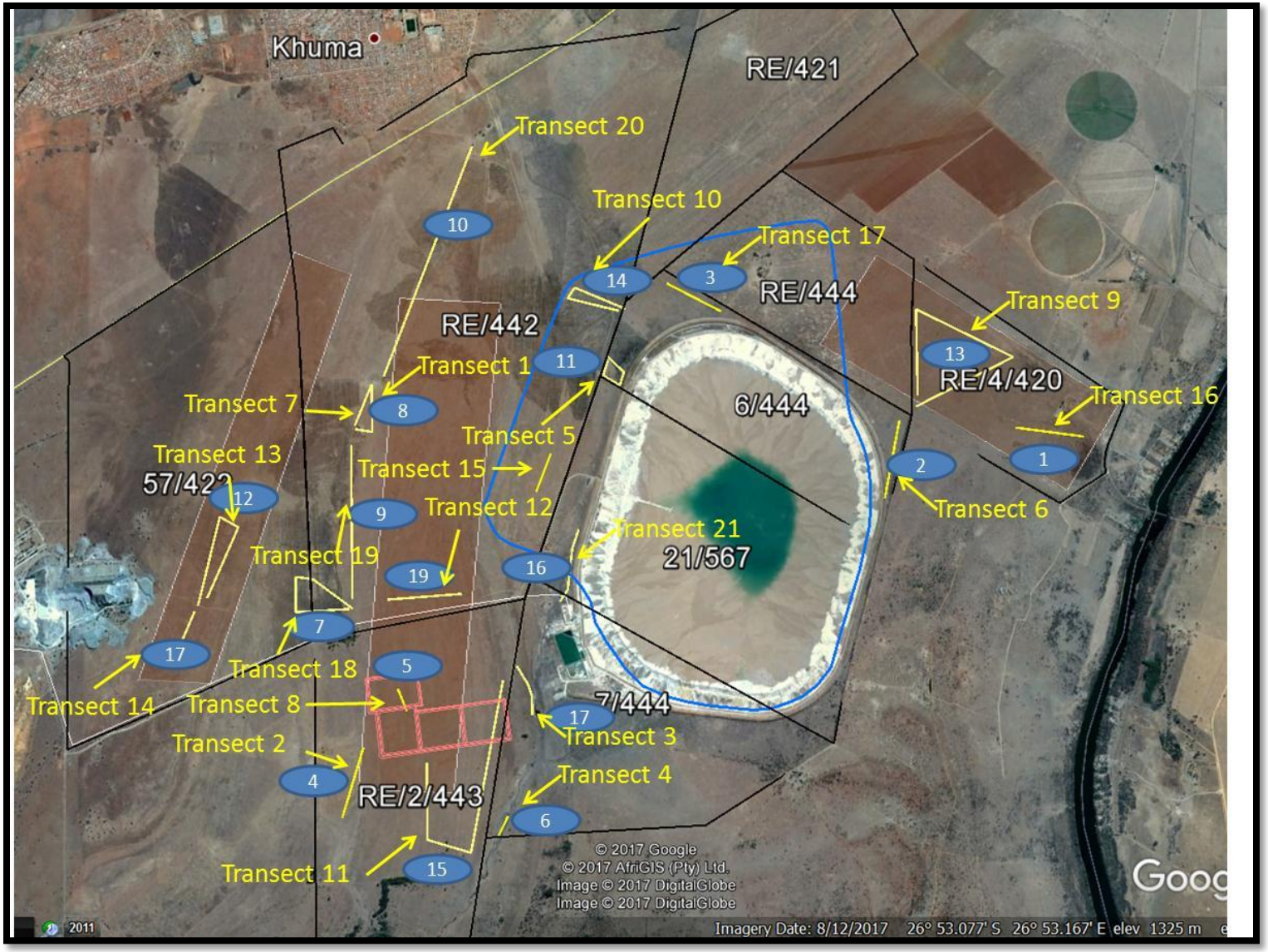

Figure 29: The locality of the detailed fauna and associated habitat transect were completed (see Table 15).

4.2 Faunal assemblages of the MWS Kareerand TSF extension project area

The fieldwork component of this study was conducted during November 2017. The survey methods described herein make use of a habitat surrogate technique, where habitat type and availability is used as a baseline assessment, with species' presence used to verify habitat integrity. The specialist report includes detailed species lists obtained from an extensive background review and the field monitoring results, with emphasis on the following:

- Probability of occurrence of species with high conservation value and assessment of the availability of their habitats on the property, as well as potential risks or threats to these species.
- Detailed overview on the current biodiversity status of the area in terms of terrestrial fauna.
- Status of faunal habitat, habitat preference and probability of occurrence.
- Provide relevant information to be used in the biodiversity management plan.

During the initial comprehensive biodiversity assessments (2013 to 2015) of the mine landscape, different vegetation and land cover units were identified. By definition, ecosystem status reflects the ecosystem's ability to function naturally, at a landscape scale and in the long-term. Vegetation types provide a good representation of terrestrial biodiversity because most animals, birds, insects and other organisms are associated with specific vegetation types (Table 4).

In order to establish a baseline of faunal occurrence, an assessment was made of the ecosystem template. The ecosystem template is a function of the geomorphology (abiotic) and the vegetation (biotic) structure of the area. By using species occurrence data from the previous surveys, the current survey (2017) and expected occurrence records of known species distributions and preferred habitat type, the baseline integrity of the study is established.

Ecosystem status reflects the ecosystem's ability to function naturally, at a landscape scale and in the long-term. The single biggest cause of biodiversity loss in South Africa is the loss and degradation of natural habitat. Vegetation types provide a good representation of terrestrial biodiversity, as they often reflect specific habitat types and associated animals, birds, insects and other organisms. The vegetation/land cover types were thus classified on the basis of structural and functional characteristics with the following objectives in mind:

- To assess the status of vegetation/land cover types impacted by development: due to either historical and/or present farming practices, residential occupation and/or mining practices;
- To assess the status of faunal assemblages in the study area, with emphasis on Species of Special Concern.

The next step is to establish the likelihood of Species of Special Concern, occurring in the vicinity (include degree of confidence). For this report, the category "Species of Special Concern" is considered to include all threatened taxa listed by South African Red Data lists (Species of Conservation Concern), Threatened or Protected Species (NEMBA) and all South African endemic taxa. Due to their limited distribution and range in South Africa, endemic species are also included as species of special interest. Traditionally, an endemic species will have a global distribution restricted to >90% of the atlas region.

More specific for the Northwest Province: a 'Species of Special Concern' is any species or subspecies of fish or wildlife or population of mammal or bird, native to the province that has entered a long-term state of decline in abundance or is vulnerable to a significant decline due to

low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance. These are species that are threatened, or, if not, their population number is in special concern of wildlife foundations:

- Occur in small, isolated populations or in fragmented habitat, and are threatened by further isolation and population reduction;
- Show marked population declines. Population estimates are unavailable for the vast majority of taxa. Species that show a marked population decline, yet are still abundant, do not meet the Special Concern definition, whereas marked population decline in uncommon or rare species is an inclusion criterion;
- Depend on a habitat that has shown substantial historical or recent declines in size. This criterion infers the population viability of a species based on trends in the habitats upon which it specializes.
- Occur only in or adjacent to an area where habitat is being converted to land uses incompatible with the animal's survival;
- Have few records, or which historically occurred here but for which there are no recent records; and
- Occur largely on public lands, but where current management practices are inconsistent with the animal's persistence.

Threatened species represent a decline in biological diversity because of their numbers decrease and their genetic variability is severely diminished. Rare species, as well as those of special concern carry challenges different to most other large and common species; characteristics of these species are:

- extremely small or localized range
- requiring a large territory
- having low reproductive success
- needing specialized breeding areas
- needing specialized feeding areas
- habitat specificity
- life-histories not captured completely in the area (migrants)

4.2.1 Invertebrates

Dragonflies

The Dragonfly Biotic Index (Samways and Simaika, 2016) was consulted for species distribution and status. The following dragonfly species were observed during the survey in November 2017 (see also Figure 30):

- Two-striped skimmer *(Orthetrum caffrum)*
- Pantala *(Pantala flavescens)*
- Broad scarlet *(Crocothemis sanguinolenta)*
- Swamp bluet *(Africallagma glaucum)*

Species of Concern: Dragonflies

No Threatened Dragonfly species is expected to occur in the project area (Samways and Simaika, 2016).

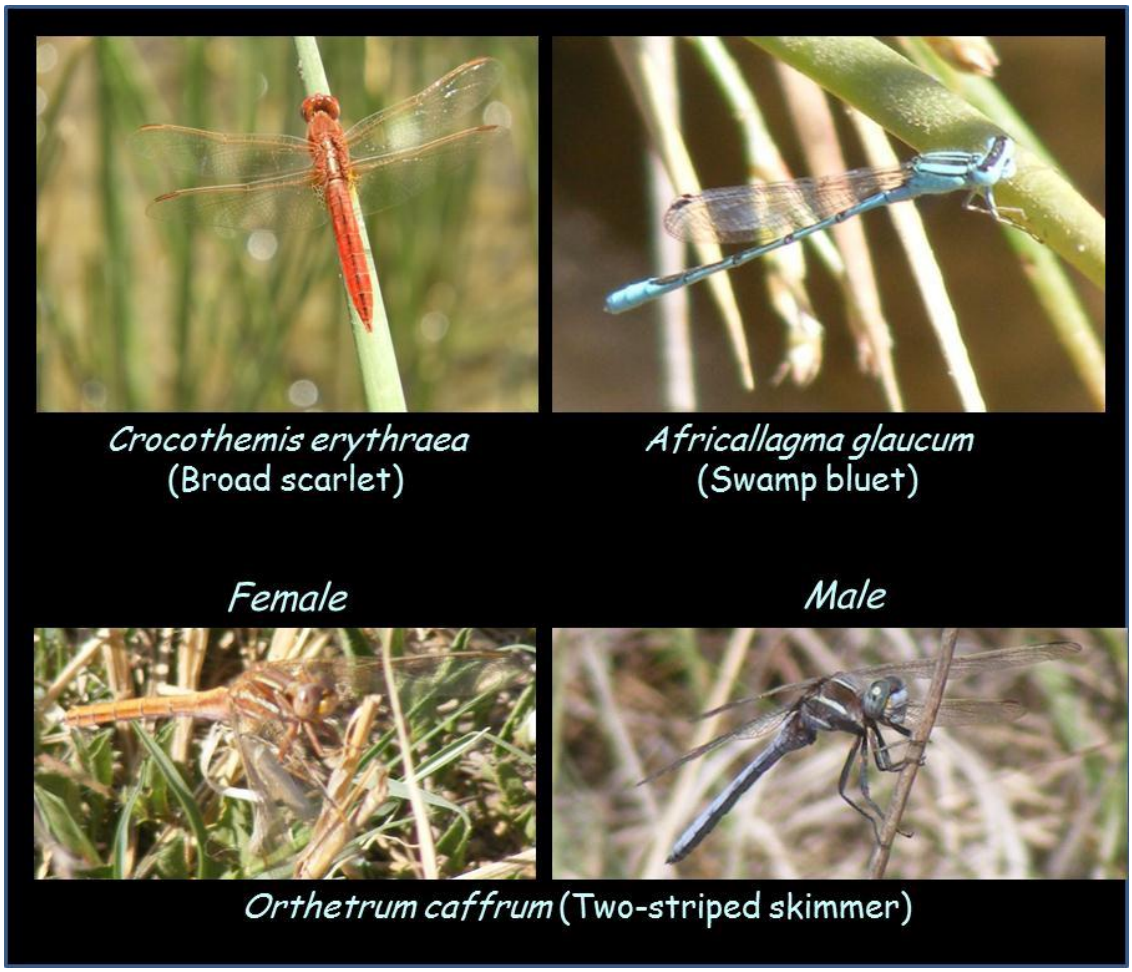

Figure 30: Some of the dragonflies encountered during the invertebrate survey.

Butterflies

The *Red List and Atlas* (Mecenero et al, 2013) for butterflies was consulted for species distribution and status. The following butterfly species were observed during the survey in November 2017(see also Figure 31):

- Dotted blue (*Tarucus sybaris*)
- African monarch *(Danaus chrysippus)*
- Broad-bordered grass yellow *(Eurema brigitta brigitta)*
- Twin-spot blue *(Lepidochrysops plebeia plebeia)*
- Citrus swallowtail *(Papilio demodocus demodocus)*

Species of Concern: Butterflies

Only one Threatened butterfly species is expected to occur in the project area, but it was not observed during the survey, probably because the distribution of the species is marginal to the area:

- Highveld Blue (*Lepidochchrysops praeterita)* - Globally endangered (ADU 2013) SA Endemic

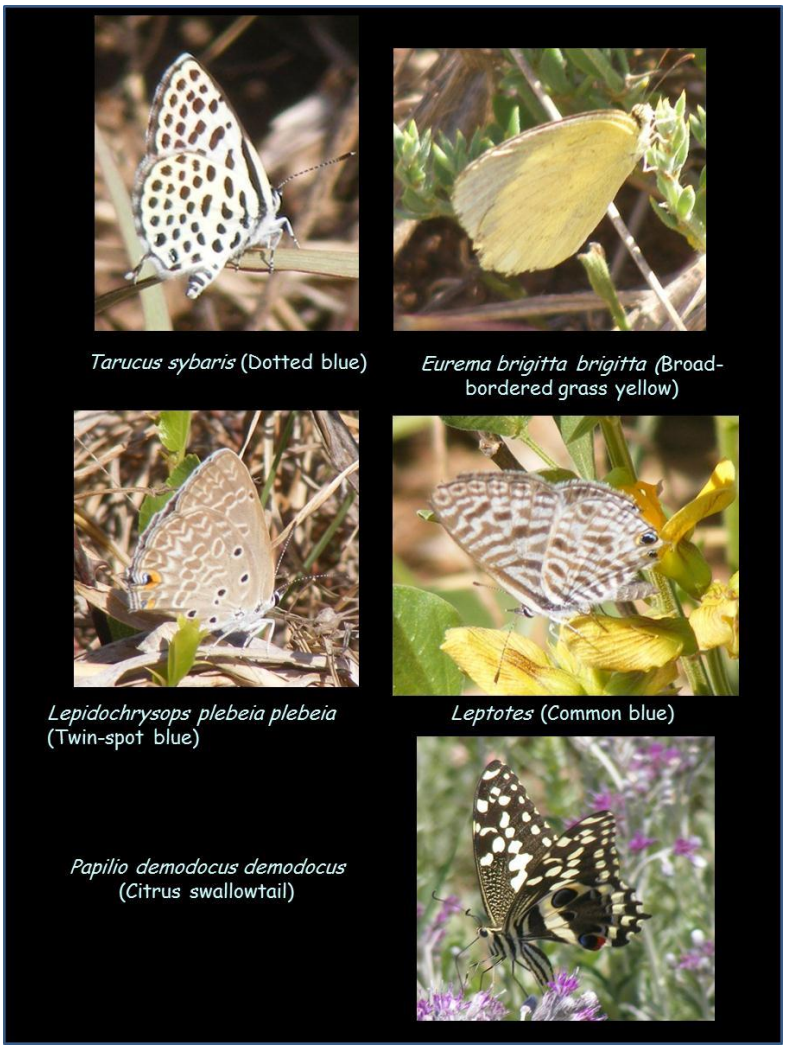

Figure 31: Some of the butterflies encountered during the invertebrate survey.

4.2.2 Frogs

Frog fauna is a product of the diversity of the region's topography, climate and associated habitats. Although frogs have adapted to almost every type of environment, many species are highly specialized to suit conditions in a particular locality. This can leave a species vulnerable when a habitat is degraded or irreversibly changed (Du Preez & Carruthers, 2009). Recent work has shown that amphibian species are declining worldwide as a result of global habitat loss. Their small areas of occupancy make them more susceptible to extinction due to habitat loss and degradation compared to other vertebrates. Suitable environmental conditions, especially breeding sites, are critically important, and species are often very specific to those habitats. Therefore habitat conservation should be a priority for amphibian preservation.

The amphibian populations in the North-West Province are faced with several environmental threats. Major threats include habitat destruction and invasion by alien vegetation resulting in fragmentation of populations. Agriculture has already resulted in the rapid destruction and fragmentation of habitats responsible for supporting populations of many species discussed here. Overgrazing and severe fires in the grassland catchment areas have resulted in extensive silting of streams and wetlands, thereby also threatening the breeding habitat of these frogs. For many reasons, frogs are important and useful indicators of environmental health. Factors that make frogs particularly sensitive to environmental deterioration include (Du Preez & Carruthers, 2009):

- Absorbent skin surface – absorbs water and any solvents it may contain
- Food contaminants – tadpoles are susceptible to ingesting pollutants
- Fragmented distribution – habitat losses may isolate surviving populations
- Sequestered tissue contaminants – disrupting hormone interference
- Temperature – extreme environmental temperature fluxes affect their biology
- Amphibious lifestyle – frogs are exposed to aquatic as well as terrestrial environment and are thus affected by changes to both
- Trophic level – important prey items to wide array of predators

In addition, water pollution is another major concern, which may arise from different contamination sources of, including:

- Chemical contamination
- Agricultural pesticides and herbicides
- Acid precipitation (atmospheric pollution)
- Heavy metals
- Eutrophication (fertilizer run-off)
- Endocrine-disrupting contaminants

Other factors include out-of-season fires caused by humans, road mortalities, diseases and climate change.

Amphibians are localized in their movement and habitat choices. Although most frogs can live away from water, they need water to lay their eggs and for the larval stage. An absence of standing water will therefore denote an absence of frog species in the area. After good rains when standing water is replenished, frogs believed absent may emerge to feed and breed. The rest of the year they will seek shelter in damp places in order to escape the dry or cold climate.

Their permeable skin gives them the advantage of being amphibious, but it is also this permeable skin that makes them very susceptible to air and water pollution. Frog surveys therefore, give a good indication of water quality and overall environmental condition. The frog diversity in areas

less affected by mining activities might appear moderately healthy, although the effects of air pollution or disease on these assemblages are unknown.

Wetlands are interlinking systems, as such upstream or wetland-adjacent impacts can adversely affect the ecosystems downstream. Numerous water quality-related problems exist in the mining area, and these will have further negative impacts on the wetland systems in the area if not contained. In compiling the expected frog lists, detailed frog distribution records (from the old Transvaal compiled by Jacobsen 1989) were used, along with interpolated distribution maps, and data from the frog atlas project (Minter et al 2004). Additional information from the latest comprehensive work of Du Preez and Carruthers (2009) was also consulted.

Surveys in primary habitats

According to the 2004 Frog Atlas (Minter, *et al* 2004), the MWS Kareerand TSF extension project area is situated in the Sweet Grassveld Assemblage. The accompanying frog distribution maps, confirms 13 frog species are expected to be present in the study area. The Sweet Grassland Assemblage has relatively moderate species richness (11-20 species per grid cell), decreasing westwards, but is low in endemic species (1-3) (Minter *et al*, 2004). During the surveys of the frog species (2017), three of the 13 expected species were encountered in the MWS Kareerand TSF extension project area. The low number can be ascribed to the fact that the summer rains had not yet arrived at the time of the survey and thus the frogs were still aestivating. During the 2017 survey the following frog species were recorded in the different habitats of the MWS Kareerand TSF extension project area (See Appendix 3 for detail):

- Guttural toad *(Amietophrynus gutturalis*)
- African clawed frog (*Xenopus laevis)*
- Boettger's dainty frog (*Cacosternum boettgeri)*

Of the 13 frog species that are expected to occur within the study area, we anticipate all 13 species will reside in the project area, accommodated by potential habitat in the area. A total of 3 species were physically encountered during the survey. Most of the expected species will be found in the Valley-bottom wetlands and Secondary Wetland (2 and 1 species respectively), the Pan wetland had no surface water available as habitat. Although the Pan wetland was dry, it will fill during good rainfall events and temporary rain-filled depressions may create favourable habitat during wet years. Certain species such as rain frogs, bull frogs and sand frogs are not so dependent on perennial water supplies, and are thus more resilient and able to survive the dry conditions of the region. Although most of these frogs will move away from wetlands in their life span, they will inevitably return to breed. Most of them aestivate in sheltering places and burrow into the soil, venturing sometimes far from wetlands during the dry cold winters. Frogs, such as the bullfrogs, might be found in the grassland areas as they dig into the loam-sandy soil. They will also emerge in wet periods and move to standing water to breed.

Species of Concern: Frogs

According to the South African Frog Atlas map (Minter, *et al.* 2004) the study area potentially contains 1-3 endemic species. Using distribution maps and habitat quality, one endemic species is expected to occur in the MWS Kareerand TSF extension project area:

- Raucous toad (*Amietophrynus rangeri*)

Currently one threatened frog species is expected to occur in the area:

- Giant Bullfrog *(Pyxicephalus adspersus)* – Protected species (NEMBA)

Viability and estimated population size: Frogs

Comparing the habitat requirements of Species of Concern species with habitat availability in the vegetation / land, the following units have habitat assemblages that correspond with the optimal requirements of these frogs, which will have a direct influence on their viability and estimated population size:

Table 17: Probability of occurrence of these frogs based on habitat availability and the viability and estimated population size for frog species of concern in the study area.

Frog species	**Habitat requirements**	**Vegetation/land cover type with the appropriate habitat, suitability for the species**
Raucous toad (*Amietophrynus rangeri*) - common	Rivers, large ponds and stream-side pools along **slow-flowing streams** in grassland; **shallow water near banks, or among reed beds**. Aquatic vegetation.	1 Pan wetland: **Optimal**
		2 Valley-bottom wetlands: **Optimal**
		9 Artificial Wetland: **Low**
Giant Bullfrog *(Pyxicephalus adspersus)* - Rare	They inhabit open **grassland areas** that are based on **poorly drained soils**, since these promote the formation of **rain-filled depressions**, or pans, which are required for successful breeding. The species typically breeds **in seasonal, shallow, grassy pans** in flat, open areas but will also utilize non-permanent vleis and shallow water on the **margins of waterholes and impoundments.**	1 Pan wetland: **Optimal**
		2 Valley-bottom wetlands: **Medium**
		5 Clay Grassland: **Medium**
		7 Sandy Grassland: **Good**
		6 Dolomite and Chert Grassland: **Medium**
		8 Secondary Grassland: **Medium**

* Viability and estimated population size scores: Poor 1; Low 2; Medium 3; Good 4; Optimal 5

According to Table 17, both species of concern have “Optimal” habitat available, therefore should the biotope be managed properly, the survival of these species will be secured. However it is estimated that both these species have small population sizes in this area.

The probable presence of the frogs in the project area:

High probability:

Raucous toad – Optimal habitat, resident.
Giant Bullfrog – Good habitat, resident.

4.2.3 Reptiles

Current knowledge of reptiles within the study area is derived from the Reptile Atlas Project (Bates, et al. 2014). In compiling the expected reptile lists, the detailed distribution records by Jacobsen (1989) of the herpetofauna of the old Transvaal were used with its interpreted distribution maps. The Animal Demographic Unit's reptile atlas project data (ADU, 2010), collated in the Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland, was also used (Bates, et al. 2014).

We expect the following factors played a role in lower numbers of reptile species being recorded across all project sites:

- Subterranean lifestyle of many species
- Nocturnal lifestyle of many species
- Secretive and retiring lifestyle of many species
- Small size of most of the species
- Well-camouflaged species

Surveys in primary habitats

The grassland ecoregion occurs over extensive parts of the central eastern South Africa. It has undergone massive degradation on account of its situation across some of the most economically important parts of the country. At present, 80% has been irreversibly transformed and only 2% is formally conserved (Alexander & Marais, 2007). Reptile richness is medium to low, and endemism is low. Because of the degraded state of this ecoregion, several species are of conservation concern, a situation that is likely to deteriorate further with continued urbanization in the area (Alexander & Marais, 2007).

According to the distribution of reptiles in South Africa, 35 species have distribution ranges extending into the region. All 35 of these species are expected to occur in the area (Jacobsen, 1989; Animal Demographic Unit, 2010) as adequate habitat is available. During the surveys of reptile species (2017), six of the 35 expected species were encountered in the MWS Kareerand TSF extension project area. The low number of species can be ascribed to the fact that the summer rains have not yet arrived and most of the reptile species were still aestivating.

During the 2017 survey the following reptile species were recorded in the different habitats of the MWS Kareerand TSF extension project area (See Appendix 4 for detail):

- South African slug-eater *(Duberria lutrix)*
- Red-lipped snake *(Crotaphopeltis hotamboeia)*
- Variable skink (*Trachylepis varia)*
- Speckled Rock Skink *(Trachylepis punctatissima)*
- Southern rock agama *(Agama atra atra)*
- Common dwarf gecko *(Lygodactylus capensis capensis)*

Species of Concern: Reptiles

Threatened reptile species are rated by standards established by the International Union for Conservation of Nature (IUCN) 2014*,* National Environmental Management: Biodiversity Act (NEMBA) of 2004, and the SA Red List (Bates, et al. 2014). There are more endemic reptiles in

southern Africa than any other vertebrates, and new species are being discovered regularly in this country.

Due to their limited distribution and range in South Africa, endemic species are included as species of special interest below. An endemic species has a global distribution restricted to >90% of the atlas region. According to the South African Reptile Atlas (ADU, 2010), there is one endemic reptile species expected to be found in the study area (SA endemic - Including Lesotho & Swaziland):

- Aurora house snake (*Lamprophis aurora*)

There are no threatened reptile species expected to occur in the area.

Viability and estimated population size: Reptiles

Comparing the habitat requirements of the Species of Concern with the habitat availability in the biotopes, the following units have habitat assemblages that correspond with the optimal requirements of reptiles, which will have a direct influence on their viability and estimated population size:

Table 18: Probability of occurrence based on habitat availability and the viability and estimated population size for frog species of concern in the study area.

Reptile species	Habitat requirements	Habitat requirements
Aurora house snake *(Lamprophis aurora)*	**Grasslands,** entering coastal bush and fynbos. **Terrestrial. Favours damp localities in grasslands, moist savannah**, lowland forest and fynbos.	1 Pan wetland: **Good**
		2 Valley-bottom wetlands: **Optimal**
		3 *Acacia karoo* Woodland: **Medium**
		4 *Acacia erioloba* Woodland: **Medium**
		5 Clay Grassland: **Good**
		6 Dolomite and Chert Grassland: **Medium**
		7 Sandy Grassland: **Good**
		8 Secondary Grassland: **Medium**
		9. Artificial Wetland: **Medium**

* Viability and estimated population size scores: Poor 1; Low 2; Medium 3; Good 4; Optimal 5

According to Table 18, favourable habitat is available for the endemic Aurora house snake. Ample damp localities are present in the pan, wetland and grassland units, thus providing good to optimal habitat for the snake. However, it is not a common species.

The probable presence of the herpetofauna in the project area:

Medium probability:

Aurora house snake - Favourable habitat, resident but not abundant.

4.2.4 Birds

Birds are important species in many ecosystems, fortunately they are also relatively easy to observe and count. Bird count data has been shown to accurately detect environmental change. A decline in species richness and diversity, as determined by routine monitoring, may serve as an early warning of environmental degradation. The presence or absence of bird species with specific habitat requirements can be indicative of the state of the environment.

The Bird Atlas (Harrison et al. 1997, Volumes 1 & 2) formed the basis of the distribution data used in this report, as it is currently the most updated printed information sources on South African birds available. Roberts Birds of southern Africa (Hockey, et al. 2005) was also consulted for habitat and bird data. Of the bird species expected to be found in the study area, certain birds were resident and thus remain in the area throughout the year. Nomadic species periodically move to other areas further away from the study area for feeding or breeding purposes. Of the expected migratory bird species, some North African visitors will only appear during the warmer seasons where they will feed and likely breed. The Palaearctic migrants spend our winters in Eurasia and are summer visitors to the warm south during the cold winters up north, however very few breed in southern Africa.

Surveys in primary habitats

During the 2017 survey, a wide variety of biotopes and sites were surveyed for bird species, including both transformed and untransformed lands. A total of 294 bird species were observed in this region during the Bird Atlas project (Harrison *et al.* 1997) (Appendix 4). If bird distribution and local habitat are evaluated, it is clear that a total of 287 species of birds are likely to utilize the different biotopes of the study area. Two of these bird species are alien exotics.

- House Sparrow (*Passer domesticus*)
- Common Myna (*Acridotheres tristis*)

The 2017 surveys produced 54 bird species across all transects in the MWS Kareerand TSF extension project area. See the list further down and Appendix 5 for detail.

The Clay Grassland biotope is the most diverse habitat type in terms of observed bird assemblages, being home to 32 species, while the Secondary Grassland produced 27 birds species. Only 12 species were recorded on the Dolomite and Chert Grassland and 9 species on the Sandy Grassland. The woodland biotopes provide refuge to 24 observed bird species in the *Acacia karoo* Woodland) and 10 observed bird species in the *Acacia erioloba* Woodland. With regards to the wetlands, 12 species were recorded in the Valley-bottom wetland biotope, only 4 species at the dry Pan wetland, and 16 species in the Secondary Wetland.

During the 2017 survey the following bird species were recorded (Red = “Species of Special Concern”):

1. Black-headed heron (*Ardea melanocephala*)
2. Western Cattle egret (*Bubulcus ibis*)
3. Hadeda Ibis (*Bostrychia hagedash*)
4. Hamerkop (*Scopus umbretta*)
5. Egyptian goose (*Alopochen aegyptiaca*)
6. Black-winged Kite *(Elanus caeruleus)*
7. Lesser Kestrel *(Falco naumanni)*
8. Rock Kestrel *(Falco rupicolus)*
9. Greater Kestrel *(Falco rupicoloides)*
10. Orange River Francolin *(Scleroptila levaillantoides)*
11. Helmeted Guineafowl (*Numida meleagris*)
12. Kurrichane Buttonquail *(Turnix sylvatica)*
13. Northern Black Korhaan (*Afrotis afraoides)*
14. Blacksmith plover (*Vanellus armatus*)
15. Crowned Lapwing *(Vanellus coronatus)*
16. Spotted Thick-knee *(Burhinus capensis)*
17. Speckled Pigeon (*Columba guinea)*
18. Laughing dove (Spilopelia *senegalensis*)
19. Ring-necked Dove (*Streptopelia capicola*)
20. Red-eyed Dove (*Streptopelia semitorquata*)
21. African Palm-Swift (*Cypsiurus parvus*)
22. European Bee-eater (*Merops apiaster*)
23. Rufous-naped Lark (*Mirafra africana*)
24. Eastern Clapper Lark *(Mirafra fasciolata)*
25. Eastern Long-billed Lark *(Certhilauda semitorquata)*
26. Pink-billed Lark *(Spizocorys conirostris)*
27. Barn Swallow (*Hirundo rustica*)
28. Common Ostrich *(Struthio camelus)*
29. Pied Crow (*Corvus albus*)
30. African Stonechat *(Saxicola torquata)*
31. Capped Wheatear *(Oenanthe pileata)*
32. Ant-eating Chat *(Myrmecocichla formicivora)*
33. Great reed warbler (*Acrocephalus arundinaceus*)
34. Levaillant’s cisticola (*Cisticola tinniens*)
35. Neddicky (*Cisticola fulvicapilla*)
36. Zitting Cisticola *(Cisticola juncidis)*
37. Desert Cisticola *(Cisticola aridulus)*
38. Cloud Cisticola *(Cisticola textrix)*
39. Wing-snapping Cisticola (*Cisticola ayresii)*
40. Black-chested Prinia *(Prinia flavicans)*
41. Cape Longclaw *(Macronyx capensis)*
42. African Pipit *(Anthus cinnamomeus)*
43. Common Fiscal *(Lanius collaris)*
44. Bokmakierie *(Telophorus zeylonus)*
45. Pied Starling *(Lamprotornis bicolor)*
46. Wattled Starling *(Creatophora cinerea)*
47. Cape Sparrow *(Passer melanurus)*
48. White-browed Sparrow-Weaver *(Plocepasser mahali)*
49. Southern Masked weaver (*Ploceus velatus*)
50. Red-billed Quelea *(Quelea quelea)*
51. Long-tailed Widowbird *(Euplectes progne)*
52. Southern red bishop (*Euplectes orix*)
53. Scaly-feathered Finch *(Sporopipes squamifrons)*
54. African Quail-finch *(Ortygospiza fuscocrissa)*

Species of Special Concern: Birds

In this document, the category “Species of Special Concern” is considered to include all threatened taxa listed by South African Red Data lists, and all South African endemic taxa. Through comparisons with the expected bird lists, a total of 21 bird species expected to be found in the area are listed as “Species of Special Concern”. If bird distribution and local habitat are evaluated, a total of 20 Species of Special Concern birds are likely to utilize the different biotopes of the study area.

Species of Special Concern habitat requirements

Currently two endemic bird species are expected to occur in the area:

- Eastern Long-billed Lark (*Certhilauda semitorquata*)
- Pied Starling *(Spreo bicolor)*

The following threatened bird species are expected to occur in the area (IUCN, 2014; NEMBA, 2014; Red Data Book, 2000):

1. **Greater flamingo (*Phoenicopterus ruber*)** – SA Red Data (Barnes 2000): Near threatened
2. **Lesser flamingo (*Phoeniconaias minor*)** – IUCN 2010 NT: Near-threatened; SA Red Data (Barnes 2000): Near-threatened.
3. **Yellowbilled stork (*Mycteria ibis*)** - SA Red Data (Barnes 2000): Near-threatened.
4. **Black stork (*Ciconia nigra*)** - SA Red Data (Barnes 2000): Near-threatened.
5. **Blue Crane *(Anthropoides paradisea)*** – IUCN 2010 VU Vulnerable A2acde: NEMBA TOPS (2015): Protected species; SA Red Data (Barnes 2000): Vulnerable.
6. **African White-backed Vulture *(Gyps africanus)*** - IUCN 2010 NT: Near-threatened; NEMBA TOPS (2015): Endangered species; SA Red Data (Barnes 2000): Vulnerable.
7. **Cape Vulture *(Gyps coprotheres)*** - IUCN 2010 NT: Near-threatened; NEMBA TOPS (2015): Endangered species; SA Red Data (Barnes 2000): Vulnerable.
8. **Secretary bird (*Sagittarius serpentarius*)** - IUCN status (2014): Vulnerable. SA Red Data (Barnes 2000): Near-threatened.
9. **African marsh harrier (*Circus ranivorus*)** – SA Red Data (Barnes 2000): Vulnerable.
10. **Black Harrier *(Circus maurus)*** - IUCN 2014 NT – Near-threatened; SA Red Data (Barnes 2000): Near-threatened.
11. **Martial Eagle *(Polemaetus bellicosus)*** - IUCN 2014 Status: Vulnerable. NEMBA TOPS (2015): Endangered species; SA Red Data (Barnes 2000): Vulnerable.
12. **Lesser Kestrel *(Falco naumanni)*** - SA Red Data (Barnes 2000): Vulnerable. IUCN 2014 Status: Least concern.
13. **Lanner Falcon *(Falco biarmicus)*** - SA Red Data (Barnes 2000): Near-threatened. IUCN 2014 Status: Least concern;
14. **White-bellied korhaan (*Eupodotis caffra*)** – SA Red Data (Barnes 2000): Vulnerable.
15. **Greater Painted snipe (*Rostratula benghalensis*)** - SA Red Data (Barnes 2000): Near-threatened.
16. **Black-winged Pratincole *(Glareola nordmanni)*** - IUCN 2014 NT: Near-threatened; SA Red Data (Barnes 2000): Near-threatened.
17. **European Roller (*Coracias garrulus*)** - IUCN 2014 NT: Near-threatened.

Viability and estimated population size: Birds

Comparing the habitat requirements of Species of Concern with habitat availability in the biotopes, the following units have habitat assemblages that correspond with the optimal requirements of these birds, which will have a direct influence on their viability and estimated population size. The reporting rates supplied by the ADU Atlas report supply an indication of the population sizes of these birds in the area:

Table 19: Probability of occurrence of these birds based on habitat availability and the viability and estimated population size for frog species of concern in the study area. Reporting Rates (RR) supply the reporting rate (%) according to the Atlas of South African birds (Harrison, et al, 1997).

Bird species	Habitat requirements	Habitat potential
Greater flamingo (*Phoenicopterus roseus)* **RR =** <2.0	**Shallow eutrophic wetlands; breeds on pans and mudflats.** Large bodies of shallow water, both inland and coastal. Saline and brackish waters preferred.	1 Pan wetland: **Poor**
		2 Valley-bottom wetlands: **Low**
		9 Artificial Wetland: **Low**
Lesser flamingo (*Phoeniconaias minor*) **RR =** <2.0	**Shallow eutrophic wetlands,** saltpans and sheltered coastal lagoons. Larger brackish or saline inland and coastal waters.	1 Pan wetland: **Poor**
		2 Valley-bottom wetlands: **Low**
		9 Artificial Wetland: **Low**
Yellow-billed stork (*Mycteria ibis*) **RR =** 6.0-14.2	**Dams, large marshes,** swamps, estuaries, margins of lakes and **rivers, seasonal wetlands.** Wetlands, including alkaline and freshwater lakes, rivers, pans, **flood plains, flooded grasslands**, small pools or streams.	1 Pan wetland: **Medium**
		2 Valley-bottom wetlands: **Good**
		9 Artificial Wetland: **Good**
Black stork (*Ciconia nigra*) **RR =** 2.0-5.4	**Shallow water: streams, rivers, marshes, floodplains,** coastal estuaries, flooded grassland; large and small dams; dry land. **Shallows of rivers, pools in dry riverbeds.** Uncommon in seasonal pans lacking fish.	1 Pan wetland: **Medium**
		2 Valley-bottom wetlands: **Good**
		9 Artificial Wetland: **Good**
Blue Crane *(Anthropoides paradiseus)* **RR =** <2.0	Karoo and **grassland biome. Croplands.**	2 Valley-bottom wetlands: **Low**
		5 Clay Grassland: **Medium**
		6 Dolomite Grassland: **Medium**
		7 Sandy Grassland: **Medium**
		8 Secondary Grassland: **Medium**
		9 Artificial Wetland: **Low**
African White-backed Vulture *(Gyps africanus)*	**Drier woodlands,** mopane**,** arid Kalahari; tall trees for roosting and nesting	3. *Acacia karoo* Woodland: **Medium**

RR = <2.0		4 *Acacia erioloba* Woodland: **Medium**
Cape Vulture *(Gyps coprotheres)* **RR =** <2.0	**Both open country (grasslands) and woodland.** Reliant on tall cliffs for breeding and roosting. **Wanders widely.**	3 *Acacia karoo* Woodland: **Medium**
		4 *Acacia erioloba* Woodland: **Medium**
		5 Clay Grassland: **Medium**
		6 Dolomite Grassland: **Medium**
		7 Sandy Grassland: **Medium**
Secretary bird (*Sagittarius serpentarius*) **RR =** 2.0-10.2	**Open country: savannah, open woodland, grassland** and dwarf shrubland	3 *Acacia karoo* Woodland: **Medium**
		4 *Acacia erioloba* Woodland: **Medium**
		5 Clay Grassland: **Optimal**
		6 Dolomite Grassland: **Optimal**
		7 Sandy Grassland: **Optimal**
		8 Secondary Grassland: **Medium**
African marsh harrier (*Circus ranivorus*) **RR =** <2.0	**Nests in extensive reed beds; forage over reeds, lake margins, floodplains and woodland.**	1 Pan wetland: **Poor**
		2 Valley-bottom wetlands: **Good**
		9 Artificial Wetland: **Good**
Black Harrier *(Circus maurus)* **RR =** <2.0	**Grassland,** Karoo scrub, mountain fynbos **cultivated lands,** subalpine vegetation, semi-desert.	5 Clay Grassland: **Good**
		6 Dolomite Grassland: **Good**
		7 Sandy Grassland: **Good**
		8 Secondary Grassland: **Good**
Martial Eagle *(Polemaetus bellicosus)* **RR =** <2.0	**Open grassland and scrub. Large trees for nests.** Wide range of vegetation types: deserts, densely wooded and forested areas.	3 *Acacia karoo* Woodland: **Medium**
		4 Woodland: **Medium**
		5 Clay Grassland: **Medium**
		6 Dolomite Grassland: **Medium**
		7 Sandy Grassland: **Medium**
		8 Secondary Grassland: **Medium**
Lesser Kestrel *(Falco naumanni)*	**Semi-arid grassland.** Avoid wooded areas; forage in **agricultural fields.** Grassy Karoo,	5 Clay Grassland: **Optimal**
		6 Dolomite Grassland: **Optimal**

RR = >15.3	Sweet and Mixed grassland, Central Kalahari vegetation types.	7 Sandy Grassland: **Optimal** 8 Secondary Grassland: **Good**
Lanner Falcon *(Falco biarmicus)* **RR =** 7.1-16.6	**Open habitats. Most frequent in open grassland, open or cleared woodland, and agricultural areas.** Cliff-nester, also in old nests in trees or **electricity pylons** and buildings.	3 *Acacia karoo* Woodland: **Medium** 4 *Acacia erioloba* Woodland: **Medium** 5 Clay Grassland: **Good** 6 Dolomite Grassland: **Good** 7 Sandy Grassland: **Good** 8 Secondary Grassland: **Good**
White-bellied korhaan (*Eupodotis senegalensis*) **RR =** <2.0	**Open grassland and lightly wooded savannah; prefer taller grass.**	3 *Acacia karoo* Woodland: **Medium** 4 *Acacia erioloba* Woodland: **Medium** 5 Clay Grassland: **Good** 6 Dolomite Grassland: **Good** 7 Sandy Grassland: **Good** 8 Secondary Grassland: **Good**
Greater Painted snipe (*Rostratula benghalensis*) **RR =** <2.0	**Pans and marshy river flood plains**. Exposed mud adjacent to cover. Marshes, muddy edges of swamps, lake edges, and riverbanks with thick vegetation cover. Favours waterside habitats with substantial cover and receding water levels with exposed mud among vegetation.	1 Pan wetland: **Good** 2 Valley-bottom wetlands: **Good** 9 Artificial Wetland: **Good**
Black-winged Pratincole *(Glareola nordmanni)* **RR =** 2.0-3.5	**Open grassland.**	5 Clay Grassland: **Good** 6 Dolomite Grassland: **Medium** 7 Sandy Grassland: **Medium** 8 Secondary Grassland: **Medium**
European Roller (*Coracias garrulus*) **RR =** <2.0	**Woodlands, bushveld and grasslands. Open woodland.**	3 *Acacia karoo* Woodland: **Optimal** 4 *Acacia erioloba* Woodland: **Optimal** 5 Clay Grassland: **Good** 6 Dolomite Grassland: **Good** 7 Sandy Grassland: **Good**

		8 Secondary Grassland: **Good**
Eastern Long-billed Lark *(Certhilauda semitorquata)* **RR =** 2.0-9.9	Upland grassland and mixed shrubland and **grassland, usually on rocky ridges.**	5 Clay Grassland: **Good** 6 Dolomite Grassland: **Optimal** 7 Sandy Grassland: **Optimal** 8 Secondary Grassland: **Good**
Pied Starling *(Lamprotornis bicolor)* **RR =** 33.3-70.4	Open Karoo and grassland habitats. Open fields. Not found in wooded areas. **Areas of broken ground.**	1 Pan wetland: **Optimal** 5 Clay Grassland: **Optimal** 6 Dolomite Grassland: **Optimal** 7 Sandy Grassland: **Optimal** 8 Secondary Grassland: **Good**

According to Table 19, habitat for Species of Concern is available at different scales of suitability per habitat. In the following section species are grouped by the probability of utilizing and/or colonizing these habitats. This approach evaluates the integrity of the biotope as a refuge to the birds and their food items, and does not attempt to rate human-related influences such as physical disturbance (movement, sound or lights).

Probability to successfully inhabit MWS Kareerand TSF extension project area:

The valley bottom wetlands, Pan wetland, and Secondary Wetlands, where surface water and favourable marginal and emergent vegetation habitats combine, renders this unit favourable for a few bird species. These habitats form good feeding grounds for Yellow-billed stork and Black stork while the waterside habitats with substantial cover and receding water levels which expose mud among vegetation harbours Greater Painted snipe.

Raptors, such as African marsh harrier make use of this productive surrounding to hunt for rodents and smaller birds. The artificial dams, tailings storage facilities and secondary wetlands, that hold water for long periods during the year, even in the dry season, will attract wetland birds such as Greater and Lesser flamingo.

The presence of woodland mixed with grassland, attracts small mammals and birds, including ground birds. These small to medium animals serve as food for certain raptors, such as the Martial Eagle, and these large raptors may only visit the area occasionally to hunt. The large expanses of woodland and grassland serve as hunting grounds and the trees to perch and rest in. The presence of large animals (in game farm) and therefore possibility of carrion being available periodically, renders this habitat Good for the vulture species: African White-backed Vulture and Cape Vulture.

Although the White-bellied korhaan might fall prey to these raptors, it has the ability to frequent the ecotone between grassland and woodland and can escape the attention of these predators. European Roller also uses the ecotone as it hunts from woodland trees in the surrounding grasslands. The large expanses of diverse grassland types, as well as the relative lower interference of human beings, renders these areas beneficial for larger bird species that have a preference for open plains, such as Blue Crane in hunting insects, and the Secretary bird searching for reptiles.

The open character of the grassland plains makes it ideal for medium and small raptors to fly or perch in seeking for their prey between grass tussocks. Raptors such as the Black Harrier, Lesser Kestrel and Lanner Falcon will hunt a variety of species, including insects, small birds and rodents. Smaller bird species will hunt insects or find seeds in the shorter grassy layers. Here they also breed and camouflage their nests in grassy surrounding. The Black-winged Pratincole, Eastern Long-billed Lark and Pied Starling are examples of these birds.

The probable presence of these species in the project area:

High probability:

Secretary bird – the favourable wide expenses of grassland, wood clumps and rocky areas present good hunting grounds.
Lesser Kestrel – the favourable wide expenses of grasslands present good hunting grounds.
Eastern Long-billed Lark – Favourable habitat, resident.
Pied Starling – Optimal habitat, resident.

Medium probability:

Black stork – Lack of fish in these systems
Lanner Falcon – will visit the area to hunt, cliff-nester
Black-winged Pratincole – the favourable wide expenses of grasslands present good habitat, the bird is a very rare straggler and vagrant to the area.
Greater flamingo – will make use of artificial water bodies which are not always beneficial to the birds
Lesser flamingo - will make use of artificial water bodies which are not always beneficial to the birds

Low probability (rare <2.0 reporting rates):

Yellow-billed stork – Rare visitor to the area
Greater Painted snipe – Rare visitor to the area
African marsh harrier – Rare visitor to the area
Martial Eagle – Rare visitor to the area
African White-backed Vulture – Rare visitor to the area
Cape Vulture – Rare visitor to the area
White-bellied korhaan – On the edge of its distribution range
European Roller – Rare summer visitor
Blue Crane – Rare visitor to the area
Black Harrier – Rare visitor to the area

Although some habitats have a “Low probability” rating (Table 18), all the bird Species of Special Concern in the study area will find a “Medium” to “Optimal” habitat assemblage to utilise. Accordingly this renders the project area favourable for 19 bird Species of Special Concern, but not all will become resident to the area and may only temporarily utilise the habitat. These species could be nomads, migrators, stragglers, vagrants or species with a wide range utilising the area temporarily for feeding or roosting.

4.2.5 Mammals

The Highveld in the south-east is part of this Grassland Biome which sustains many endemic and red data mammal species. The habitats of the study area include some woodland, riverine systems, wetlands, pans and a mosaic of short and tall grassland, and all of these habitats contribute significantly to the ecological requirements of different mammal species.

Surveys on primary habitats

Of all the mammal species that have distribution ranges in the region, 77 coincide with the MWS Kareerand TSF extension project area (Friedman & Daly, 2004). Under natural conditions the area has the potential to accommodate all these species. However, due to persecution by humans and habitat loss, some of the expected larger game species are most likely lost to the area. Fortunately some of these species are conserved in reserves and game parks, and it is only the South western black rhinoceros that are lost to the area. Thus, 76 mammal species remain and are expected to occur in the area.

During the 2017 surveys, signs and/or sights of 9 mammal species were recorded (See Appendix 6 for detail):

- Black-backed jackal (*Canis mesomelas*)
- Yellow mongoose *(Cynictis penicullata*)
- Water mongoose (*Atilax paludinosus*)
- Steenbok (*Raphicerus campestris)*
- Cape Porcupine *(Hystrix africaeaustralis)*
- Cape Ground squirrel (*Xerus inauris*)
- Brants' (Highveld) Gerbil *(Gerbilliscus brantsii brantsii)*
- Common Molerat *(Cryptomys hottentotus)*
- Cape hare (*Lepus capensis*)

Species of Concern: Mammals

Of the 76 remaining mammal species in the study area, potential habitat aspects are present and are expected to be capable of accommodating all these species, should human influence not escalate. Eleven species are listed as Species of Special Concern, most of which are considered threatened. No endemic mammal is listed for the area. Some of the larger game species are most likely lost to the area due to persecution by humans and habitat loss, are listed below and include 1 Species of Special Concern:

- South western black rhinoceros (*Diceos bicornis bicornis)* - **IUCN (2012): Critically endangered. NEMBA (TOPS 2015): Endangered species**

Species of Concern: Habitat requirements

None of the Species of Special Concern were encountered during our surveys. This is not surprising as these species have obviously reached this level of IUCN concern, due to their scarcity. Since some of the larger mammals no longer occur here, they are not listed or discussed further as Red Data species. The following 5 mammal species that are expected to occur in the area (two of them in the game farm) and which are considered threatened are listed below (SA Red List, 2016; IUCN, 2014; NEMBA, 2004; Red Data Book, 2000):

- **Brown hyaena (*Parahyaena brunnea*)** - IUCN 2014: Near threatened; SA Red List 2016: Near threatened; NEMBA (TOPS 2015): Protected species.
- **Black-footed cat (*Felis nigripes*)** - IUCN (2014): VU Vulnerable. SA Red List 2016: Vulnerable; NEMBA (TOPS 2015): Protected species.
- **Cape fox (*Vulpes chama)*** - NEMBA (TOPS 2015): Protected species; IUCN (2014) Least concern; SA Red List 2016: Least concern.
- **Plains zebra (*Equus quagga*)** - IUCN (2014) Near-threatened; SA Red List 2016: Least concern; NEMBA (TOPS 2015): None.
- **Black wildebeest (*Connochaetes gnou*) –** NEMBA (TOPS 2015): Protected species. IUCN (2014): Least concern; SA Red List 2016: Least concern.

Viability and estimated population size: Mammals

During the evaluation of the suitability of habitats for the mammal species of concern, the entire habitat assemblage per Vegetation unit and landcover type was assessed. Comparing the habitat requirements of Species of Concern species with habitat availability in the Vegetation unit and land cover type, the following units have habitat assemblages that correspond with the optimal requirements of these mammals, which will have a direct influence on their viability and estimated population size:

Table 20: Probability of occurrence of these mammals based on habitat availability and the viability and estimated population size for frog species of concern in the study area.

Mammal species	Habitat requirements	Habitat potential
Brown hyaena (*Parahyaena brunnea*)	Semi-desert, **open scrub and open woodland savanna.** Nocturnal, holes in ground.	3 *Acacia karoo* Woodland: Medium
		4 *Acacia erioloba* Woodland: Medium
		5 Clay Grassland: Medium
		6. Dolomite Grassland: Medium
		7 Sandy Grassland: Medium
		8 Secondary Grassland: Medium
Black-footed cat (*Felis nigripes*)	**Dry open shrub country.**	3 *Acacia karoo* Woodland: Medium
		4 *Acacia erioloba* Woodland: Medium
		7 Sandy Grassland: Medium
Cape fox (*Vulpes chama)*	Widespread. **Open country, open grassland.** Nocturnal & solitary. Holes in ground, in cover, underbrush.	5. Clay Grassland: Good
		6. Dolomite Grassland: Good
		7 Sandy Grassland: Good
		8 Secondary Grassland: Medium
Burchell's (Plains) zebra (*Equus burchellii*)	**Open plains to heavily wooded savannas.** Reintroduced.	5 Clay Grassland: Optimal
		6. Dolomite Grassland: Good
		7 Sandy Grassland: Good
Black wildebeest (*Connochaetes gnou*)	**Open plains: grassveld and highveld.** Reintroduced.	5 Clay Grassland: Optimal
		6. Dolomite Grassland: Good
		7 Sandy Grassland: Good
		8 Secondary Grassland: Good

According to Table 20, habitat for Species of Concern is available at different scales of suitability per Vegetation unit and landcover type. In the following section it will be attempted to group the species on the probability of utilizing and/or colonizing these Vegetation unit and landcover types. This approach evaluates the integrity of the biotope as a refuge to the mammals and their food items, and does not attempt to rate human-related influences such as physical disturbance (movement, sound or lights).

Probability to successfully inhabit MWS Kareerand TSF extension project area:

The presence of large animals in the area (game farm), and therefore the possibility of prey or carrion being available periodically, renders this habitat "Good" for the Brown hyaena as a predator and a scavenger. A variety of habitats in open country are also conducive to certain plains mammals. Black-footed cat hunts successfully in an open shrub country while the Cape fox prefer open grassland. The grassy plains of three grassland types in the game farm are favourable to most of the local grazers. Herbivores such as Burchell's zebra and Black wildebeest will therefore do well in these environments.

The probable presence of these species in the project area:

High probability:

Cape fox – the favourable wide expenses of grassland, wood clumps and rocky areas present good hunting grounds.
Burchell's zebra – the favourable wide expenses of grasslands present good feeding grounds; dependant on the existence of the game farm.
Black wildebeest – the optimal wide expenses of grasslands present good feeding grounds; dependant on the existence of the game farm.

Medium probability:

Brown hyaena – mostly dependant on the existence of the game farm, but will survive in other areas
Black-footed cat – not a common species; perhaps the area is too open for the animal

Low probability (rare <2.0 reporting rates):

None

4.2.6 Summary of all vertebrate fauna

After analysing the fauna distribution data and habitat availability, 13 frog species, 36 reptile species, 287 bird species and 77 mammal species are expected to occur in the project area, a total of 413 animal species. The presence of these different faunal groups is however dependent on availability of potential habitats in each distinct biotope. In order to establish the biodiversity importance of these biotopes, in the project area, Table 21 was compiled to describe habitat preferences of the faunal species expected to occur here.

Table 21: Summary of the expected faunal groups per habitat.

Biotope	1. Pan wetland	2. Valley-bottom wetlands	3. *Acacia karoo* Woodland	4. *Acacia erioloba* Woodland	5. Clay Grassland	6. Dolomite Grassland	7. Sandy Grassland	8. Secondary Grassland	9. Artificial Wetland	10. Alien trees	11. Infrastructure
Frogs	12	9	0	0	3	3	3	1	11	0	2
Reptiles	8	7	30	30	28	25	31	6	8	0	1
Birds	113	110	146	145	116	113	116	73	96	25	27
Mammals	15	14	50	51	46	46	60	21	17	3	1
Totals	148	140	226	226	193	187	210	101	132	28	31
% of total	36%	34%	55%	55%	47%	45%	51%	24%	32%	7%	8%

According to Table 21, the units supporting the largest number of species are the Woodland vegetation types: *Acacia karoo* Woodland and the *Acacia erioloba* Woodland (both 55% of total species). The three grassland units, Clay Grassland, Dolomite and Chert Grassland and the Sandy Grassland biotope have between 187 and 201 species that are expected to occur in these biotopes. The Secondary Grassland has 24% and the Artificial Wetlands 32%. The rest of the Transformed biotopes scored low: Alien trees – 7% and Infrastructure – 8%.

Table 22: A synopsis of the faunal assemblages and their associated biotopes.

Vegetation/land cover unit	
Pan wetland	This unit meets the general habitat requirements of 148 terrestrial animal species (12 amphibians, 8 reptiles, 113 birds and 15 mammals) which includes 10 species of conservation concern (2 frog species, 1 reptile species and 7 bird species). Of the expected species, 4 bird species were observed in this biotope during the current study.
Valley-bottom wetlands	This unit meets the general habitat requirements of 140 terrestrial animal species (9 amphibians, 7 reptiles, 110 birds and 14 mammals) which includes 10 species of conservation concern (2 frog species, 1 reptile species and 7 bird species). Of the expected species, 2 frogs and 12 bird and 1 mammal species were observed in this biotope during the current study.
Acacia karoo Woodland	This unit meets the general habitat requirements of 226 terrestrial animal species (30 reptiles, 146 birds, 50 mammals) which includes 14 species of conservation concern (1 reptile species, 7 bird species

Vegetation/land cover unit	
	and 6 mammal species). Of the expected species 2 reptiles and 24 bird species were observed in this biotope during the current study.
Acacia erioloba Woodland	This unit meets the general habitat requirements of 226 terrestrial animal species (30 reptiles, 145 birds, 51 mammals) which includes 14 species of conservation concern (1 reptile species, 7 bird species and 6 mammal species). Of the expected species, 4 reptiles 10 bird and 2 mammal species were observed in this biotope during the current study.
Clay Grassland – Diabase and Andesitic lava	This unit meets the general habitat requirements of 193 terrestrial animal species (3 amphibians, 28 reptiles, 191 birds, 54 mammals) which includes 22 species of conservation concern (1 frog species, 1 reptile species, 12 bird species and 8 mammal species). Of the expected species 32 bird species were observed in this biotope during the current study.
Dolomite and Chert Grassland	This unit meets the general habitat requirements of 187 terrestrial animal species (3 amphibians, 25 reptiles, 116 birds, 46 mammals) which includes 22 species of conservation concern (1 frog species, 1 reptile species, 12 bird species and 8 mammal species). Of the expected species, 2 reptiles 12 bird and 2 mammal species were observed in this biotope during the current study.
Sandy Grassland	This unit meets the general habitat requirements of 210 terrestrial animal species (3 amphibians, 31 reptiles, 116 birds, 60 mammals) which includes 22 species of conservation concern (1 frog species, 1 reptile species, 11 bird species and 9 mammal species). Of the expected species 9 bird and 2 mammal species were observed in this biotope during the current study.
Secondary Grassland	This unit meets the general habitat requirements of 101 terrestrial animal species (1 amphibian, 6 reptiles, 73 birds, 21 mammals) which includes 17 species of conservation concern (1 frog species, 1 reptile species, 9 bird species and 6 mammal species). Of the expected species, and 27 bird and 4 mammal species were observed in this biotope during the current study.
Secondary Wetland	This unit meets the general habitat requirements of 132 terrestrial animal species (11 amphibians, 8 reptiles, 96 birds and 17 mammals) which includes 9 species of conservation concern (1 frog species, 1 reptile species and 7 bird species). Of the expected species, 1 frog, 16 bird and 1 mammal species were observed in this biotope during the current study.
Alien trees	This unit meets the general habitat requirements of 28 terrestrial animal species (25 birds, 3 mammals) which includes no species of

Vegetation/land cover unit	
	conservation concern. Of the expected species, no animal was observed in this biotope during the current study.
Existing Infrastructure	This unit meets the general habitat requirements of 31 terrestrial animal species (1 reptile, 27 birds, 1 mammal) which includes no species of conservation concern. Of the expected species, no animal was observed in this biotope during the current study.

Table 23: Summary of the expected threatened species per habitat.

Threatened species											
Biotope	**1. Pan wetland**	**2. Valley-bottom wetlands**	**3. *Acacia karoo* Woodland**	**4. *Acacia erioloba* Woodland**	**5. Clay Grassland**	**6. Dolomite Grassland**	**7. Sandy Grassland**	**8. Secondary Grassland**	**9. Artificial Wetland**	**10. Alien trees**	**11. Infrastructure**
Frogs	2	2	0	0	1	1	1	1	1	0	0
Reptiles	1	1	1	1	1	1	1	1	1	0	0
Birds	7	7	7	7	12	12	11	9	7	0	0
Mammals	0	0	6	6	8	8	9	6	0	0	0
Totals	10	10	14	14	22	22	22	17	9	0	0

According to Table 23, the units with the largest number of threatened species are three grassland units, Clay Grassland, Dolomite and Chert Grassland and the Sandy Grassland biotope; each with 22 threatened species. Secondary grassland also has a high number of these species (17 species). The untransformed Woodland vegetation types, *Acacia karoo* Woodland and the *Acacia erioloba* Woodland have similar numbers of total threatened species (14 species each), and so do the untransformed wetlands, Pan wetland and Valley-bottom wetlands, 10 species each. Secondary wetland threatened species numbers are marginally lower at 9 species. The other transformed habitat, alien trees and infrastructure do not have the available habitat to harbour threatened species.

Assessing the conservation status of species has become a critical aspect of monitoring trends in biodiversity conservation at both a national and global level, but identifying threatened species using internationally accepted criteria and through a standardised process is also a very powerful tool for conservation and for priority species.

Proposed developments that will involve a change of land use may cause loss of natural habitat or alteration of such habitat. Habitat destruction and habitat change are the greatest threats to fauna in South Africa. In terms of some of the principles of the National Environmental Management Act (Act 107 of 1998) (NEMA, 1998), sustainable development requires the consideration of disturbance and loss of biodiversity, which should be avoided or, if that is not possible, should be minimised and remedied.

According to the project brief, the large number of Red Data listed and endemic species necessitates a monitoring program to assess their numbers and status in the project area. In the event that any threatened or near-threatened animal species are recorded within the study area in future, appropriate conservation measures should be developed in consultation with the relevant conservation authorities.

The following Threatened or Species of Special Concern were observed in the project area:

Frogs:

African bullfrog (*Pyxicephalus adspersus*); – at the Pan Wetland observed by Gunther Wiegenhagen - 2016

Birds:

Lesser Kestrel *(Falco naumanni);* SA Red Data (Barnes 2000): Vulnerable – at the *Acacia erioloba* Woodland (S26^{0}52.901 E26^{0}51.787) observed by AR Deacon – November 2017

Eastern Long-billed Lark *(Certhilauda semitorquata);* SA Endemic - Sandy Grassland (S26^{0}54.020 E26^{0}52.578) observed by AR Deacon – November 2017

Pied Starling *(Lamprotornis bicolor);* SA Endemic - Very common resident observed by AR Deacon – November 2017

Mammals:

Black wildebeest (*Connochaetes gnou*); NEMBA (TOPS 2015): Protected species – in the game farm on Clay Grassland (S26^{0}54.214 E26^{0}52.103) observed by AR Deacon – November 2017.

5. Impact Assessment

5.1 Sensitivity mapping

Sensitivity assessments identify those parts of the study area that have high conservation value or that may be sensitive to disturbance. Sensitivities could be determined based on:

- Areas containing untransformed natural vegetation and associated faunal habitat;
- irreplaceability of the vegetation type and associated faunal habitat;
- ecological importance of vegetation and faunal habitat;
- high diversity or complexity of faunal habitat;
- observations of the abundance and diversity of floral and faunal species present at the time of the assessment;
- occurrence of Species of Conservation Concern (SCC);
- systems vital to sustaining ecological functions;
- presence or absence of CBAs and ESAs;
- degree of disturbance encountered as a result of historical activities.

In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have low sensitivity.

An ecological sensitivity map of the project area was produced by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various relevant reports. This includes delineating the different vegetation and habitat units identified in the field (De Castro, 2018) and assigning sensitivity values to the units based on their ecological properties. Additionally values and potential presence of vegetation and fauna species diversity, as well as species of conservation concern were evaluated.

Five, broad-scale botanical biodiversity ‘sensitivity’ categories were identified and used in the botanical report by De Castro (2018). These categories were developed for practical mapping purposes and are intended as a summary of the perceived botanical biodiversity value and sensitivity, of mapped broad-scale vegetation and land-cover type units. Based on the assessment, the sensitivity of the project footprint can be divided into five categories of sensitivity: Very high, High, Moderate, Low and Negligible. These categories will also be used as biodiversity sensitivity categories in Table 23.

The wetland report (Grobler, 2018) undertook an Ecological Importance and Sensitivity (EIS) assessment of identified natural wetland areas to provide an indication of the conservation value and sensitivity of delineated wetlands.

By using the results of these two reports, and overlay the faunal information on the identified map categories, a sensitivity map (Figure 32) for the faunal components could be extrapolated. Table 24 illustrates the listing of the biodiversity sensitivity categories.

Table 24: Important parameters relating to faunal diversity and landscape sensitivity listed in the different vegetation and land cover types in order to establish the faunal biodiversity sensitivity and value of the project area.

Vegetation/ Land cover type unit	Botanical value and sensitivity	Status of vegetation type	CBA Category	Expected faunal species	Species of Special Concern	Faunal biodiversity value and sensitivity
1. Pan wetland	High	Rand Highveld Grassland 'Endangered'	CBA Category 1 (for wetlands)	148 species	10 species	**High**
2. Valley-bottom wetland	High or moderate (varies between wetlands)	Rand Highveld Grassland 'Endangered'	CBA Category 1 (for wetlands)	140 species	10 species	**High**
3. *Acacia karoo* Woodland	High	Rand Highveld Grassland 'Endangered'	CBA Category 1	226 species	14 species	**High**
4. *Acacia erioloba* Woodland	High	Rand Highveld Grassland 'Endangered'	CBA Category 2	226 species	14 species	**High**
5. Clay Grassland	High	Rand Highveld Grassland 'Endangered'	CBA Category 1 or 2	193 species	22 species	**High**
6. Dolomite Grassland	Very high	Vaal Reefs Dolomite Sinkhole Woodland 'Vulnerable'	CBA Category 2	187 species	22 species	**Very high**
7. Sandy Grassland	High	Rand Highveld Grassland 'Endangered'	CBA Category 2	210 species	22 species	**High**
8. Secondary Grassland	Moderate	Rand Highveld Grassland 'Endangered'	CBA Category 1 or 2	101 species	17 species	**Moderate**
9. Artificial wetland	Low	Rand Highveld Grassland 'Endangered'	CBA Category 2	132 species	9 species	**Moderate**
10. Alien trees	Low	Rand Highveld Grassland 'Endangered'	CBA Category 1 or 2	28 species	0 species	**Low**

11. Infrastructure	Negligible	Rand Highveld Grassland 'Endangered'	CBA Category 1 or 2	31 species	0 species	**Negligible**

Where the structure of the landscape rendered certain vegetation types similar in sensitivity for the fauna assemblages (e.g. untransformed grasslands), the Botanical sensitivity value will be used as the overriding factor.

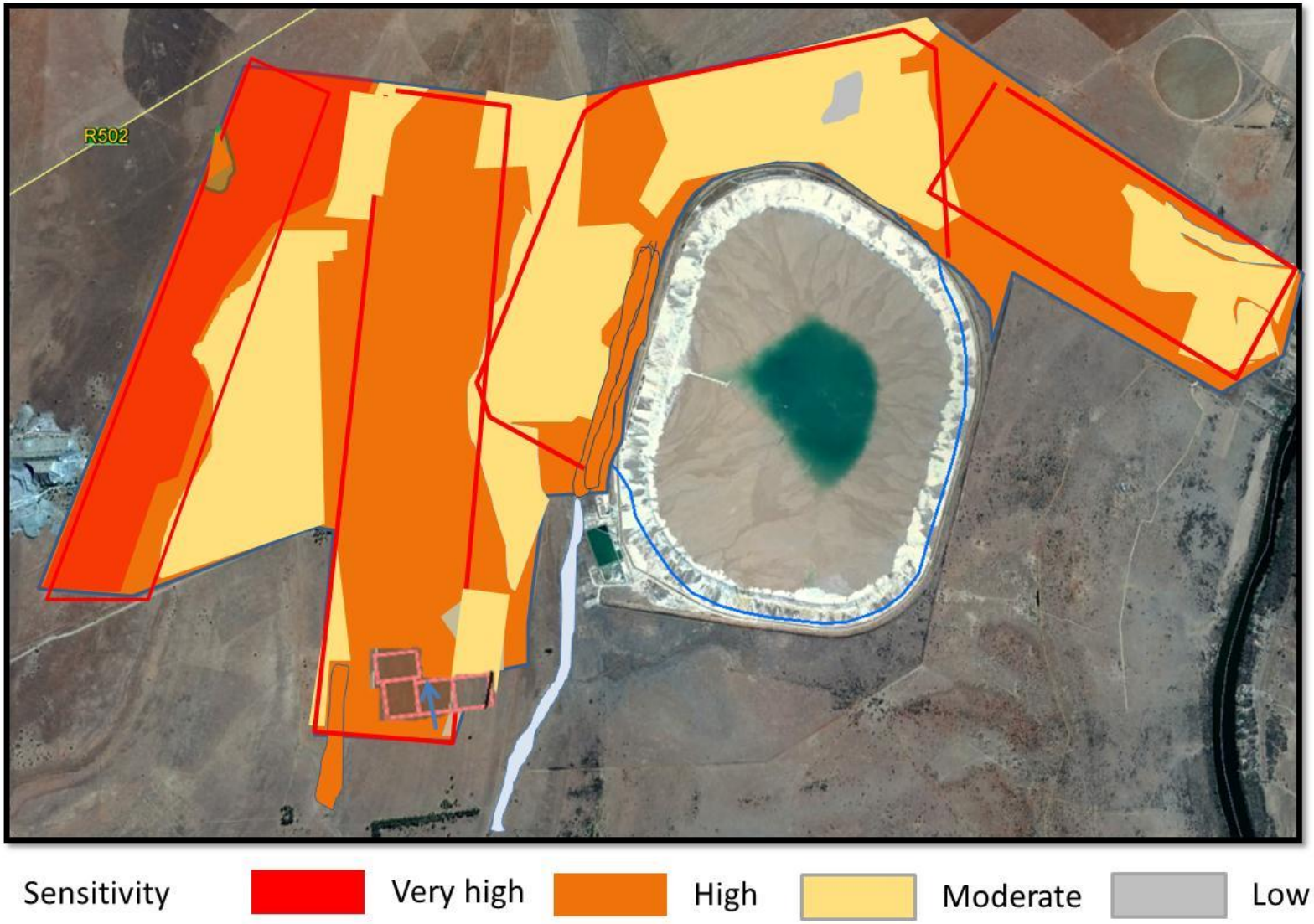

Figure 32: A map depicting the vegetation and land cover types and their faunal sensitivity values.

5.2 Assessment of impacts

The potential impacts of the project on the faunal biodiversity of the study area are assessed under four broad impacts, namely:

- Impact 1: Loss of wetland habitat types for wetland, aquatic and amphibian fauna (excluding fish).
- Impact 2: Loss of habitat for indigenous fauna.
- Impact 3: Loss of spatially restricted habitat and associated faunal assemblages.
- Impact 4: Loss of terrestrial fauna species (species richness).
- Impact 5: Loss of fauna 'species of conservation concern'.

The impact assessment provided below describes each broad impact, determines the significance of the impact and provides summarised mitigation and monitoring measures for each impact.

Impact 1: Loss of wetland habitat types for wetland, aquatic and amphibian fauna (excluding fish).

Applicable Phase: CONSTRUCTION PHASE

Applicable activity 1: Expansion of the Tailing Storage Facility (TSF)

Nature of impact: Identified aspects and associated impacts related to the expansion of the TSF include the following for the construction and operational phases of the project (detail in Grobler, 2018):

- Alteration of natural runoff patterns due to alterations of catchments through construction of dams and infrastructure (including TSF and return water dam) and canals (east and west storm water canals).
- Infrastructure encroachment into wetlands will result in the permanent loss of wetland habitat within overlapping portions of the proposed footprint.
- Tailings material and seepage from the new TSF extension transported via runoff can result in water quality deterioration in the downstream wetlands.
- Refuelling of machinery might create additional pollution and movement of heavy motorised vehicles (HMVs) in wetlands during the construction and operational phases will compact and disturb soils in the wetland.
- Both the destruction of wetlands and the deterioration of water quality in the remaining wetlands will impact on the welfare of the wetland, aquatic and amphibian fauna.
- This unit meets the general habitat requirements of 140 wetland animal species (9 amphibians, 7 reptiles, 110 birds and 14 mammals) which includes 10 species of conservation concern (2 frog species, 1 reptile species and 7 bird species).
- The larval stages of all resident dragonflies will be impacted since they are aquatic during this life stage.
- The nine species of frogs (especially the aquatic life stage of these amphibians), of which one is considered Species of Special Concern. It is especially adverse water quality conditions which will influence the tadpoles.
- Of the reptiles, most prefer the moist habitats of the wetlands, and most of the snakes are present due to the frog populations (prey). If frogs are compromised due to water quality, the snakes will move away. Two expected reptile species, water snakes and water monitors will be affected adversely should the flow in the wetland be compromised.
- Birds are mainly attracted by the habitat surrounding reed beds and bulrush supply, as well as the availability of surface water. This combination supplies ample shelter and

productive feeding sources. Should the system lose these qualities, 110 bird species of which 7 species of special concern will leave the area.

- Most of the mammal species are also present due to the surface water and surrounding reed bulrush, since this combination supplies ample shelter and productive feeding sources. Should the system lose these qualities, 14 mammal species will leave the area.

Notes:

Intensity of impact: It is expected that ecological functioning of the receiving water bodies will be altered, thus the Category: Medium. During the Operational Phase, it is expected that ecological functioning of the receiving water bodies may still be altered but they will be able to continue albeit in a modified way, thus the Category: Low.

Table 25: Impact 1: Loss of wetland habitat types for wetland, aquatic and amphibian fauna (excluding fish) – Construction Phase

Nature of Impact: Alteration of natural runoff, infrastructure encroachment into wetlands, seepage from tailings dam..								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	Medium	Definite	Medium	Medium	High
With mitigation	Negative	Local	Permanent	Medium	Definite	Medium	Medium	Medium
Mitigation Description: Ensure that water quality and quantity is not jeopardized, maintenance of an 80m buffer, erosion and vehicle movement control. The recommended impact avoidance and mitigation measures include the following (detail in Grobler, 2018): 1. All actions must be taken to ensure that the runoff from the area to be impacted will be routed to the receiving water bodies, and that the volume as well as quality of this runoff is not jeopardized (containment structures, liners and an existing in-channel dam). 2. Maintenance of the 80 m buffer to keep the channelled valley bottom wetland functional. Temporary infrastructure features, should also be located outside of the buffered wetlands. 3. Refrain from any forms of disturbance, harassment or persecution concerning the faunal species frequenting these spatially restricted habitats, especially Species of Special Concern. 4. No unauthorised driving in wetlands and erosion control measures should be implemented. 6. The collection, hunting or harvesting of animals at the site should be strictly forbidden. Personnel should not be allowed to wander off on the construction site. No pets (especially dogs and cats) should be allowed on-site.								
Residual Impact: Natural flow and water quality will not be recovered by the proposed mitigation as the upstream area of the catchment will be compromised extensively.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	Medium	Definite	Medium	Medium	High
With mitigation	Negative	Local	Permanent	Low	Definite	Medium	Medium	Medium
Cumulative Impact: Even with mitigation in place, it is not expected that the flow and water quality will improve in the receiving wetlands and thus the situation will be similar to condition of the wetlands before the expansion of the Tailing Storage Facility due to the scale of the development.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	Medium	Definite	Medium	Medium	High
With mitigation	Negative	Local	Permanent	Low	Definite	Medium	Medium	Medium

Table 26: Predicted risk matrix for Impact 1.

IMPACT 1:	Loss of wetland habitat types for wetland, aquatic and amphibian fauna (excluding fish).				
	CRITERIA	CONSTRUCTION		OPERATIONAL	
		Rating	Description	Rating	Description
PRE-MITIGATION	Extent	2	Local	2	Local
	Duration	4	Permanent	4	Permanent
	Intensity	3	Medium	3	Medium
	CONSEQUENCE	9		9	
	Probability	4	Definite	4	Definite
	Frequency	4	Medium-High	4	Medium-High
	LIKELYHOOD	6		6	
	SIGNIFICANCE	17	MEDIUM	17	MEDIUM
POST-MITIGATION	Extent	2	Local	2	Local
	Duration	4	Permanent	4	Permanent
	Intensity	3	Medium	1	Low
	CONSEQUENCE	9		7	
	Probability	4	Definite	4	Definite
	Frequency	4	Medium-High	4	Medium-High
	LIKELYHOOD	6		6	
	SIGNIFICANCE	17	MEDIUM	15	MEDIUM

Impact 1: Loss of wetland habitat types for wetland, aquatic and amphibian fauna (excluding fish).

Applicable Phase: OPERATIONAL PHASE

Applicable activity 1: Expansion of the Tailing Storage Facility (TSF)

Nature of impact: Identified aspects and associated impacts related to the expansion of the TSF include the following for the construction and operational phases of the project (detail in Grobler, 2018):

- Alteration of natural runoff patterns due to alterations of catchments through presence of dams and infrastructure (including TSF and return water dam) and canals (east and west storm water canals).
- Infrastructure encroachment into wetlands will result in the permanent loss of wetland habitat within overlapping portions of the proposed footprint.
- Tailings material and seepage from the new TSF extension transported via runoff can result in water quality deterioration in the downstream wetlands.
- Refuelling of machinery might create additional pollution and movement of heavy motorised vehicles (HMVs) in wetlands during the construction and operational phases will compact and disturb soils in the wetland.
- Both the destruction of wetlands and the deterioration of water quality in the remaining wetlands will impact on nine species of frogs (especially the aquatic life stage of these amphibians) of which two are considered Species of Special Concern. The larval stages of all resident dragonflies will be impacted on since they are aquatic.

Table 27: Impact 1: Loss of wetland habitat types for wetland, aquatic and amphibian fauna (excluding fish) – Operational Phase

Nature of Impact: Nature of Impact: Alteration of natural runoff, infrastructure encroachment into wetlands, seepage from tailings dam.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	Medium	Definite	Medium	Medium	High
With mitigation	Negative	Local	Permanent	Low	Definite	Medium	Medium	Medium
Mitigation Description: Ensure that water quality and quantity is not jeopardized, maintenance of an 80m buffer, erosion and vehicle movement control. The recommended impact avoidance and mitigation measures include the following (detail in Grobler, 2018): • All actions must be taken to ensure that the runoff from the area to be impacted will be routed to the receiving water bodies, and that the volume as well as quality of this runoff is not jeopardized (containment structures, liners and an existing in-channel dam). • Maintenance of the 80 m buffer to keep the channelled valley bottom wetland functional. All new infrastructure features, should be located outside of the buffered wetlands. • No unauthorised driving in wetlands and erosion control measures should be implemented. • Refrain from any forms of disturbance, harassment or persecution concerning the faunal species frequenting these spatially restricted habitats, especially Species of Special Concern.								
Residual Impact: Natural flow and water quality will not be recovered by the proposed mitigation as the upstream area of the catchment will be compromised extensively.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	Medium	Definite	Medium	Medium	High
With mitigation	Negative	Local	Permanent	Low	Definite	Medium	Medium	Medium
Cumulative Impact: Even with mitigation in place, it is not expected that the flow and water quality will improve in the receiving wetlands and thus the situation will be similar to condition of the wetlands before the expansion of the Tailing Storage Facility due to the scale of the development.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	Medium	Definite	Medium	Medium	High
With mitigation	Negative	Local	Permanent	Low	Definite	Medium	Medium	Medium

Impact 2: Loss of habitat for indigenous fauna.

Applicable Phase: CONSTRUCTION PHASE

Applicable activity: Excavation of burrow pits and structuring the TSF Extension.

Nature of impact: This impact refers to the loss of terrestrial habitat assemblages for faunal communities (based on broad-scale vegetation units).

Table 28: This table indicates the vegetation units in the area covered by the proposed infrastructure components and the sensitivity value per area:

Habitat (broad-scale vegetation units) and total cover area in the study area	TSF Extension	Borrow Area 1 (western borrow pit)	Borrow Area 2 (central borrow pit)	Borrow Area 3 (eastern borrow pit)	Return water dams:	Biodiversity value and sensitivity
Untransformed habitats (Total Ha)	145	169	283	127.7	34.5	
1. Pan wetland (Total 0.7ha)						**High** faunal biodiversity value and sensitivity
2. Valley-bottom wetland (Total 30.3ha)	10.1		1.4	10.5		**High** faunal biodiversity value and sensitivity
3. *Acacia karoo* Woodland (Total 1.9ha)	0.2					Endangered Rand Highveld Grassland; **High** faunal biodiversity value and sensitivity
4. *Acacia erioloba* Woodland (Total 2.1ha)		1.5				Vulnerable Vaal Reefs Dolomite Sinkhole Woodland, **High** faunal biodiversity value and sensitivity
5. Clay Grassland (Total 666.7ha)	108.8	32.5	279.3	117.2	32.5	Endangered Rand Highveld Grassland; **High** faunal biodiversity value and sensitivity
6. Dolomite Grassland (Total 158.2ha)		135				Vulnerable Vaal Reefs Dolomite Sinkhole Woodland, **Very high** faunal biodiversity value and sensitivity
7. Sandy Grassland (Total 60.1ha)	27.6		3.0		2.0	Endangered Rand Highveld Grassland; **High** faunal biodiversity value and sensitivity

Transformed habitats (Total Ha)	235	11.0	6.3	127.7	8.7	
8. Secondary Grassland (Total 557.4ha)	230.5	11.0		57.6	8.7	**Moderate** faunal biodiversity value and sensitivity
9. Artificial wetland (Total 2.2ha)	1.6					**Moderate** faunal biodiversity value and sensitivity
10. Alien trees (Total 2.3ha)	1.1					**Low** faunal biodiversity value and sensitivity
11. Infrastructure (Total 13.6ha)	2.7		6.3	1.2		**Low** faunal biodiversity value and sensitivity

The clearing of vegetation and top-soils within the construction footprints of the proposed infrastructure components during the construction phase, will result in the loss of 1 017.2ha of potential faunal habitat and aspects of habitat in the untransformed Rand Highveld Grassland and Vaal Reefs Dolomite Sinkhole Woodland (31.9% comprises of transformed habitats). The clearing of these threatened biotopes within areas were mapped in the NWBSP as CBA 1 or CBA 2, which rates as an impact of high severity.

Bulk earthworks and construction related activities will result in the permanent removal of all vegetation, topsoil and potential habitat earmarked for the proposed infrastructure components. All habitat units and associated floral and faunal habitat will therefore be lost from this area.

Although the habitat associated with the different untransformed grassland types does not differ much between the grassland types due to their similarity in structure and function, these grasslands are much more diverse in aspect of habitat than the transformed Secondary Grassland. On the other hand, the Dolomite Grassland has the added habitat aspects of the rocky areas which supply potential habitat to a different faunal assemblage.

Due to this it will be preferred that Dolomite Grassland receives a higher priority of conservation, and that transformed Secondary Grassland should rather be utilized as the footprint for proposed infrastructure components than any of the untransformed grasslands.

When analysing the components in Table 28, it becomes clear that Borrow Area 1 is the proposed development footprint with the highest scoring vegetation type (Vulnerable Vaal Reefs Dolomite Sinkhole Woodland) and the highest biodiversity sensitivity value of “Very high”. Rated second on the priority list is Borrow Area 2 with 279 ha of Endangered Rand Highveld Grassland.

Roads will likely impact on the edges of natural habitats during construction and power line options could potentially affect areas of natural habitats, depending on the exact location of power line structures.

The additional loss of faunal habitat may also result from soil pollution caused by contaminated seepage, runoff and spillage from the TSF extension, and to a lesser extent other edge effects such as dust emissions and alien plant invasion.

Note: Extent of impact: The loss of significant areas of these two vegetation types which are regarded as Endangered and Vulnerable respectively is regarded as an impact on a regional scale, thus the Category: Regional**.**

Table 29: Impact 2: Loss of habitat for indigenous fauna – Construction Phase

Nature of Impact: This impact refers to the loss of terrestrial habitat types for faunal communities.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Regional	Permanent	High	Definite	High	High	High
With mitigation	Negative	Local	Permanent	Medium	Definite	High	High	High
Mitigation Description: The recommended impact avoidance and mitigation measures to address the loss of terrestrial habitat types for faunal communities include the following: 1. Realign the footprints of the proposed Borrow Areas so that the greatest extent possible of the Borrow Area footprints is located within the footprint of the TSF Extension. 2. Borrow Area 1 should be removed from the proposed infrastructure plan, or a major realignment of its footprint should be conducted in order to ensure it is not situated in any area of Dolomite Grassland. 3. Modify the remaining infrastructure footprints so as to reduce the area of untransformed Rand Highveld Grassland and Vaal Reefs Dolomite Sinkhole Woodland, as well as other untransformed vegetation units situated within the infrastructure footprints wherever possible. Realigned footprints should be placed within the transformed vegetation and land-cover type units in as far as possible. 4. Limit construction impacts only to development footprints. Ensure that unnecessary impacts on natural habitat do not occur, e.g. driving around in the veld. 5. The exact positioning of roads and power lines should be shifted at the detailed design stage to have the least impact on sensitive habitats. Before construction, demarcate the extent of the construction footprint and ensure that construction impacts are contained within this area and do not affect areas of natural habitat. Use existing access roads as far as possible. 6. The collection, hunting or harvesting of animals at the site should be strictly forbidden. Personnel should not be allowed to wander off on the construction site. No pets (especially dogs and cats) should be allowed on-site.								
Residual Impact: Even if the borrow areas are rehabilitated it will never reach the quality of habitat through vegetation succession alone and thus will have a similar habitat quality to that of the Transformed vegetation types.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Regional	Permanent	High	Definite	High	High	Medium
With mitigation	Negative	Local	Permanent	Medium	Definite	High	High	Medium
Cumulative Impact: The primary avenue for cumulative impact will be through cumulative habitat loss and the disruption of landscape connectivity.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Regional	Permanent	High	Definite	High	High	Medium
With mitigation	Negative	Local	Permanent	Medium	Definite	High	High	Medium

Table 30: Predicted risk matrix for Impact 2.

IMPACT 2:	Loss of habitat for indigenous fauna.				
	CRITERIA	CONSTRUCTION		OPERATIONAL	
		Rating	Description	Rating	Description
PRE-MITIGATION	Extent	3	Regional	3	Regional
	Duration	4	Permanent	3	Long
	Intensity	5	High	3	Medium
	CONSEQUENCE	**12**		**9**	
	Probability	4	Definite	4	Definite
	Frequency	5	High	5	High
	LIKELYHOOD	**9**		**9**	
	SIGNIFICANCE	**21**	**HIGH**	**18**	**HIGH**
POST-MITIGATION	Extent	2	Local	2	Local
	Duration	4	Permanent	3	Long
	Intensity	3	Medium	1	Low
	CONSEQUENCE	**9**		**6**	
	Probability	4	Definite	4	Definite
	Frequency	5	High	5	High
	LIKELYHOOD	**9**		**9**	
	SIGNIFICANCE	**18**	**HIGH**	**15**	**MEDIUM**

Impact 2: Loss of habitat for indigenous fauna.

Applicable Phase: OPERATIONAL PHASE

Applicable activity: Expansion of the Tailing Storage Facility (TSF)

Nature of impact: Identified aspects and associated impacts related to the expansion of the burrow pits and structuring the TSF Extension relating to habitat for indigenous fauna are:

1. The potential increase in alien invasive plants which will impact on habitat integrity.
2. Vehicle movement generating dust during operational activities which will impact on sensitive habitats.
3. Soil contamination by polluted seepage and runoff from the TSF will impact on soil as a habitat for sub-surface faunal species and ground cover of plants.

Table 31: Impact 2: Loss of terrestrial habitat types for faunal assemblages – Operational Phase

Nature of Impact: This impact refers to the loss of terrestrial habitat types for faunal communities.

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Regional	Long	Medium	Definite	High	High	High
With mitigation	Negative	Local	Long	Low	Definite	High	Medium	High

Mitigation Description: The recommended impact avoidance and mitigation measures to address the loss of terrestrial habitat types for faunal communities include the following:

1. Develop and implement an alien plant control programme for the study area in order to prevent the further degradation of the faunal habitat.
2. Implement dust control measures during the construction and operational phases.
3. Implement design and operational measures to avoid or reduce soil contamination by polluted seepage and runoff from the TSF.
4. Develop and implement a rehabilitation plan for any borrow areas not placed within the TSF Footprint. The principal objective of the plan should be the establishment similar habitat assemblages through the natural process of secondary succession of the vegetation.
5. Develop and implement a veld management plan for the study area, which emphasises the use of sustainable grazing and controlled fires to ensure optimal vegetation condition and biodiversity levels in areas of untransformed grassland, which will enhance the habitat integrity of the local faunal assemblages.

Residual Impact: Not all faunal impacts can be mitigated and there will be some residual impact resulting from noise, disturbance and mortality of species unable to flee the construction activities (considering yellow mongoose and ground squirrel colonies). Not all avifaunal impacts can be mitigated and many birds, especially larger species such as raptors, cranes and bustards are likely to avoid the area during construction.

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Regional	Long	Medium	Definite	High	High	Medium
With mitigation	Negative	Local	Long	Low	Definite	High	Medium	Medium

Cumulative Impact: The primary avenue for cumulative impact will be through cumulative habitat loss and the disruption of landscape connectivity.

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	Medium	Definite	High	Medium	Medium
With mitigation	Negative	Local	Permanent	Low	Definite	High	Medium	Medium

Impact 3: Loss of spatially restricted habitat and associated faunal assemblages.

Applicable Phase: CONSTRUCTION PHASE

Applicable activity: Excavation of burrow pits and other project related activities.

Nature of impact: This impact refers to the loss of spatially restricted untransformed habitats included in the following vegetation units in the study area:

- Pan wetland, which comprises 0.05% (or 0.7ha) of the study area.
- *Acacia karoo* Woodland which comprises 0.13% (or 1.9ha) of the study area.
- *Acacia erioloba* Woodland which comprises 0.14% (or 2.1ha) of the study area.

The Pan wetland does not occur within a footprint of an infrastructure component and is represented by a single small, ephemeral endorheic pan situated some 100m to the west of the proposed footprint of Borrow Area 2. Though not situated within any of the proposed infrastructure footprints, it is at risk due to changes in the geohydrology of the area due to the construction of the Borrow Area 2. According to De Castro (2017) no other endorheic pans occur within a wide area surrounding the project area and must therefore be considered to be a unique and conservation-worthy habitat in this region of the North West Province. This unit is regarded as being of 'High' faunal biodiversity value and sensitivity.

Of the 148 faunal species expected to be resident or to visit the Pan wetland, ten of these are considered Species of Special Concern. Although the seven bird species will be able to move out of the area during the course of construction and operational activities, frogs are not so mobile and will certainly be impacted on by dust and soil pollution. It is especially the Giant Bullfrog *(Pyxicephalus adspersus)* which is a Protected species (NEMBA) that raises concern. Changes in the hydrology and any pollution (air, water and soil pollution) will impact on these sensitive species. The Raucous toad (*Amietophrynus rangeri*), which is an endemic species will be impacted similarily.

A total of 0.2ha of *Acacia karoo* Woodland occurs within the combined infrastructure footprints, all of which is situated within the TSF Extension footprint. This unit is regarded as being of 'High' faunal biodiversity value and sensitivity.

A total of 1.5ha of *Acacia erioloba* Woodland occurs within the combined infrastructure footprints, all of which is situated within the footprint of Borrow Area 1. The woodland communities comprising this unit constitute a unique and highly restricted woody habitat within the study area and are regarded as being of 'High' faunal biodiversity value and sensitivity.

Due to the structural composition of these "islands" of spatially restricted woodlands (*Acacia karoo*) and (*Acacia erioloba)* woodlands, many faunal species (nomadic and residential) utilise these habitats for perching, nesting, feeding and temporary stop-overs. 226 different species are expected to favour these woodland habitat types, of which 14 species are Species of Special Concern.
The larger, more mobile species (most birds and large mammals) will be able to move away whenever these habitats are threatened, however less mobile species such as subsurface species (tunnels and holes), retreating species in holes and crevices in the tree structures and slow moving species will not be able to escape degradation of their habitat. The less mobile species consists of lizards, snakes, nesting birds (the nests with young), rodents and mongoose.

Table 32: Impact 3: Loss of spatially restricted habitat and associated faunal assemblages – Construction Phase

Nature of Impact: This impact refers to the loss of spatially restricted habitat assemblages.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	High	Highly probable	High	Medium	High
With mitigation	Neutral	Site	Short	Low	Probable	Medium	Low	High
Mitigation Description: The recommended impact avoidance and mitigation measures to address the loss of spatially restricted habitat assemblages and associated faunal assemblages include the following: 1. Realign the footprints of the proposed Borrow Areas so that the greatest extent possible of the Borrow Area footprints is located within the footprint of the TSF Extension. 2. Modify the remaining infrastructure footprints so as to reduce the area of untransformed Rand Highveld Grassland and Vaal Reefs Dolomite Sinkhole Woodland, as well as other untransformed vegetation units situated within the infrastructure footprints wherever possible. Realigned footprints should be placed within the transformed vegetation and land-cover type units in as far as possible. 3. No infrastructure footprints should be situated within a minimum preliminary buffer of 200m of the Pan Wetland. The final buffer for the pan should be extended to include the entire catchment of the pan which should be determined using accurate contour line data. 4. The small patches of *Acacia erioloba* Woodland should be excluded from the infrastructure footprints. 5. Refrain from any forms of disturbance, harassment or persecution concerning the faunal species frequenting these spatially restricted habitats, especially Species of Special Concern.								
Residual Impact: These restricted habitat assemblages are also impacted by nearby local communities (wood collection and hunting with dogs) and the well-being of these areas cannot be guaranteed unless the area is secured.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	High	Highly probable	High	Medium	High
With mitigation	Neutral	Site	Short	Low	Probable	Medium	Low	High
Cumulative Impact: Due to their unique these habitat types are in constant threat which will include the impact of personnel and local communities (watering of stock, wood collection, hunting).								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	High	Highly probable	High	Medium	High
With mitigation	Neutral	Site	Short	Low	Probable	Medium	Low	High

Table 33: Predicted risk matrix for Impact 3.

IMPACT 3:	Loss of spatially restricted habitat and associated faunal assemblages.				
	CRITERIA	CONSTRUCTION		OPERATIONAL	
		Rating	Description	Rating	Description
PRE-MITIGATION	Extent	2	Local	2	Local
	Duration	4	Permanent	4	Permanent
	Intensity	5	High	3	Medium
	CONSEQUENCE	**11**		**9**	
	Probability	3	Highly probable	3	Highly probable
	Frequency	5	High	3	Medium
	LIKELYHOOD	**8**		**6**	
	SIGNIFICANCE	**19**	**HIGH**	**15**	**MEDIUM**
POST-MITIGATION	Extent	1	Site	1	Site
	Duration	1	Short	1	Short
	Intensity	1	Low	3	Medium
	CONSEQUENCE	**3**		**5**	
	Probability	2	Probable	3	Highly probable
	Frequency	2	Medium	2	Medium
	LIKELYHOOD	**4**		**5**	
	SIGNIFICANCE	**7**	**LOW**	**10**	**LOW**

Impact 3: Loss of spatially restricted habitat and associated faunal assemblages.
Applicable Phase: OPERATIONAL PHASE

Applicable activity: Excavation of burrow pits and other project related activities.

Nature of impact: Identified aspects and associated impacts related to the expansion of the burrow pits and structuring the TSF Extension during the operational phase on spatially restricted untransformed habitats and associated faunal assemblages are:

1. Vehicle movement generating dust during operational activities which will impact on sensitive habitats and fauna.
2. Due to their unique these habitat types are in constant threat which will include the impact of personnel and local communities (watering of stock, wood collection, hunting).
3. These restricted habitat assemblages are also impacted by nearby local communities (wood collection and hunting with dogs) and the well-being of these areas cannot be guaranteed unless the area is secured.
4. Human presence and activity can lead to disturbance, harassment or persecution of faunal species frequenting these spatially restricted habitats, especially Species of Special Concern.

Table 34: Impact 3: Loss of spatially restricted habitat and associated faunal assemblages – Operational Phase

Nature of Impact: This impact refers to the loss of spatially restricted habitat assemblages.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	Low	Probable	High	Low	High
With mitigation	Neutral	Site	Short	Low	Probable	Medium	Low	High
Mitigation Description: The recommended impact avoidance and mitigation measures to address the loss of spatially restricted habitat assemblages include the following: 1. Implement dust control measures during operational phases. 2. These restricted habitat assemblages should be protected from local communities (wood collection and hunting with dogs) by fencing off the project area. 3. Staff should be informed of the significance of these areas and any consumptive use of resources in these habitats should be discouraged. 4. Refrain from any forms of disturbance, harassment or persecution concerning the faunal species frequenting these spatially restricted habitats, especially Species of Special Concern.								
Residual Impact: These restricted habitat assemblages are also impacted by nearby local communities (wood collection and hunting with dogs) and the well-being of these areas cannot be guaranteed unless the area is secured.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	Low	Probable	High	Low	High
With mitigation	Neutral	Site	Short	Low	Probable	Medium	Low	High
Cumulative Impact: Due to their unique these habitat types are in constant threat which will include the impact of personnel and local communities (watering of stock, wood collection, hunting).								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Permanent	Low	Probable	High	Low	High
With mitigation	Neutral	Site	Short	Low	Probable	Medium	Low	High

Impact 4: Loss of terrestrial fauna species (species richness).

Applicable Phase: CONSTRUCTION PHASE

Applicable activity: Excavation of burrow pits and structuring the TSF Extension.

Nature of impact: This impact refers to the loss of terrestrial fauna species in the project area:

The most extensive and species rich (faunal assemblages) untransformed vegetation units identified for the 1 495.5ha study area and designated to be impacted by the excavation of burrow pits and structuring the TSF Extension, comprise the following in order of species richness:

- *Acacia karoo* and *Acacia erioloba w*oodlands (both with 226 expected species),
- Sandy Grassland (210 expected species)
- and Clay and Dolomite grasslands (193 and 187 expected species),

The construction of the proposed infrastructure footprints will lead to the loss of approximately 85% of Clay and Dolomite grasslands for both units; 71% of *Acacia erioloba w*oodland; 54% of Sandy Grassland; and 10% of *Acacia karoo w*oodland.

Should these areas be impacted by the excavation of burrow pits and structuring of the TSF Extension, a reduction in the species richness of the study area can therefore be expected. The loss of faunal species as a result of the construction of the proposed infrastructure footprints is therefore expected to be an impact of significant severity at the scale of the study area. However, most of these expected faunal species are widespread and will occur in the region and without any risk. Although the immediate surrounding area is transformed, ample untransformed land cover types occurs with the expected assemblages mostly intact.

The operation of construction machinery in the project area will create a visual impact of movement as well as generate noise, pollution and other forms of disturbance on site. Slow moving fauna and subsurface communities would also not escape construction activities.

The construction of the infrastructure will result in habitat loss for resident fauna, while increased levels of noise, pollution, disturbance and human presence will be detrimental to fauna. Sensitive and shy fauna would move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed. Some mammals and reptiles such as tortoises would be vulnerable to illegal collection or poaching during the construction phase. Thus the increase in human presence can lead to poaching and other disturbances such as runaway fires.

Table 35: Impact 4: Loss of terrestrial fauna species (species richness) – Construction Phase

Nature of Impact: This impact refers to the loss of terrestrial fauna species (species richness).

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Site	Permanent	High	Definite	Medium	Medium	High
With mitigation	Negative	Site	Permanent	Medium	Definite	Medium	Medium	High

Mitigation Description: The recommended impact avoidance and mitigation measures include the following:

1. Realign the footprints of the proposed Borrow Areas so that the greatest extent possible of the Borrow Area footprints is located within the footprint of the TSF Extension.
2. Modify infrastructure footprints so as to reduce the area of untransformed habitat situated within the footprints wherever possible. Realigned footprints should be placed within the transformed habitats in as far as possible.
3. Limit construction impacts only to development footprints.
4. The loss of faunal diversity from the project footprint is unavoidable, however, if an attempt is made to rescue and relocate faunal species to a suitable habitat outside of the project footprint, the probability of loss of faunal diversity is reduced and the impact associated with the loss can be reduced to a lower significance. Any fauna directly threatened by construction activities should be removed to a safe location by the ECO or other suitably qualified person.
5. The collection, hunting or harvesting of animals at the site should be strictly forbidden. Personnel should not be allowed to wander off on the construction site. No pets (especially dogs and cats) should be allowed on-site.

Residual Impact: Even if the borrow areas are rehabilitated it will never reach the quality of habitat through vegetation succession alone and thus will have a similar habitat quality to that of the Transformed vegetation types.

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Site	Permanent	High	Definite	Medium	Medium	High
With mitigation	Negative	Site	Permanent	Medium	Definite	Medium	Medium	High

Cumulative Impact: Direct impacts on fauna during construction will be transient and will not generate significant long-term cumulative impact.

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Site	Permanent	High	Definite	Medium	Medium	High
With mitigation	Negative	Site	Permanent	Medium	Definite	Medium	Medium	High

Table 36: Predicted risk matrix for Impact 4.

IMPACT 4:	Loss of terrestrial fauna species (species richness).				
	CRITERIA	CONSTRUCTION		OPERATIONAL	
		Rating	Description	Rating	Description
PRE-MITIGATION	Extent	1	Site	1	Site
	Duration	4	Permanent	4	Permanent
	Intensity	5	High	3	Medium
	CONSEQUENCE	**10**		**8**	
	Probability	4	Definite	4	Definite
	Frequency	3	Medium	3	Medium
	LIKELYHOOD	**7**		**7**	
	SIGNIFICANCE	**17**	**MEDIUM**	**15**	**MEDIUM**
POST-MITIGATION	Extent	1	Site	1	Site
	Duration	3	Long	3	Long
	Intensity	1	Low	1	Low
	CONSEQUENCE	**5**		**5**	
	Probability	4	Definite	4	Definite
	Frequency	1	Low	1	Low
	LIKELYHOOD	**5**		**5**	
	SIGNIFICANCE	**10**	**LOW**	**10**	**LOW**

Impact 4: Loss of terrestrial fauna species (species richness).

Applicable Phase: OPERATIONAL PHASE

Applicable activity: Excavation of burrow pits and structuring the TSF Extension.

Nature of impact: Identified aspects and associated impacts related to the excavation of the burrow pits and structuring the TSF Extension during the operational phase on terrestrial fauna species (species richness) are:

1. Vehicle movement generating dust during operational activities which will impact on sensitive habitats.
2. People presence and movement will impact on sensitive fauna.
3. Every day operational noise and lights at night will also impact on faunal distribution in the project area.
4. Human presence and activity can lead to disturbance, harassment or persecution of faunal species frequenting these spatially restricted habitats, especially Species of Special Concern.

Table 37: Impact 4: Loss of terrestrial fauna species (species richness) – Operational Phase

Nature of Impact: This impact refers to the loss of terrestrial fauna species (species richness).								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Site	Permanent	Medium	Definite	Medium	Medium	High
With mitigation	Negative	Site	Long	Low	Definite	Low	Low	High
Mitigation Description: The recommended impact avoidance and mitigation measures include the following: 1. Implement dust control measures during operational phases. 2. Personnel should not be allowed to wander off on the construction site. 3. No pets (especially dogs and cats) should be allowed on-site. 4. Any fauna directly threatened by operational activities should be removed to a safe location by the ECO or other suitably qualified person. 5. The collection, hunting or harvesting of animals at the site should be strictly forbidden. Personnel should not be allowed to wander off on the construction site. No pets (especially dogs and cats) should be allowed on-site.								
Residual Impact: Not all faunal impacts can be mitigated and there will be some residual impact resulting from noise, disturbance and mortality of species unable to flee the construction activities (considering yellow mongoose and ground squirrel colonies). Not all avifaunal impacts can be mitigated and many birds, especially larger species such as raptors, cranes and bustards are likely to avoid the area during construction.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Site	Permanent	Medium	Definite	Medium	Medium	High
With mitigation	Negative	Site	Long	Low	Definite	Low	Low	High
Cumulative Impact: Although many species will return to rehabilitated areas and areas of original distribution, however most larger and sensitive species will avoid the area due to people presence and movement, as well as every day operational noise and lights at night.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Site	Permanent	Medium	Definite	Medium	Medium	High
With mitigation	Negative	Site	Long	Low	Definite	Low	Low	High

Impact 5: Loss of fauna 'Species of Special Concern'.

Applicable Phase: CONSTRUCTION PHASE

Applicable activity: Excavation of burrow pits and structuring the TSF Extension.

Nature of impact: This impact refers to the loss of terrestrial fauna 'Species of conservation concern' in the project area:

The destruction of fauna 'Species of Special Concern' will result from the construction of all five proposed infrastructure footprints, and the most significant impact will result from the construction of Borrow Area 1.

The untransformed vegetation units giving refuge to the greatest number of 'Species of Special Concern' in the study area and designated to be impacted by the excavation of burrow pits and structuring the TSF Extension, comprise the following in order of species numbers:

- Clay-, Dolomite and Sandy grasslands (all with 22 expected 'Species of Special Concern'),
- *Acacia karoo* and *Acacia erioloba w*oodlands (both with 14 expected 'Species of Special Concern'),

The construction of the proposed infrastructure footprints will lead to the loss of approximately 85% of Clay and Dolomite grasslands for both areas; 71% of *Acacia erioloba w*oodland; 54% of Sandy Grassland; and 10% of *Acacia karoo w*oodland.

Should these areas be impacted by the excavation of burrow pits and structuring of the TSF Extension, a certain impact on the presence of 'Species of Special Concern' in the study area can be expected. Though the destruction of the habitat for 'Species of Special Concern' will be restricted largely to the construction footprints and possibly their immediate surrounds, the loss of these conservation important species is therefore expected to be an impact of significant severity at the scale of the study area.
During the construction of the burrow pits and covering of the TSF Extension footprint, smaller less mobile 'Species of Special Concern' (frogs, snakes, nests of birds, burrowing mammals) will be eliminated. The construction of the infrastructure will result in habitat loss for resident fauna, while increased levels of noise, pollution, disturbance and human presence will be detrimental to fauna. Additionally animals could be killed by overhead power lines, pollutants and persecution by humans.

Note: The category "Species of Special Concern" is considered to include all threatened taxa listed by South African Red Data lists (Species of Conservation Concern), Threatened or Protected Species (NEMBA) and all South African endemic taxa.

Table 38: Impact 5: Loss of fauna 'Species of Special Concern' – Construction Phase

Nature of Impact: This impact refers to the loss of fauna 'Species of Special Concern'.

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Long	High	Definite	Medium	High	Medium
With mitigation	Negative	Local	Long	Medium	Definite	Medium	Medium	Medium

Mitigation Description: The recommended impact avoidance and mitigation measures include the following:

1. Realign the footprints of the proposed Borrow Areas so that the greatest extent possible of the Borrow Area footprints is located within the footprint of the TSF Extension.
2. Borrow Area 1 should be removed from the proposed infrastructure plan, or a major realignment of its footprint should be conducted in order to ensure it is not situated in any area of Dolomite Grassland.
3. Modify the remaining infrastructure footprints so as to reduce the area of untransformed Rand Highveld Grassland and Vaal Reefs Dolomite Sinkhole Woodland, as well as other untransformed vegetation units situated within the infrastructure footprints wherever possible. Realigned footprints should be placed within the transformed vegetation and land-cover type units in as far as possible.
4. Limit construction impacts only to development footprints. Ensure that unnecessary impacts on natural habitat do not occur, e.g. driving around in the veld.
5. The exact positioning of roads and power lines should be shifted at the detailed design stage to have the least impact on sensitive habitats. Before construction, demarcate the extent of the construction footprint and ensure that construction impacts are contained within this area and do not affect areas of natural habitat. Use existing access roads as far as possible.
6. The loss of faunal diversity from the project footprint is unavoidable, however, if an attempt is made to rescue and relocate faunal species to a suitable habitat outside of the project footprint, the probability of loss of faunal diversity is reduced and the impact associated with the loss can be reduced to a lower significance. Any fauna directly threatened by construction activities should be removed to a safe location by the ECO or other suitably qualified person.
7. The collection, hunting or harvesting of animals at the site should be strictly forbidden. Personnel should not be allowed to wander off on the construction site. No pets (especially dogs and cats) should be allowed on-site.

Residual Impact: Even if the borrow areas are rehabilitated it will never reach the quality of habitat through vegetation succession alone and thus will have a similar habitat quality to that of the Transformed vegetation types.

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Long	High	Definite	Medium	High	Medium

With mitigation	Negative	Local	Long	Medium	Definite	Medium	Medium	Medium
Cumulative Impact: Direct impacts on fauna during construction will be transient and will not generate significant long-term cumulative impact.								
Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Long	High	Definite	Medium	High	Medium
With mitigation	Negative	Local	Long	Medium	Definite	Medium	Medium	Medium

Table 39: Predicted risk matrix for Impact 5.

IMPACT 5:	Loss of fauna 'Species of Special Concern'.				
	CRITERIA	CONSTRUCTION		OPERATIONAL	
		Rating	Description	Rating	Description
PRE-MITIGATION	Extent	2	Local	2	Local
	Duration	3	Long	3	Long
	Intensity	5	High	5	High
	CONSEQUENCE	**10**		**10**	
	Probability	4	Definite	4	Definite
	Frequency	4	Medium	4	Medium
	LIKELYHOOD	**8**		**8**	
	SIGNIFICANCE	**18**	**HIGH**	**18**	**HIGH**
		Rating	Description	Rating	Description
POST-MITIGATION	Extent	2	Local	2	Local
	Duration	3	Long	3	Long
	Intensity	3	Medium	3	Medium
	CONSEQUENCE	**8**		**8**	
	Probability	4	Definite	4	Definite
	Frequency	4	Medium	4	Medium
	LIKELYHOOD	**8**		**8**	
	SIGNIFICANCE	**16**	**MEDIUM**	**16**	**MEDIUM**

Impact 5: Loss of fauna 'Species of Special Concern'.

Applicable Phase: OPERATIONAL PHASE

Applicable activity: Excavation of burrow pits and structuring the TSF Extension.

Nature of impact: Identified aspects and associated impacts related to the excavation of the burrow pits and structuring the TSF Extension during the operational phase on fauna 'Species of Special Concern' are:

1. Vehicle movement generating dust during operational activities which will impact on sensitive habitats.
2. People presence and movement will impact on sensitive fauna.
3. Every day operational noise and lights at night will also impact on faunal distribution in the project area.
4. Human presence and activity can lead to disturbance, harassment or persecution of faunal species frequenting these spatially restricted habitats, especially Species of Special Concern.

Table 40: Impact 5: Loss of fauna 'Species of Special Concern' – Operational Phase

Nature of Impact: This impact refers to the loss of fauna 'Species of Special Concern'.

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Local	Long	High	Definite	Medium	High	Medium
With mitigation	Negative	Local	Long	Low	Definite	Medium	Medium	Medium

Mitigation Description: The recommended impact avoidance and mitigation measures include the following:

1. Implement dust control measures during operational phases.
2. Personnel should not be allowed to wander off on the construction site.
3. No pets (especially dogs and cats) should be allowed on-site.
4. Any fauna directly threatened by operational activities should be removed to a safe location by the ECO or other suitably qualified person.
5. The collection, hunting or harvesting of animals at the site should be strictly forbidden. No pets (especially dogs and cats) should be allowed on-site.

Residual Impact: Not all faunal impacts can be mitigated and there will be some residual impact resulting from noise, disturbance and mortality of species unable to flee the construction activities (considering yellow mongoose and ground squirrel colonies). Not all avifaunal impacts can be mitigated and many birds, especially larger species such as raptors, cranes and bustards are likely to avoid the area during construction.

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Site	Permanent	Medium	Definite	Medium	Medium	High
With mitigation	Negative	Site	Long	Low	Definite	Low	Low	High

Cumulative Impact: Although many species will return to rehabilitated areas and areas of original distribution, however most larger and sensitive species will avoid the area due to people presence and movement, as well as every day operational noise and lights at night.

Impact	Nature / Status	Extent	Duration	Intensity	Probability	Frequency	Significance	Confidence
Without mitigation	Negative	Site	Permanent	Medium	Definite	Medium	Medium	High
With mitigation	Negative	Site	Long	Low	Definite	Low	Low	High

Closure/Decommissioning Phase

No detail was available at this phase of the project regarding the exact processes that will be followed during closure/decommissioning. No detailed impact assessment can therefore be completed.

5.3 Conditions for inclusion in the environmental authorization

a) It is clear that the proposal relating to the realigning the footprints of the proposed Borrow Areas: ***"The footprints of the proposed Borrow Areas are designed in such a way that the greatest extent possible of the Borrow Area footprints is located within the footprint of the TSF Extension"*** - is regarded as the single most effective possible mitigation measure for mitigating impacts to faunal biodiversity of the project.

The final alignment before construction should be scrutinised by a component ecologist who was part of the impact assessment process (i.e. Tony de Castro, who compiled the vegetation report). Realigned footprints should be placed within the transformed vegetation and land-cover type units in as far as possible. Should the proposed footprint not change to mitigate for identified impacts, this should be considered a flaw in the process.

b) It is also of a proposed with urgency that Borrow Area 1 should be removed from the proposed infrastructure plan, or a major realignment of its footprint should be conducted in order to ensure it is not situated with any area of Dolomite Grassland. The two small patches of *Acacia erioloba* Woodland should also be excluded from the infrastructure footprints.

c) No infrastructure footprints should be situated within a minimum buffer of 80m of the boundaries of valley-bottom wetlands or within a minimum preliminary buffer of 200m of the Pan Wetland.

These conditions are aimed at potential habitats and special biotopes for the faunal component of the study area and correspond with the conditions set for the vegetation-, wetland- and aquatic components of the study, and if these conditions are met, the fauna frequenting these habitats will benefit correspondingly

5.4 Monitoring requirements

A monitoring programme for the faunal assemblages associated with the project, would ideally be to record the reaction of the fauna to changes in the environment due to the impacts of the project. It will be impossible to monitor all 413 species over a period of time; therefore certain key species could be singled out to be monitored.

- Visiting the Pan wetland after good rainfall events and investigate the presence of Giant Bullfrog occurrences and the integrity of the population. It also will be important to locate the positions and extent of their aestivation refuge areas.

- A monitoring programme using the Dragonfly Biotic Index (Samways and Simaika, 2016) should be implemented in the valley-bottom wetlands, which will support the SASS5 macro-invertebrate method of the aquatic monitoring programme.

- Periodically visit the area with a vehicle (once a week) and drive a prearranged trail in order to investigate the presence of any Red Data or Species of Special Concern in the project area, during construction and operation of the project.

- An inventory system should be established in a concerted effort with regular staff working in the project area to identify Red Data or Species of Special Concern and record these species.

- Acquire some inside information regarding the presence of the neighboring communities regarding animal species and numbers hunted during their incursions into the project area.

5.5 Recommendations

5.5.1 Reasoned opinion

i) "....as to whether the proposed activity or portions thereof should be authorised,"

If conditions 5.3a and 5.3b are adhered to in some ecologically approved form, the project activities for the faunal component will be mitigated reasonably well and no major reason for not authorising the proposed activity is foreseen.

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

Avoidance, management and mitigation measures are stipulated in the section "5.3 Conditions for inclusion in the environmental authorization" and it must be included in the EMPr after coordinating the conditions with corresponding sections in the vegetation, wetland and aquatic reports. No detail was available for the closure plan of the project.

5.5.2 Consultation process

The input from Mr. Gunther Wiegenhagen was very valuable during all the different studies since 2013. His interest and knowledge of the environment on the AngloGold Ashanti's properties were invaluable during field visits. It is hereby also requested, should a monitoring programme be established for the faunal component, that he is consulted throughout the process.

6. Summary of mitigation measures

The following measures are recommended in order to minimise envisaged negative impacts of the proposed project infrastructure on the faunal biodiversity within the MWS Kareerand TSF Extension Project study area:

Impact 1: Loss of wetland habitat types for wetland, aquatic and amphibian fauna (excluding fish)

- All actions must be taken to ensure that the runoff from the area to be impacted will be routed to the receiving water bodies, and that the volume as well as quality of this runoff is not jeopardized (containment structures, liners and an existing in-channel dam).
- Maintenance of the 80 m buffer to keep the channelled valley bottom wetland functional. Temporary infrastructure features, should also be located outside of the buffered wetlands.
- Refrain from any forms of disturbance, harassment or persecution concerning the faunal species frequenting these spatially restricted habitats, especially Species of Special Concern.
- No unauthorised driving in wetlands and erosion control measures should be implemented.
- The collection, hunting or harvesting of animals at the site should be strictly forbidden. Personnel should not be allowed to wander off on the construction site. No pets (especially dogs and cats) should be allowed on-site.

Impact 2: Loss of terrestrial habitat types for faunal assemblages

- Realign the footprints of the proposed Borrow Areas so that the greatest extent possible of the Borrow Area footprints is located within the footprint of the TSF Extension.
- Borrow Area 1 should be removed from the proposed infrastructure plan, or a major realignment of its footprint should be conducted in order to ensure it is not situated in any area of Dolomite Grassland.
- Modify the remaining infrastructure footprints so as to reduce the area of untransformed Rand Highveld Grassland and Vaal Reefs Dolomite Sinkhole Woodland, as well as other untransformed vegetation units situated within the infrastructure footprints wherever possible. Realigned footprints should be placed within the transformed vegetation and land-cover type units in as far as possible.
- Limit construction impacts only to development footprints. Ensure that unnecessary impacts on natural habitat do not occur, e.g. driving around in the veld.
- The exact positioning of roads and power lines should be shifted at the detailed design stage to have the least impact on sensitive habitats. Before construction, demarcate the extent of the construction footprint and ensure that construction impacts are contained within this area and do not affect areas of natural habitat. Use existing access roads as far as possible.
- Develop and implement an alien plant control programme for the study area in order to prevent the further degradation of the faunal habitat.
- Implement dust control measures during the construction and operational phases.
- Implement design and operational measures to avoid or reduce soil contamination by polluted seepage and runoff from the TSF.
- Develop and implement a rehabilitation plan for any borrow areas not placed within the TSF Footprint. The principal objective of the plan should be the establishment similar habitat assemblages through the natural process of secondary succession of the vegetation.
- Develop and implement a veld management plan for the study area, which emphasises the use of sustainable grazing and controlled fires to ensure optimal vegetation condition and biodiversity levels in areas of untransformed grassland, which will enhance the habitat integrity of the local faunal assemblages.
- The collection, hunting or harvesting of animals at the site should be strictly forbidden. Personnel should not be allowed to wander off on the construction site. No pets (especially dogs and cats) should be allowed on-site.

Impact 3: Loss of spatially restricted habitat and associated faunal assemblages.

- Realign the footprints of the proposed Borrow Areas so that the greatest extent possible of the Borrow Area footprints is located within the footprint of the TSF Extension.
- Modify the remaining infrastructure footprints so as to reduce the area of untransformed Rand Highveld Grassland and Vaal Reefs Dolomite Sinkhole Woodland, as well as other untransformed vegetation units situated within the infrastructure footprints wherever possible. Realigned footprints should be placed within the transformed vegetation and land-cover type units in as far as possible.
- No infrastructure footprints should be situated within a minimum preliminary buffer of 200m of the Pan Wetland. The final buffer for the pan should be extended to include the entire catchment of the pan which should be determined using accurate contour line data.
- The small patches of *Acacia erioloba* Woodland should be excluded from the infrastructure footprints.
- Refrain from any forms of disturbance, harassment or persecution concerning the faunal species frequenting these spatially restricted habitats, especially Species of Special Concern.

- Implement dust control measures during operational phases.
- These restricted habitat assemblages should be protected from local communities (wood collection and hunting with dogs) by fencing off the project area.
- Staff should be informed of the significance of these areas and any consumptive use of resources in these habitats should be discouraged.

Impact 4: Loss of terrestrial fauna species (species richness).

- Realign the footprints of the proposed Borrow Areas so that the greatest extent possible of the Borrow Area footprints is located within the footprint of the TSF Extension.
- Modify infrastructure footprints so as to reduce the area of untransformed habitat situated within the footprints wherever possible. Realigned footprints should be placed within the transformed habitats in as far as possible.
- Limit construction impacts only to development footprints.
- The loss of faunal diversity from the project footprint is unavoidable, however, if an attempt is made to rescue and relocate faunal species to a suitable habitat outside of the project footprint, the probability of loss of faunal diversity is reduced and the impact associated with the loss can be reduced to a lower significance. Any fauna directly threatened by construction activities should be removed to a safe location by the ECO or other suitably qualified person.
- The collection, hunting or harvesting of animals at the site should be strictly forbidden. Personnel should not be allowed to wander off on the construction site. No pets (especially dogs and cats) should be allowed on-site.
- Implement dust control measures during operational phases.
- Personnel should not be allowed to wander off on the construction site.
- No pets (especially dogs and cats) should be allowed on-site.

Impact 5: Loss of fauna 'Species of Special Concern'.

- Realign the footprints of the proposed Borrow Areas so that the greatest extent possible of the Borrow Area footprints is located within the footprint of the TSF Extension.
- Borrow Area 1 should be removed from the proposed infrastructure plan, or a major realignment of its footprint should be conducted in order to ensure it is not situated in any area of Dolomite Grassland.
- Modify the remaining infrastructure footprints so as to reduce the area of untransformed Rand Highveld Grassland and Vaal Reefs Dolomite Sinkhole Woodland, as well as other untransformed vegetation units situated within the infrastructure footprints wherever possible. Realigned footprints should be placed within the transformed vegetation and land-cover type units in as far as possible.
- Limit construction impacts only to development footprints. Ensure that unnecessary impacts on natural habitat do not occur, e.g. driving around in the veld.
- The exact positioning of roads and power lines should be shifted at the detailed design stage to have the least impact on sensitive habitats. Before construction, demarcate the extent of the construction footprint and ensure that construction impacts are contained within this area and do not affect areas of natural habitat. Use existing access roads as far as possible.
- The loss of faunal diversity from the project footprint is unavoidable, however, if an attempt is made to rescue and relocate faunal species to a suitable habitat outside of the project footprint, the probability of loss of faunal diversity is reduced and the impact associated with the loss can be reduced to a lower significance. Any fauna directly threatened by construction activities should be removed to a safe location by the ECO or other suitably qualified person.
- The collection, hunting or harvesting of animals at the site should be strictly forbidden. Personnel should not be allowed to wander off on the construction site. No pets (especially dogs and cats) should be allowed on-site.

- Implement dust control measures during operational phases.
- Personnel should not be allowed to wander off on the construction site.

7. Conclusion

a) It is clear that the proposal relating to the realigning the footprints of the proposed Borrow Areas: ***"The footprints of the proposed Borrow Areas are designed in such a way that the greatest extent possible of the Borrow Area footprints is located within the footprint of the TSF Extension"*** - is regarded as the single most effective possible mitigation measure for mitigating impacts to faunal biodiversity of the project.

The final alignment before construction should be scrutinised by a component ecologist who was part of the impact assessment process (i.e. Tony de Castro, who compiled the vegetation report). Realigned footprints should be placed within the transformed vegetation and land-cover type units in as far as possible. Should the proposed footprint not change to mitigate for identified impacts, this should be considered a flaw in the process.

b) It is also of a proposed with urgency that Borrow Area 1 should be removed from the proposed infrastructure plan, or a major realignment of its footprint should be conducted in order to ensure it is not situated with any area of Dolomite Grassland. The two small patches of *Acacia erioloba* Woodland should also be excluded from the infrastructure footprints.

c) No infrastructure footprints should be situated within a minimum buffer of 80m of the boundaries of valley-bottom wetlands or within a minimum preliminary buffer of 200m of the Pan Wetland.

These conditions are aimed at potential habitats and special biotopes for the faunal component of the study area and correspond with the conditions set for the vegetation-, wetland- and aquatic components of the study, and if these conditions are met, the fauna frequenting these habitats will benefit correspondingly

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Appendices

Appendix 1: The details of the specialist who prepared the report.

Appendix 2: The declaration that the specialist is independent in a form as may be specified by the competent authority.

Appendix 3: FROGS: Available habitat, expected occurrence and observed presence of frog species during surveys.

Appendix 4: REPTILES: Available habitat, expected occurrence and observed presence of reptile species during surveys.

Appendix 5: BIRDS: Available habitat, expected occurrence and observed presence of bird species during surveys.

Appendix 6: MAMMALS: Available habitat, expected occurrence and observed presence of mammal species during surveys.

Appendix 1: The details of the specialist who prepared the report:

Dr Andrew Richard Deacon (*Pr. Sci. Nat. 116951*)

PO Box 784
MALALANE 1320

House Address: House 4, Jakkalsbessie, Opdraende Road, Malalane, 1320.

Tel (h) 087 802 5272
Cell 082 325 5583
Email: andrewd@mpu.co.za

Identity number: 5108105091082
Tax #: 0161503701

Appendix 1.2 The expertise of that specialist to compile a specialist report including a curriculum vitae:

CURRICULUM VITAE - Dr Andrew Richard Deacon (*Pr. Sci. Nat. 116951*)

Born in Klerksdorp, South Africa in 1951. Matriculated at the Goudveld High School in 1969. South African citizen. Married and with one child.

FORMAL EDUCATION
Ph.D., Zoology (RAU 1987) Thesis: "The nutritional ecology and physiology of *Tilapia rendalli* and *Oreochromis mossambicus* in a warm, sewage-enriched habitat".
M.Sc., Zoology (RAU 1983) Thesis: "The occurrence and feeding habits of *Anguilla*-species in selected rivers of the Transkei".
B.Sc., Hons. in Zoology (RAU 1980)
B.Sc., majors Zoology and Botany (PU for CHE 1974)

PROFESSIONAL EXPERIENCE

2012-ongoing Environmental consultant
1989-2012 Scientific Services, Kruger National Park, SANParks
2000-2012 Programme Manager: Small vertebrates
1989-2000 Senior Scientist: Freshwater Ecologist.
1988 Consulting - Technikon of RSA; Berghoek Nature Reserve; Klaserie Nature Reserve.
1985-1987 Lecturer (Part-time) - Witwatersrand Technikon. Biology for the Food Technologists.
1984-1986 Lecturer - Department of Zoology at RAU. Biology and Taxonomy.
1983 Lecturer - Goudstad College of Education. Zoology.
1979-1982 Research assistant - Department of Zoology at RAU.
1978 Research technician - Onderstepoort Veterinary Institute. Helminthology - Taxonomy and physiology of South African helminths.
1975 – 1977 Teacher - Biology and Science

National Biomonitoring Programme - Project leader for River Health Programme (1998 - 2010)
Olifants River Forum - Vice Chairman (1994)
Research Unit for Terrestrial and Aquatic Ecology (RAU) (1991-1996)
Water Research Commission Steering Committee (30 projects) (1990 - 2011)
Lowveld Pollution Incident Committee – collaborator (1991-1998)

Mpumalanga River Health Programme - Project leader (1999 - 2005)

CONSULTING PROJECTS (112 projects)

Specialist fields for environmental studies (surveys and monitoring):

Specialist studies for:

Environmental Impact Assessments – Specialist studies (10 studies)
Reserve Determination – Environmental Water Requirements (13 projects)

Aquatic ecosystem

Hydro-electrical projects (5 projects)
Fish, macro-invertebrates and riparian (37 project)
Fish-ways (3 projects)
Wetland delineation (3 projects)

Terrestrial ecosystems (Mammals, birds, reptiles, frogs, plants)

Fauna specialist studies (40 projects)
Faunal and ecosystems monitoring: (6 projects)
Biodiversity and Habitat integrity: (30 projects)
Vegetation studies (2 projects)

Lecturing & Training: Ecology (10 projects)

OTHER

Registered: Professional Natural Scientist, SA Council for Natural Scientific Professions.
Initiated the Olifants River Forum. Received the trophy for the ORF Top Project of the Year competition and awarded honorary life membership of the Olifants River Forum.
Completed the Environmental Impact Assessment short course at the University of Cape Town.
Submitted a proposal for the Limpopo floodplains to be declared as a Ramsar site.
Accredited for SASS4 Macro-invertebrate Biomonitoring Methods.
Completed: Wetland Introduction and Delineation – Centre for Environmental Management: University of the Free State
Scientific Advisor: Leadership for Conservation in Africa
10 scientific papers in refereed journals

Appendix 2: The declaration that the specialist is independent in a form as may be specified by the competent authority.

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

KAREERAND EXTENSION PROJECT – MINE WASTE SOLUTIONS

Specialist:	Dr Andrew Deacon (Pr. Sci. Nat. 116951)		
Contact person:	Dr Andrew Deacon		
Postal address:	Pos Adres: PO Box 784, Malalane,		
Postal code:	1320	Cell:	082 325 5583
Telephone:		Fax:	
E-mail:	andrewd@mpu.co/za		
Professional affiliation(s) (if any)	SACNASP: Pr. Sci. Nat. 116951		

Project Consultant:	Clean Stream Biological Services		
Contact person:	Dr Pieter Kotze		
Postal address:	P.O. Box 11216 Silver Lakes, Pretoria		
Postal code:	0054	Cell:	(082) 890 – 6452
Telephone:		Fax:	

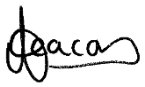
E-mail: pieter@cleanstream-bio.co.za

4.2 The specialist appointed in terms of the Regulations_

I, **Andrew Richard Deacon,**

declare that -- General declaration:

I act as the independent specialist in this application;
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 Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
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 48 and is punishable in terms of section 24F of the Act.



Signature of the specialist:

Private

Name of company (if applicable):

Andrew Deacon Environmental Consultant

Date: 16 December 2017

Appendix 3: FROGS: Available habitat, expected occurrence and observed presence of frog species during surveys (Jacobsen, 1989: Interpreted distribution map; Minter et al, 2004).

Different biotopes surveyed:

1. Pan Wetland 2. Valley-bottom Wetlands 3. Acacia karoo Woodland 4. Acacia erioloba Woodland 5. Clay Grassland – Diabase and Andesitic lava 6. Dolomite and Chert Grassland	7. Sandy Grassland 8. Secondary Grassland 9. Secondary Wetland 10. Alien trees 11. Infrastructure

Frogs expected to occur in the available natural habitats on the MWS project area, are listed below. The words in **bold font** represent qualifying habitat (preferred habitat), and *underlined italics* disqualifying habitat (the reason why the organism will not occur in the area). The shaded cells indicate the land type that incorporates the preferred habitat, and the number inside a cell gives the number of individuals or definite signs detected during surveys.

CP = Confirmed presence – Previous surveys Clean Stream (2005 to 2015)

FROG SPP	HABITAT PREFERENCE	RSA STATUS	CP	1	2	3	4	5	6	7	8	9	10	11
Family: Bufonidae														
Eastern Olive toad *(Amietophrynus garmani*)	Various bushveld vegetation types in the **savannah biome. Prefer well-wooded low-lying areas** where there is relatively high rainfall (above 600mm/annum). Breeds in **vleis, pans and dams** in open or wooded savannah. Occasionally in **quiet backwaters of rivers** and pools along **small, slow-flowing streams**. Tadpole metamorphosis complete after 64-91 days.	Least concern Common and widespread – habitat not threatened; range may have expanded.												
Guttural toad *(Amietophrynus gutturalis*)	**Savannah, Grassland** & Thicket biome: **Breeds in open shallow pools, vleis, dams, rivers, streams or other more or less permanent water.** Common in **suburban gardens and farmland**. Excavate burrows in soft ground. Tadpole metamorphosis complete after 5-6 weeks.	Least concern. Population trend: increasing. Not threatened. Relatively secure as it is widely distributed, locally abundant and highly adaptable to human settlement.	CP									1		

Raucous toad *(Amietophrynus rangeri*)	Mesic temperate areas: Fynbos and **Grassland** biomes. Breeds in **rivers (pools along slow-flowing streams), streams and ponds in grassland or woodland. Suburban gardens and farmland.** Favour **running water** sources. Call from floating vegetation, shallow water near banks, or among reeds. Breeds in still reaches of rivers, streams and man-made ponds; in rivers (pools along slow-flowing streams), streams in grassland or woodland. In still reaches of rivers, streams. Favour running water sources. Tadpole metamorphosis complete after 64-91 days. Eggs entangled in aquatic vegetation.	Least concern. Not threatened. Species secure, however decline along northeastern escarpment. **SA endemic** (Incl. Lesotho & Swaziland). Population trend: decreasing.												
Western Olive toad *(Amietophrynus poweri)*	Occurs around **vleis and pans in thornveld savannah** where rainfall is relatively low (less than 600mm/ann). Tadpole metamorphosis complete after 73 days.	Least concern.												
African split-skin toad (*Schismaderma carens)*	Wide variety of vegetation types in savannah biome, also in **Rocky Highveld, and Grassland.** Breeds in **permanent, often fairly deep, muddy - pools, dams** or waterholes in open or wooded savannah. Wanders to forage. Hibernates at a considerable distance from water, under stones, logs and piles of dead vegetation. Tadpole metamorphosis complete after 37-52 days.	Least concern. Not threatened. Adapts in disturbed areas. Tadpole survives in polluted water.												
Family: Hyperoliidae Subfamily: Kassininae														
Bubbling kassina (*Kassina senegalensis*)	Wide variety of vegetation types in **savannah and Grassland biomes.** Breeds in both **temporary and permanent water bodies: ponds, vleis, well-vegetated shallow pans, marshes and deeper dams** in grassland. Tadpole metamorphosis slow: 2-3 months.	Least concern. Not threatened. Widely distributed and abundant. Does not require conservation attention. Dams improve breeding habitat. Population trend: stable.	CP											
Family: Phrynoatrachidae														
Natal dwarf puddle frog (*Phrynobatrachus natalensis*)	A variety of vegetation types in the **savannah and Grassland biome.** Shelter **under rocks** near breeding sites. **Fairly deep water - slow-flowing streams. Temporary pans and pools, vleis and dams, and even small, slow-flowing streams.** Breeding sites usually have vegetation or other types of cover along their banks.Eggs on water surface, hatch in 3-4 days; metamorphosis 4-5 weeks.	Least concern. Not threatened. Abundant and often near human habitation. Population trend: stable.	CP											
Family: Xenopodinae														

African clawed frog (*Xenopus laevis)*	Most of the biomes. **Restricted to aquatic habitats.** Historically occurred in **streams, rivers and their pools**. Currently in **man-made water bodies**. Breeds in any more or less permanent bodies of water. Eutrophic waters seem to produce the highest densities. Burrow into dry mud to aestivate when pools dry up. Washed down during heavy rains into dry river courses. Breeds in remnant pools. Breeding and non-breeding habitats the same. Hatch in 2-3 days; metamorphosis within 2 mounths.	Least concern. Not threatened. Not threatened in any part of its range. Unprotected. Population trend: Increasing. Common and widespread.	CP		1										
Family: Pyxicephalidae															
Boettger's dainty frog (*Cacosternum boettgeri)*	Nama Karoo, succulent Karoo, **grassland** and thicket. Wide variety of vegetation types. Favors open areas with **short vegetation and grassy areas**. Forest clearings - absent from dense forest. **Pans or along river courses.** Aestivates in cracks, under logs and stones and in animal burrows or unused termitaria. Call from: concealed positions under vegetation or other cover at water level, also from exposed position. Breeds in any small, temporary water body: **marshy area, vlei, pools in inundated grassland, rain-filled depression or shallow pan**. Eggs attached to vegetation below surface of water. Tadpole hatch in 2 days, complete metamorphosis in about 2-3 weeks.	Least concern. Not threatened. Not threatened. Generalist, adapting well to disturbance. Unaffected by moderate eutrophication. Population trend: unknown.	CP		1										
Common river frog (*Amietia angolensis*)	**Grassland and savannah biomes; grassland streams** and forest fringes. Wide range of wetland habitats. Adults occur in the **grassy edges of rivers and streams,** escape into the water. Banks of slow flowing streams or other permanent bodies of water favoring those with aquatic vegetation. Edges of **pools, dams, streams and slow-flowing rivers.** Jump in water and hide in soft mud to escape. Spend day floating amongst vegetation or basking on rocks above water level. Call from floating vegetation or from shallow water at the edge. Breeds in both standing and flowing water: edges of pools, streams and slow-flowing rivers. Both standing water in flat areas, and running water transversing slopes of more than 14 degrees. Tadpoles complete development in 9-12 months, but take up to 2 years if food is in short supply or water is very cold.	Least concern. Not threatened. Widespread – found in all rivers, ponds, farm dams and other wetlands in its range. Not generally threatened. Population trend: stable.	CP												

Cape river frog (*Amietia fuscigula*)	**Grassland** and Fynbos biomes. Uses same habitat throughout year. **Rivers and streams**. Permanent springs, **ponds and farm dams** in dryer areas. **Well-vegetated waterways**. Calls from surface of deep water. Breeds in large still bodies of water or permanent streams and rivers.	Least concern. Widespread; not threatened; no special conservation measures needed. Population trend: stable.													
African bullfrog (*Pyxicephalus adspersus*)	**Seasonal shallow grassy pans, vleis and other temporary rain-filled depressions** in open flat areas of **grassland or savannah**. At the limits of its distribution in Nama Karoo in thicket. For much of the year it remains buried. Tadpoles complete development in 18-33 days	**NEMA (Tops): Protected species.** IUCN Least concern. **Frog Atlas: Near Threatened**													
Common sand frog (*Tomopterna cryptotis*)	Variety of habitats in open **savannah and grassland**, including arid areas. Open arid landscapes with **sandy soils** form the habitat of this species. The frogs spend most of the year buried in the soil; hibernate half a meter or more beneath the soil surface. Males call from exposed sites at the **banks of streams, pools and puddles**. They call at least partially from subterranean refuges, too. The frogs spawn in **small temporary waters**. They are usually nocturnal, but occasionally diurnal during periods of heavy rainfall. Breeds in **temporary rain pools and vleis**. In Transvaal, the breeding season lasts about 150 days. The frogs spawn at night, reacting spontaneously to favorable environmental conditions but stopping their activities with similar promptitude. Rainfall plays a significant role as a trigger of reproductive activity. Eggs are deposited individually in shallow, usually rather turbid water. The tadpoles hatch 2–3 days later	Least concern. Not threatened. Unprotected. Widespread. Secure. Population trend: stable.													

Appendix 3: REPTILES: Available habitat, expected occurrence and observed presence of reptile species during surveys (Jacobsen, 1989; Interpreted distribution map - Branch, 1988; Atlas and Red List - Bates, et al 2014).
Different biotopes surveyed:

1. Pan Wetland 2. Valley-bottom Wetlands 3. Acacia karoo Woodland 4. Acacia erioloba Woodland 5. Clay Grassland – Diabase and Andesitic lava 6. Dolomite and Chert Grassland	7. Sandy Grassland 8. Secondary Grassland 9. Secondary Wetland 10. Alien trees 11. Infrastructure

Reptiles expected to occur in the available natural habitats of on the MWS project area are listed below. The words in **bold font** represent qualifying habitat (preferred habitat), and *<u>underlined italics</u>* disqualifying habitat (the reason why the organism will not occur in the area). The shaded cells indicate the land type that incorporates preferred habitat, and the number inside a cell gives the number of individuals or definite signs detected during surveys.

CP = Confirmed presence – Previous surveys Clean Stream (2005 to 2015)

SPECIES	Total habitat	Status		1	2	3	4	5	6	7	8	9	10	11
Family Pelomedusidae														
Marsh terrapin (*Pelomedusa subrufa)*	Grassland, Closed woodland, **Rivers, Seasonal pools, Pans**. **Slow-moving and still water,** including natural temporary veld pans and pools (seasonal waters) **away from perennial rivers** and **dams** (permanent water - crocodiles). Basking - at water's edge, exposed rock, and protruding log or mud bank; fresh or stagnant water-bodies (tolerates wide variation in water quality). Bury themselves up to 5 cm deep in soil, mud or debris to aestivate during winter. Lays eggs in moist soil above high water mark; dig with hind feet.	Secure, protected	CP											
Family Typhlopidae														
Bibron's blind snake *(Afrotyphlops bibronii)*	**Highveld** and coastal **grassland.** Under **stones and in termitaria**. Underground.	Partially protected. Widespread. Secure and out of danger.												

Delalande's beaked blind snake *(Rhinotyphlops lalandei)*	Found in variety of veld types. Varied, semi-desert, **savannah. Under stones and in termitaria. It is most commonly found in or near the nest of termites or under loose boulders.**	Partially protected. Widespread. Secure.												
Family Leptotyphlopidae														
Peter's thread snake *(Leptotyphlops scutifrons scutifrons)*	Varied; grassland, coastal bushland, mesic and arid **savannah. Burrow underground. Usually taken under stones, under rocks on soil, under rotting logs, among grass roots.**	Partially protected. Secure.												
Family Colubridae														
Brown water snake *(Lycodonomorphus rufulus)*	**Small streams, pans and vleis**. Water-living and confined to **rivers, streams** and other permanent water or the immediate vicinity thereof. Under cover around water margins. Under rocks, debris, holes in the ground. Among swampy vegetation. Small streams, pans and vleis.	Partially protected. Widespread. Secure.												
Brown house snake *(Boaedon capensis)*	Wide distribution: Highveld **grassland** and arid karroid regions. Terrestrial Nocturnal. Eggs being laid in **decaying vegetable matter, termite hills or other suitable location**. Variety of habitats: **Moribund termitaria or any form of shelter. Tolerant of urban sprawl.**	Partially protected. Widespread, adaptable. Under no threat.												
Aurora house snake *(Lamprophis aurora)*	**Grasslands,** entering coastal bush and fynbos. **Terrestrial. Favours damp localities in grasslands, moist savannah**, lowland forest and fynbos.	**Endemic to South Africa.** Partially protected. Uncommon but widespread; secure but need monitoring												
Cape wolf snake *(Lycophidion capense capense)*	Varied: **Grassland and savannah** (open woodland), entering coastal bush and fynbos in Cape. Well-vegetated situations. **Damp situations under stones and vegetable debris. Under rocks, logs, in moribund termitaria and under debris.**	Partially protected. Widespread, considered secure.												
South African slug-eater *(Duberria lutrix)*	**Highveld grassland & savannah,** entering coastal bush and fynbos. Variable habitats – **moist areas. Under stones, rotting logs, under plant litter. Moribund termitaria.**	Partially protected. Currently secure.							1					
Mole snake *(Pseudaspis cana)*	Sandy scrubland in SW Cape, **highveld grassland**, mountainous and desert regions. **Open woodland. Abandoned animal burrows: Rodent burrows, larger animal burrows.**	Partially protected. Uncommon, vulnerable.												

Sundevall's shovel-snout (*Prosymna sundevallii sundevallii*)	**Open woodland.** Dry areas, including savannah woodlands: **burrow in loose soil. Nocturnal, partially fossorial. Under rocks, logs or even piles of bricks.**													
Striped grass snake *(Psammophylax tritaeniatus)*	**Open grassland and savannah.** Highveld grassland to open bushveld and scrub veld (300-1600m). **Holes in moribund termitaria, under rocks, piles of grass. Flee to nearest shrub or clump of grass, or might flee into water** – submerge to over 5min. Eggs laid under rock or other suitable cover.	Partially protected. Widespread, under no immediate threat.												
Fork-marked sand snake *(Psammophis trinasalis)*	Desert and semi-desert, entering **savannah. Open woodland; grassland; open scrub veld. Moribund termitaria; under rocks on soil.**	Partially protected. Uncommon. Requires conservation action.												
Short-snouted whip snake *(Psammophis brevirostris brevirostris)*	**Highveld** & montane **grassland.** Grassland, moist savannah and lowland forest in the east, and Karoo scrub and Namib desert in the west.	Partially protected. Common, under no immediate threat.												
Atractaspididae														
Black-headed centipede-eater *(Aparallactus capensis)*	Varied: **Highveld** and montane grassland, **open woodland**, open scrub veld, grassland and coastal bush. Open bush or savannah country. Found in **moribund termitaria, which offer shelter, warmth and food. Under stones, under logs, among roots of shrubs and grasses.**	Partially protected. Common, not threatened or endangered. Adequately protected.	CP											
Rhombic egg-eater *(Dasypeltis scabra)*	**Widespread in most veld types:** from sea level to an altitude of 2300m. Common in grassveld and bushveld. Absent only from true desert and closed-canopy forest. Mainly terrestrial, but climb **trees in search of birds**' eggs. Any place where it can find **shelter: Moribund termitaria, rock crevices, rock faces, heaps of rubble, rotting logs.**	Partially protected. Widespread, common. Secure.												
Red-lipped snake *(Crotaphopeltis hotamboeia)*	Most habitats: **savannahh and open woodland; Grassland** to coastal forest but not in desert. **Preference for damp localities**. **Marshy areas**. Under virtually any available cover: **Under rocks, in termitaria. Eggs laid in vegetable matter.**	Partially protected. Occurs widely. Considered secure.								1				

Boomslang (*Dispholidus typus typus*)	Common in most wooded regions outside actual rainforests. From **closed woodland through more open areas to scrub**, from sea level to 1700m. Diurnal, mostly arboreal; move through branches of **trees, shrubs and bushes**. Mating takes place in trees and eggs are deposited in holes or hollows of trees, woodpeckers' nests or leaf litter on ground wherever suitable conditions exist. Take shelter in holes in trees and large termitaria and hibernate in holes in trees.	Partially protected. Widespread, secure.													
Family: Elapidae															
Rinkhals *(Hemachatus haemachatus)*	Grassland, from the coast up to 2 500m. Montane **grasslands** of old escarpment. Close to **vleis. Rodent and mole burrows, under rocks, among thick grass tussocks.**	Partially protected. Declined in numbers. Indeterminate.													
Family: Viperidae															
Puff adder *(Bitis arietans arietans)*	Widespread: Fynbos, **grassland, scrub and woody savannahs**, from sea level to 1800m. Absent only from desert, dense forest and mountain tops. Any sort: **rock on rock, rock on soil, logs, moribund grass.**	Partially protected. Widespread, status is secure.													
Rhombic night adder *(Causus rhombeatus)*	Mesic **savannah.** In undergrowth, under **stones or logs, in termitaria.** Forages at night.	Partially protected. Widely distributed, uncommon. Status is currently secure.													
Family: Scincidae															
Cape skink *(Trachylepis capensis)*	Very varied, **grassland:** arid karroid veld, moist coastal bush, montane grassland, etc. Hunting on ground, open sandy spots. **Digs tunnels in loose sand at base of bushes or boulders, also dead trees and aloe stems.**	Protected. Status is currently secure.													
Speckled Rock Skink *(Trachylepis punctatissima)*	Variety of bushveld and Savannah types, and a wide range of ecological conditions from sea level to high mountain tops, desert to tropical bush. Although mainly **arboreal, they also inhabit rocky koppies and will cross open ground** readily. Among rocks and boulders, on the ground and in trees. Forages on rock outcrops as well as trees.	Protected. Widespread and adaptable. Status is currently secure.				2									

Variable skink (*Trachylepis varia)*	**Varied:** Very adaptive, wide variety of habitats: from sea level to high mountain slopes: **Bushveld, open woodland and scrubby grasslands** without rocks and grassland. Desert, karroid veld, montane grassland, savannahh, coastal bush, mesic thicket. Terrestrial and diurnal: **Amongst rocks and stones at rocky or stony localities**, but avoids extensive rocky areas. Broken ground, rocks and tree bases. cracks.	Protected. Widespread. Considered secure.	CP				1							
Wahlberg's snake-eyed skink *(Afroblepharus wahlbergii*)	Arid & **mesic savannah. From highveld grasslands** and mountain tops through the bushveld and into the lowveld. Forage among **grass and leaf-litter, seeking prey under fallen leaves. Shelter among grass tussocks, grass roots, under stones and rotting logs, in moribund termitaria** and among leaf-litter in shady places under shrubs, in termite hills, and on broken ground. es. Rocky outcrops and **rocky hillsides.**	Protected. Widespread. Considered secure.													
Family: Lacertidae															
Holub's sandveld lizard *(Nucras holubi)*	Broken rocky ground in **mesic savannah.** Among **grass tussocks, the base of bushes, holes in the ground, under rocks on soil and under debris.**	Protected. Widespread. Currently secure.													
Spotted sandveld lizard (*Nucras intertexta*)	Arid savannah – Kalahari sand: **Open dry savannah. Holes in the ground, under rocks on soil, among grass tussocks and in leaf litter.**	Protected. Widespread. Secure.													
Family: Gerrhosauridae															
Yellow-throated plated lizard *(Gerrhosaurus flavigularis)*	**Wide range of habitat:** Scrub- or bush-covered flats near coast to high mountain slopes and plateau; including highveld, bushveld and lowveld. Bushveld, lowveld, grasslands (highveld) savannahh. **On stony hillsides, sandy flats, woodland and grassland. Burrows of considerable lengths dug in ground under suitable sheltering bushes, shrubs, under boulders etc. Also shelters in rodent burrows, under rocks (lay half buried in soil), moribund termitaria.**	Protected. Status – secure.													
Family: Cordylidae															
Common girdled lizard *(Cordylus vittifer)*	**Rock outcrops in Grassland. In cracks in small rock outcrops.**	Protected. Widespread, status is secure.													
Family: Varanidae															

Rock monitor *(Varanus albigularis albigularis)*	savannah and open bush or forest country, **open woodland, rocky hillsides, ridges and outcrops**. Moister Karroid areas. Terrestrial. Dig tunnel under rock overhangs. Cracks and fissures between or under rocks, or in disused animal burrows or in hollow trees or holes in trees. **Expert climbers: tree and rocks. Great wanderers** – even far from water. Eggs deposited in holes in suitable soil dug to 150-230 mm - cover and camouflage nest. Eggs in live termite nest, hollow tree, usually hole in soft moist sand.	Protected by Provincial legislation (CITES, Appendix 11). Widespread, status considered secure.													
Water monitor *(Varanus niloticus niloticus)*	**Near water: rivers, dams**, **pans** and major lakes. Major river valleys. Shelter in holes in banks, in animal burrows or in crevices between rocks or under rocks, marginal vegetation. Basking in sun on rocks, outcrops, tree stumps, branches of overhanging trees or amongst vegetation on banks - never far from water. Escape into water – swim swiftly. Forage in marginal vegetation. Hibernate in large rock crag on rocky cliff or koppie bordering river. Young – marginal reed beds. Eggs deposited in hole dug deep into a living termite nest or sandbank by female, roughly covered over – termites seal up securely.	Protected by Provincial legislation (CITES, Appendix 11). Widespread, status considered secure.													
Family: Agamidae															
Distant's ground agama (*Agama aculeata distanti*)	Semi-desert and savannah: **Open highveld (Grassland) and sandy thornbush (woodland)** country with suitable rodent and other small animal burrows for shelter. **Utilize rodent and other small animal burrows for shelter; burrows in termitaria; under stones and debris, partly buries in soil.**	Protected. Widespread in TVL. Sparsely distributed. Secure.													
Southern rock agama *(Agama atra atra)*	Semi-desert to fynbos, from sea level to mountain tops. **Rock outcrops** and mountain plateaus, also **rocky plains**. May shelter under bark of dead trees. Shelter in deep cracks. Eggs in hole in damp soil.	Protected. Widespread, locally common. Secure.	CP			2									
Family: Chamaeleonidae															
Common flap-necked chameleon (*Chamaeleo dilepis dilepis*)	Various kinds of woodland: **savannah woodland; and wooded grassland, along streams**. Wooded areas; branches of trees; branches of shrubs; Open forest and bush country, savannah woodland. Lays eggs in tunnel in damp soft soil at a sheltered spot.	Protected. Widespread, out of danger.													

	Diurnal, arboreal species, common in suitable habitat.													
Family: Gekkonidae														
Common dwarf gecko *(Lygodactylus capensis capensis)*	**Well-wooded dry savannah**: Open woodland and well-wooded dry savannah country. Diurnal and arboreal gecko. **Inhabiting trees with holes or loose bark, which provides shelter. Also shelters among rocks and dead vegetation.** Marked preference for Baobab, Acacia and Mopane – plenty suitable rough bark as cover. Eggs are laid in rock cracks, crevices, under stones or under loose bark. Forage in low scrub and on dead trees. Observed clinging, head down, near base of tree waiting for prey.	Protected. Widespread, abundant. Under no threat.	CP				1							
Cape gecko *(Pachydactylus capensis)*	**Grassland and mesic savannah.** Terrestrial, **rotting logs, disused termitaria, low rock cracks**. Under calcrete blocks in Kalahari. Eggs are laid in old termitaria or under stones.	Protected. Widespread, sparse. Secure.												

Appendix 4: BIRDS: Available habitat, expected occurrence and observed presence of bird species during surveys (Gibbons, 1997; Harrison et al, 1997; Hockey et al, 2005 – latest name changes).
Different biotopes surveyed:

1. Pan Wetland 2. Valley-bottom Wetlands 3. Acacia karoo Woodland 4. Acacia erioloba Woodland 5. Clay Grassland – Diabase and Andesitic lava 6. Dolomite and Chert Grassland	7. Sandy Grassland 8. Secondary Grassland 9. Secondary Wetland 10. Alien trees 11. Infrastructure

Birds expected to occur in the available natural habitats on the MWS project area, are listed below. The words in **bold font** represent qualifying habitat (preferred habitat), and *underlined italics* disqualifying habitat (the reason why the organism will not occur in the area). The shaded cells indicate land types that incorporate preferred habitat, and the number inside a cell gives the number of individuals or definite signs detected during surveys.
CP = Confirmed presence – Previous surveys Clean Stream (2005 to 2015)

BIRD	Biotope (Geographical area)	SA status	CP	1	2	3	4	5	6	7	8	9	10	11
Flamingos														
Greater flamingo (*Phoenicopterus roseus)*	**Shallow eutrophic wetlands; breeds on pans and mudflats.** Large bodies of shallow water, both inland and coastal. Saline and brackish waters preferred.	**SA Red Data (Barnes 2000): Near-threatened.** Locally abundant; highly nomadic; partly migratory, moving north in winter. Least concern.												
Lesser flamingo (*Phoeniconaias minor*)	**Shallow eutrophic wetlands,** saltpans and sheltered coastal lagoons. Larger brackish or saline inland and coastal waters.	IUCN 2010 NT: Near-threatened; SA Red Data (Barnes 2000): Near-threatened. Locally abundant; highly nomadic. Population trend: decreasing.												
Grebes														
Little Grebe *(Tachybaptus ruficollis)*	More permanent waters: lakes, **ephemeral pans and dams;** emergent or overhanging vegetation, weedy shores. Backwaters in slow flowing rivers and streams. More permanent water. Infrequent: slow-flowing streams. Rarely in estuaries and sheltered bays.	Common resident or nomad												

Great Crested Grebe *(Podiceps cristatus)*	Inland waters at higher elevations: **more permanent waters – lakes & dams, endorheic pans** with **emergent vegetation;** clean oligotrophic waters.	Sparse over most of southern Africa, can be locally common; resident or nomadic													
Black-necked Grebe *(Podiceps nigricollis)*	**Ephemeral pans** in arid areas; Open pans with depth exceeding 1.2m with emergent grass. Larger pans and vleis inland.	Uncommon, nomadic in arid areas, migrate to coastal areas when not breeding													
Cormorants															
White-breasted cormorant (*Phalacrocorax lucidus)*	Coastal and **fresh waters: Dams and impoundments, streams and rivers**. Mainly aquatic, in both salt and freshwater. Interior - streams and rivers.	Common resident													
Reed cormorant (*Microcarbo africanus*)	Virtually all **freshwater habitats** except fast flowing streams. Prefers gently sloping shores. Also estuaries, lagoons and sheltered coastal waters. Freshwater wetlands **(any size) and water bodies: ephemeral habitats, major rivers and fast-flowing streams with pools, artificial wetlands: dams, sewage works.**	Common resident	CP												
Darters															
African Darter (*Anhinga rufa*)	**Freshwater wetlands, rivers and streams;** avoids fast-flowing and turbulent water; adapted to **artificial wetlands. Still and slow-moving freshwater bodies with open water.** Scarce on fast flowing rivers and in areas with dense floating vegetation. **Prefers areas with dead trees, rocks or banks** where it can rest after feeding.	Common resident													
Egrets, herons and bitterns															
Grey heron (*Ardea cinerea*)	**Bodies of shallow open water. Wetlands – rivers, dams, pans, marshes** and estuaries – provided there is sufficient **shallow water to feed** in. Mountainous areas: keep to valleys. Tall trees, reed beds and cliffs for roosting. Also marine intertidal zone, estuaries, lagoons. Rarely in dry grasslands.	Relatively uncommon; resident Breeding resident (Har97) Numbers augmented by Palearctic migrants (Har97) Expansion in range – artificial water bodies. Common													

Black Heron (*Egretta ardesiaca*)	Inland waters: **shallow rivers, marshes, flooded grasslands, dams,** and tidal mudflats. Perennial wetlands. Generally associated with relatively **shallow, perennial waters**. At marshes. The edge of rivers and lakes, as well as seasonally flooded grasslands and estuarine waters, including mudflats and mangroves.	Common in tropical parts of southern Africa, resident													
Little egret (*Egretta garzetta*)	**Open areas of shallow water: margins of lakes, dams, rivers, marshes,** saltpans, estuaries and mangrove swamps. Breeds near water in trees or bushes. Edges of rivers and lakes, estuaries, pans, marshes, and saltpans. Also mangroves, open coastal.	Fairly common resident													
Intermediate egret (*Egretta intermedia*)	**Shallow water or wet grasslands.** Margins of lakes, rivers, saltpans and estuaries; especially seasonal waterbodies, marshes and flooded grasslands. Prefers shallow water, but also forages in dry grassland close to water.	Uncommon to locally common; local movements, possibly migratory in part													
Western Great Egret (*Egretta alba*)	**Shallow open water at lakes, rivers, floodplains, flooded grasslands, marshes,** saltpans and estuaries.	Uncommon resident													
Black-headed heron (*Ardea melanocephala*)	Open habitats, **preferring grasslands. Pastures** and field of **stubble near wetlands. Tall trees for breeding** and roosting.	Common resident	CP		1										
Goliath heron (*Ardea goliath*)	**Open water: lakes, dams, large wide rivers** and estuaries with extensive shallows and where there are extensive reeds or papyrus. Nests on islands. Shallow margins of large water bodies.	Uncommon resident generally, but common and conspicuous on larger rivers.	CP												
Purple heron (*Ardea purperea*)	Larger water bodies and **wetlands: Reedbeds, marshes,** reed-fringed rivers and lakes; flooded areas with tall grasses, rushes and sedges. Dense emergent vegetation, especially reed beds fringing shallow wetlands; also mangroves.	Uncommon to common resident													
Western Cattle egret (*Bubulcus ibis*)	**Terrestrial; open short grassland. Nests in trees and reedbeds.**	Very common resident	CP		1			1		2		2			
Squacco heron (*Ardeola ralloides*)	Freshwater habitats: dense emerging/fringing vegetation in the **quiet backwaters of ponds and the edges of slow-flowing rivers and streams**. Adequate reed cover and a few bushes or trees are prerequisites. Flooded grasslands and ephemeral pans with emergent vegetation.	Uncommon to locally common resident													

Straited heron (*Butorides striata*)	**Densely vegetated rivers**, estuaries, streams, lakes, ponds, swamps and mangroves. Wooded areas around margins of rivers, streams, lakes, estuaries, mangroves reedbeds, and swamps where vegetation overhangs water. Occasional - mudflats, temporarily flooded grassland and seashore.	Uncommon resident													
Black-crowned night heron (*Nycticorax nycticorax*)	**Dense vegetation along the edges of shallow, still or slow-moving water such as rivers**, lakes, pans, **marshes** or seasonal floodplains. Well-vegetated and slow-moving water - estuaries, mangroves. Roosts in trees and reedbeds.	Common resident													
Little bittern (*Ixobrychus minutus*)	**Breeding birds confined to *Typha* and *Phragmites* reedbeds in standing water**. Migrants in sedges or rank emergent vegatation in shallow water. At edges of wooded streams and rivers. Rank vegetation along ponds.	Non-breeding Palaeactric migrant													
Storks															
Yellow-billed stork (*Mycteria ibis*)	**Dams, large marshes,** swamps, estuaries, margins of lakes and **rivers, seasonal wetlands.** Wetlands, including alkaline and freshwater lakes, rivers, pans, **flood plains, flooded grasslands**, small pools or streams.	**SA Red Data (Barnes 2000): Near-threatened.** Non-breeding infra African migrant.													
Black stork (*Ciconia nigra*)	**Shallow water: streams, rivers, marshes, floodplains,** coastal estuaries, flooded grassland; large and small dams; dry land. **Shallows of rivers, pools in dry riverbeds.** Uncommon in seasonal pans lacking fish.	**SA Red Data (Barnes 2000): Near-threatened.** Uncommon to rare nomadic													
Abdim's stork (*Ciconia abdimii*)	**Grasslands, pastures and cultivated fields.**	Non-breeding intra-African migrant, very common													
White stork (*Ciconia ciconia*)	**Open woodland, grassland**, grassy Karoo and wetland areas.	Non-breeding Palaeactric migrant													
Spoonbills															
African spoonbill (*Platalea alba*)	**Shallow aquatic habitats: freshwater wetlands, marshes, pans, temporary flooded grasslands, floodplains, rivers, dams.** Almost exclusively shallow aquatic habitats, favouring lake and river margins, seasonally and permanent pans, coastal lagoons and estuaries.	Locally common nomadic													
Cranes															

Blue Crane *(Anthropoides paradiseus)*	Karoo and **grassland biome. Croplands.**	**IUCN 2010 VU Vulnerable A2acde: NEMBA TOPS (2015): Protected species; SA Red Data (Barnes 2000): Vulnerable.** Common resident with local movements. Population trend: decreasing.														
Ibis																
Glossy ibis (*Plegadis falcinellus*)	**Grassland habitats, associated with freshwater habitats:** shallow inland waters, lake and **river-edge marshes, seasonal pans, flooded grassland**. Riparian marshes, shallow rivers.	Locally common to rare Increasing in numbers.	CP													
Hadeda Ibis (*Bostrychia hagedash*)	**Open moist grasslands & savannah, along well-vegetated river courses; also marshes, flooded grasslands, edges of large wetlands, gardens.**	Very common resident	CP			1	2				1					
African Sacred ibis (*Threskiornis aethiopicus*)	**Grassland habitats, associated with freshwater habitats: marshes, estuaries and dams.**	Common to very common resident														
Hamerkop																
Hamerkop (*Scopus umbretta*)	**Large perennial waterbodies (lakes, dams and rivers),** vleis and ephemeral wetlands, perennial and seasonal rivers with pools. Edges and shallow waters of **lakes, pans, swamps and marshes, rivers, streams and seasonally flooded ponds**, including relatively small puddles.	Common resident				1										
Ducks & geese																
Fulvous whistling duck (*Dendrocygna bicolor*)	**Larger inland waters: floodplains, plentiful aquatic vegetation**. Shallow water bodies. **Thickly vegetated with aquatic grasses and other plants.** Feed in partly flooded / marshy wetland.	Nomadic probably summer migrant to SA. Not threatened.														
White-faced whistling duck (*Dendrocygna viduata*)	Inland waters, mainly in savannah and grassland. **Expanses of shallow water with emergent vegetation**: backwaters of larger rivers, grassy floodplains, small ephemeral pans. Feeds in water - usually in shallows of permanent or seasonal wetlands, or flooded grasslands; on land - natural grasslands.	Common resident. Nomadic when breeding. Not threatened.														

White-backed duck (*Thalassornis leuconotus*)	**Quite, clear inland waters with emergent of floating vegetation, natural pans, open vleis, floodplains and river backwaters**. Diving to bottom muds in open water.	Uncommon resident or nomadic at times. Not threatened.													
Maccoa duck (*Oxyura maccoa*)	*Deep, highly nutritious inland waters with emergent vegetation*; also saltpans.	**IUCN 2010 NT: Near-threatened;** Uncommon resident; sometimes locally common; local movements													
Egyptian goose (*Alopochen aegyptiaca*)	**Inland waters: rivers, dams, lakes, marshes, pans, and estuaries with some exposed shoreline;** wetland edges. Rich aquatic plant growth. Naturally: Restricted to flood plains and large rivers with broad sandbanks. Currently: Cropfields and cereal fields.	Very common resident	CP					2							
South African Shelduck *(Tadorna cana)*	**Shallow, stagnant, temporary waters**, often brackish and warm. Small farm dams, large estuaries and coastal lagoons. Wing-moult habitat: **Large impoundments. Breeding habitat: open country near a small body of water. Shallow, brackish seasonal pans, rivers.** Exposed, muddy shoreline water and extensive, open, shallow water. Continuous short vegetation.	Common; migrates to larger bodies of water for wing-moult.	CP												
Spur-winged goose (*Plectopterus gambensis*)	**Inland waters / wetland: larger bodies of water, floating vegetation; croplands**. Flightless moult: Dams and dense swamp. Breeding: smaller system or secluded bay, emerging fringing vegetation. Rivers - shallow areas in open.	Common to very common resident	CP												
Knob-billed duck (*Sarkidiornis melanotos)*	**Inland waters: seasonal flooded pans and vleis. Rivers - shallow areas in open.**	Locally common ; seasonal movements													
Cape teal (*Anas capensis*)	Saltpans, estuaries, coastal lagoons, **brackish and saline pans.**	Common resident													
African black duck (*Anas sparsa*)	**Rivers with running water**, pools with wooded banks. Mainly perennial rivers and streams, from fast-flowing mountain streams to wide sandy river mouths, preferring shallow stony bottom streams with wooded banks. Moult: lodged branches undercut banks.	Uncommon localized resident													

Yellow-billed duck (*Anas undulata*)	**Inland waters: Sluggish or still waters** and still waters of rivers and streams; mostly with marginal vegetation such as reeds. Avoid fast flow and saline/ acidic water bodies. Usually floats near emergent aquatic vegetation, occasionally on open water.	Very common resident	CP												
Cape shoveler (*Anas smithii*)	**Shallow pans,** especially with saline waters.	Uncommon resident	CP												
Red-billed teal (*Anas erythrorhyncha*)	**Shallow, permanent or temporary eutrophic fresh water with grassy surroundings.**	Common resident but nomadic	CP												
Hottentot teal (*Anas hottentota*)	**Inland waters with emergent vegetation such as floodplains, vleis, marshes with bulrushes.**	Uncommon to locally common resident													
Southern pochard (*Netta erythrophthalma*)	**Deep, permanent or seasonal fresh water pans, vleis, clear water; emergent vegetation and seasonal floodplains.**	Common to very common resident													
Jacanas															
African Jacana *(Actophilornis africanus)*	**Aquatic habitats: seasonal pans and floodplains; along fringes of slow-flowing, meandering rivers** – emergent, floating hydrophytes to forage. Permanent, seasonal and ephemeral shallow, freshwater wetlands and margins of slow-flowing rivers with low emergent vegetation. Favours areas dominated by water lilies and pondweed. Walks on floating plants or swim when hydrophytes provide insufficient support.	Common to abundant resident; local movements apparent													
Vultures															
African White-backed Vulture *(Gyps africanus)*	**Drier woodlands, mopane, arid Kalahari; tall trees for roosting and nesting**	**IUCN 2010 NT: Near-threatened; NEMBA TOPS (2015): Endangered species; SA Red Data (Barnes 2000): Vulnerable.** Common nomadic													

Cape Vulture *(Gyps coprotheres)*	**Both open country (grasslands) and woodland.** Reliant on tall cliffs for breeding and roosting. Wanders widely.	**IUCN 2010 VU Vulnerable C1+2aii; NEMBA TOPS (2015): Endangered species; SA Red Data (Barnes 2000): Vulnerable.** Locally common													
Secretary bird															
Secretary bird (*Sagittarius serpentarius*)	**Open country: savannah, open woodland, grassland** and dwarf shrubland	**IUCN status (2014): Vulnerable. SA Red Data (Barnes 2000): Near-threatened.** Uncommon to fairly common resident.													
Hawks and eagles															
Black-winged Kite *(Elanus caeruleus)*	**Wide distribution: Most abundant in grassland and fynbos with cultivated areas.**	Common resident & nomad	CP			1					1				
Yellow-billed Kite (*Milvus parasitus*)	**Great variety** of habitats: **especially woodlands** (higher rainfall areas)	Common breeding Palaearctic migrant													
African fish eagle (*Haliaeetus vocifer*)	Widespread. Coastal along the sea shore, and at estuaries and lagoons; **inland on lakes and large river**s. Usually associated with large water bodies, either flowing or still, including estuaries. Sometimes along open coastline. May remain on seasonally dry rivers once last pools dry up, subsisting on birds and scavenging carcasses. Absent from rivers that flow for only a few weeks a year.	Uncommon resident													
African marsh harrier (*Circus ranivorus*)	**Nests in extensive reedbeds; forage over reeds, lake margins, floodplains and woodland.**	**SA Red Data (Barnes 2000): Vulnerable.** Common resident													
Black Harrier *(Circus maurus)*	**Grassland,** Karoo scrub, mountainfynbos **cultivated lands,** subalpine vegetation, semi-desert.	**IUCN 2014 NT – Near-threatened; SA Red Data (Barnes 2000): Near-threatened.** Uncommon local migrant													
African Harrier-Hawk *(Polyboroides typus)*	Mainly in forests. **Dense woodland, tall riparian vegetation** and well-wooded ravines. Partial to stands of **alien trees.**	Locally common resident													
Pale Chanting Goshawk *(Melierax canorus)*	Arid areas, **drier woodland and grassland types:** open scrub and wooded drainage lines.	Very common resident													
Gabar Goshawk (*Micronisus gabar*)	Open woodland: ***Acacia* parkland and Acacia-dominated riparian zone.**	Common resident													

Common Buzzard *(Buteo buteo)*	**Open country:** dwarf shrubland, **grassland, savannah,** open woodland, thornveld & fynbos. Also found in dense woodland.	Common non-breeding Palaeactric migrant	CP													
Verreaux's Eagle *(Aquila verreauxii)*	*Rocky habitats in hills and mountains* with nest sites; vegetation types associated with mountainous regions - Alpine grasslands. Need dassies as food.	Locally fairly common resident														
Martial Eagle *(Polemaetus bellicosus)*	**Open grassland and scrub. Large trees for nests.** Wide range of vegetation types: deserts, densely wooded and forested areas.	**IUCN 2014 Status: Vulnerable. NEMBA TOPS (2015): Endangered species; SA Red Data (Barnes 2000): Vulnerable.** Fairly common to uncommon resident														
Falcons, hobbies and kestrels																
Lesser Kestrel *(Falco naumanni)*	**Semi-arid grassland.** Avoid wooded areas; forage in **agricultural fields.** Grassy Karoo, Sweet and Mixed grassland, Central Kalahari vegetation types.	**SA Red Data (Barnes 2000): Vulnerable.** IUCN 2014 Status: Least concern. Population trend: decreasing. Abundant non-breeding Palaearctic migrant.	CP						1							
Rock Kestrel *(Falco rupicolus)*	**Wide variety of habitat types**: arid to mesic conditions. Mountainous areas for breeding. Montane **grassveld with rocky outcrops.**	Common resident	CP				1	4			1					
Greater Kestrel *(Falco rupicoloides)*	**Open, arid and grassland habitats.**	Common resident						1			1					
Amur Falcon *(Falco amurensis)*	**Open and high-rainfall (sour) grasslands. Also open areas in woodland.**	Very common non-breeding Palaearctic migrant														
Lanner Falcon *(Falco biarmicus)*	**Open habitats. Cliff-nester, also in old nests in trees.**	**SA Red Data (Barnes 2000): Near-threatened.** IUCN 2014 Status: Least concern; Fairly common resident														
Francolins and spurfowl																
Coqui Francolin *(Peliperdix coqui)*	**Savannah or well-grassed woodland**, sandy areas with good bush cover: **grassy clearings** and along edges of woodland.	Common resident														
Orange River Francolin *(Scleroptila levaillantoides)*	**Open grassland, dry savannah, grassy mountain slopes with low scrub, croplands, edges of pans.**	Fairly common resident.						6	2							

Natal spurfowl (*Francolinus natalensis*)	**Woodland types: savannah** with scrub understorey, especially **along water courses**, to thickets and coastal forest. Dry riparian vegetation and wooded hills.	Common resident													
Swainson's Spurfowl *(Pternistes swainsonii)*	Wide variety of habitats. **Tall grass in open country (grassland) or woodland.** Adjacent to **cultivation** or close to water.	Very common resident	CP												
Guineafowl															
Helmeted Guineafowl (*Numida meleagris*)	**Savannah mixed with cultivation**. Inhabiting most agricultural regions	Very common resident	CP		1	5		11			8	2			
Sandgrouse															
Namaqua Sandgrouse *(Pterocles namaqua)*	Open desert and semi desert (<300mm); **usually stony with sparse low shrubs and grass tufts.**	Common resident, somewhat nomadic; southern populations migratory.													
Quails															
Common Quail *(Coturnix coturnix)*	Catholic use of habitats: **Prefer perennial grasslands,** less than 0.5m in height, **fallow weedy fields**, and grassland regenerating after burning.	Common resident or migrating													
Kurrichane Buttonquail *(Turnix sylvatica)*	**Open grassveld: neither very tall or very dense. savannah. Fallow lands.**	Uncommon resident						1							
Crake and rails															
African rail (*Rallus caerulescens*)	**Reedbeds and dense, rank growth in perennial, semi-permanent or seasonal swamps and marshes.** Beside rivers, streams, pools and lakes. Marshy ground with pools along edges of streams where there is thick cover; occasionally at mature pans.	Fairly common resident; more often heard than seen													
Black crake (*Amaurornis flavirostris*)	**Rank grass, sedges, reedbeds, bulrushes, papyrus, swampy thickets, bushes and other vegetation beside flowing, still or open fresh** and estuarine **waters.** Occurs in tangled growth in which birds climb, roost and nest. In thin cover along very small streams in arid regions.	Common resident													
Coot, moorhens and gallinules															
African Swamphen *(Porphyrio madagascariensis)*	**Fresh to brackish, sheltered, still to slow-flowing rivers and still waters fringed or overgrown by reeds, rushes, bulrushes, sedges, etc**. All marshes and swamps with permanent water, and ephemeral and seasonal flooded wetlands.	Fairly common resident	CP												

Common Moorhen (*Gallinula chloropus*)	**Wetlands with emergent fringing vegetation, including lakes, dams, ponds, pans, rivers, streams, canals, swamps and marshes.** Flooded grassland. Temp ponds on floodplains. Sheltered sites with some open water, avoids very open situations.	Common resident	CP												
Red-knobbed coot (*Fulica cristata*)	**Open freshwater of lakes, lagoons, ponds, pans and vleis, floodplains, reedy swamps.** Occasionally on rivers and tidal lagoons. Favouring wetlands with emergent vegetation and pondweed. Spend much time swimming on open water.	Abundant resident, highly nomadic	CP												
Korhaans and bustards															
White-bellied korhaan (*Eupodotis senegalensis*)	**Open grassland and lightly wooded savannah; prefer taller grass.**	**SA Red Data (Barnes 2000): Vulnerable.** Uncommon resident													
Northern Black Korhaan (*Afrotis afraoides)*	**Grassland or open bushveld where grasses are predominant.**	Very common resident	CP		1	1	3	3	5	2	2	2			
Plovers and lapwings															
Common Ringed Plover *(Charadrius hiaticula)*	**Estuaries and inland wetlands: Muddy, sandy and gritty substrate.** Gently sloping shorelines and eutrophic water conditions – vegetation no influence. Inland on mud- and sandbanks along rivers and at wetlands, favouring wide, bare shorelines with little emergent vegetation. Roosts on bare, open shoreline.	Common non-breeding Palaearctic migrant													
Kittlitz's plover (*Charadrius pecuarius*)	**Open dry mud and short grass, usually close to water. Natural pans – dry mud and short grass. Also estuaries, salt-marshes and flood plains.**	Common resident, nomadic													
Three-banded plover (*Charadrius tricollaris*)	**Any freshwater habitat with an open shoreline.** Open shores of any freshwater habitat, favouring pools, streams and seeps. Also at tidal pools, estuaries and lagoons.	Common resident, nomadic													
Chestnut-banded Plover *(Charadrius pallidus)*	Saline lagoons, saline and brackish pans, saltworks; occasionally estuaries and sandy lagoons. *Rarely in freshwater habitats.*	**IUCN 2014: NT Near-threatened; SA Red Data (Barnes 2000): Near-threatened.** Locally common resident; some populations necessarily nomadic on temporary inland pans. Rare.													
Blacksmith plover (*Vanellus armatus*)	**Moist short grasslands and mudflats on edges of pans, lakes, rivers, and estuaries.**	Common resident, nomadic	CP									2			

African Wattled plover (*Vanellus senegallus*)	**Wet short grasslands and marshes near vleis, streams and on river floodplains.** Waterlogged grasslands at seeps, streams, edges of marshes and flood plains; exposed areas around lakes and pans.	Locally common resident	CP												
Crowned Lapwing *(Vanellus coronatus)*	**Dry, short and over-grazed or burnt grassveld.** Widespread in a number of grassland and woodland types. Absent from mountainous and desert areas.	Common resident, nomadic	CP			6		10	2	2	13	1		
Sandpipers & other waders															
Marsh sandpiper (*Tringa stagnatilis*)	**Freshwater wetlands**, coastal lagoons and tidal estuaries. **Shallow water over muddy substrate.**	Fairly common non-breeding Palaearctic migrant													
Common Greenshank (*Tringa nebularia*)	Aquatic habitats: coastal sites and inland wetlands with shallow margins. **Vleis, pans, and rivers.**	Common non-breeding Palaearctic migrant													
Wood sandpiper (*Tringa glareola*)	**Marshy shorelines: ephemeral pans, vleis, marshes, streams, floodplains and upper reaches of estuaries. Muddy, sandy or gravel borders of dams and ponds,** inundated short grassland, sandy and muddy riverbeds, natural pans, mixed rocky and sandy beaches, salt marshes, estuaries, tidal and non-tidal lagoons and mangroves. Marsh-like conditions favoured over open shore-lines.	Common non-breeding Palaearctic migrant													
Common sandpiper (*Actitis hypoleucos*)	**Any aquatic habitat, but favours streams and rivers shores with sandy, gravelly, stony or rocky substrata**, estuaries, tidal creeks in salt marsh, mangroves. Open water edges: streams, rivers, marshes, vleis, coastal lagoons and upper reaches of tidal estuaries. Prefer wet conditions adjacent to water rather than wading in water.	Fairly common non-breeding Palaeartic migrant													
Curlew sandpiper (*Calidris ferruginea*)	**Wetlands: pans and wetlands with muddy edges.**	Very common non-breeding Palaeartic migrant													
Ruff (*Philomachus pugnax*)	**Shallow water, muddy margins and short emergent vegetation. Vleis, pans and saline wetlands.**	Common non-breeding Palaeartic migrant													
Little stint (*Calidris minuta*)	**Muddy edges of wetlands.**	Common non-breeding Palaeartic migrant													
Snipes															

Greater Painted snipe (*Rostratula benghalensis*)	**Pans and marshy river flood plains**. Exposed mud adjacent to cover. Marshes, muddy edges of swamps, lake edges, and riverbanks with thick vegetation cover. Favours waterside habitats with substantial cover and receding water levels with exposed mud among vegetation.	**SA Red Data (Barnes 2000): Near-threatened.** Uncommon resident													
African Snipe (*Gallinago nigripennis*)	**Temporary and permanent wetlands with short emergent vegetation, tussocks of grass or reeds, and exposed soft mud. Vleis, marshes and wet grasslands**. Fringes of well-vegetated pans and riparian wetlands. River flood plains with grassy margins. Favours areas where marsh vegetation has been disturbed by grazers, exposing patches of mud.	Locally common resident													
Dikkops or thick-knees															
Spotted Thick-knee *(Burhinus capensis)*	Various types of grasslands; whole of SA highveld. **Open grassland and savannah, edges of woodland, semi-desert with scrub, stony slopes of low hills, cultivated land.** Sparse ground cover where stony.	Common resident							2		2	2			
Stilts															
Pied Avocet (*Recurvirostra avosetta*)	Saline waters: **great saline pans** and coastal lagoons.	Locally common resident, nomadic													
Black-winged stilt (*Himantopus himantopus*)	**Extensive open, shallow waters**: coastal lagoons and saltpans. Inland and coastal wetlands, ranging from **flooded fields, flood plains** and papyrus swamps. Typically roosts communally in open areas.	Locally common resident, nomadic	CP												
Coursers															
Double-banded Courser *(Rhinoptilus africanus)*	Stony or gravelly semi-desert with **stunted shrubs; also eroded and overgrazed grassveld.**	Locally common, but sparsely distributed nomadic resident.													
Temminck's Courser *(Cursorius temminckii)*	**Open woodland, edges of vleis, grassy plains, dry pans, bare or overgrazed veld, fallow lands** and airfields. Recently burnt short grass.	Uncommon to locally common nomadic resident													
Pratincole															
Black-winged Pratincole *(Glareola nordmanni)*	**Open grassland.** Always near water and damp meadows or marshes overgrown with dense grass; **access to drinking water important. Winter: prefer open grassland, edges of pans and cultivated fields, but most common in seasonally wet grasslands and pan sysytems.**	**IUCN 2014 NT: Near-threatened; SA Red Data (Barnes 2000): Near-threatened.** Locally abundant non-breeding Palaearctic migrant; uncommon and sporadic; numbers decreasing.													

Terns, gulls & other seabirds															
Grey-hooded gull (Chroicocephalus *cirrocephalus*)	**Shallow, open water.**	Common to abundant resident or local migrant													
Whiskered tern (*Childonias hybrida*)	**Inland wetlands: Open water, marshes, reedbeds, vleis, reedy dams, flooded pastures, pans.** Favours natural wetlands, especially marshes, vleis and river flood plains with emergent, floating and submerged vegetation.	Locally common nomad, moving about according to rainfall.													
White-winged tern (*Chlidonias leucopterus*)	**Inland and coastal wetlands: Shallow vleis formed by summer rains in grassland habitat. Including ephemeral bodies.** Roost on low, bare, muddy or sandy islets.	Common to abundant non-breeding Palaearctic migrant													
Doves and pigeons															
Common pigeon (*Columba livia*)	**Urban areas, less often farmland.**	Abundant resident; introduced.													
Speckled Pigeon (*Columba guinea)*	Mountains, cliffs, rocky gorges, boulder-strewn hills. Inhabitant of cliffs and crags, fly out to **forage on open ground**. **Artificial structures.** Roosts on cliff ledges, in caves and sometimes on **trees.**	Common to abundant resident, nomadic	CP										4		
African Olive-Pigeon *(Columba arquatrix)*	Afromontane, lowland and coastal forests, **riverine forests.**	Locally common resident													
Laughing dove (Spilopelia *senegalensis*)	**Open savannah, Acacia thornveld and grassland; avoids natural high altitude grasslands.**	Very common resident	CP			1									
Ring-necked Dove (*Streptopelia capicola*)	**Catholic choice of habitats: all vegetation types**, except forests.	Very common resident	CP				2						1		
Red-eyed Dove (*Streptopelia semitorquata*)	Tall trees in the vicinity of water. **Riparian woodland,** forest verges and other well-wooded country.	Common resident	CP			1		1							
Namaqua Dove *(Oena capensis)*	Dry to semi-arid open woodlands and **savannahs**. More open habitat.	Common resident, nomad	CP												
Louries															
Grey go-away-bird (*Corythaixoides concolor*)	Open woodland, ***Acacia* woodlands, near water.**	Common resident													

Coucals															
Burchell's Coucal (*Centropus burchellii*)	Rank and tangled growth. **Reedbeds, marshes, and thickets, coastal bush. Along drainage lines, edges of wetlands.**	Common resident													
Cuckoos															
Jacobin Cuckoo *(Clamator jacobinus)*	Dry open savannahs, Acacia. Dry to **moist woodlands.**	Fairly common non-breeding Palaeartic and Indian migrant													
Red-chested Cuckoo (*Cuculus solitarius*)	Forest and **well-wooded habitats: riparian growth**, thickets and evergreen forests. **Trees around habitation.**	Common intra African breeding migrant													
African Cuckoo (*Cuculus gularis*)	**Variety of woodlands – broadleaved and *Acacia*.**	Uncommon breeding intra African migrant													
Klaas's Cuckoo (*Chrysococcyx klaas*)	**Forest, moist woodland and savannah. Trees around habitation.**	Fairly common resident and intra African breeding migrant	CP												
Diederik Cuckoo (*Chrysococcyx caprius*)	**Variety of habitats**: from forest edge to semi desert. Not in forests and uncommon in mopane.	Very common intra African breeding summer visitor	CP												
Owls															
Western Barn owl (*Tyto alba*)	Wide range of vegetation types. Northern **woodlands. Needs large trees to roost**. Nomadic owls moving in response to rodent population explosion.	Locally common resident													
Spotted eagle-owl (Bubo africanus)	**Broad range of habitats. Man-made structures. Rocky areas, woodland, forest edge savannah, semi desert. Towns.**	Common resident													
Marsh owl (*Asio capensis*)	**Open grasslands, marshlands and short scrub with high rodent populations preferred.**	Uncommon to rare. IUCN Least concern	CP												
Nightjars															
Rufous-cheeked Nightjar *(Caprimulgus rufigena)*	**Woodland, grassland,** semi-desert bush and scrub. Ground gravelly, stony or covered with sparse, dry leaf litter, trees and bushes. Avoid forests, dense bush and high mountains.	Fairly common breeding intra-African migrant													
Swifts and spinetails															
African Palm-Swift (*Cypsiurus parvus*)	Governed by the distribution of the **flabelliform palms,** nests underside dead leaves.	Locally common resident	CP			1		2			1				
Alpine Swift *(Tachymarptis melba)*	**Over all vegetation types**: Especially over Alpine grassland and Fynbos – breeding sites. Dry vertical cracks in overhanging cliffs.	Common breeding intra-African migrant													

Common Swift *(Apus apus)*	Aerial and wide ranging; often in large flocks; roosts on the wing. **Mostly open country, but occurs almost anywhere.**														
African Black Swift *(Apus barbatus)*	Montane habitats: nesting – horizontal cracks on cliffs or in caves. **Forage - open country.**	Breeding intra-African migrant													
Little Swift *(Apus affinis)*	**Over all vegetation types: prefers open grasslands** and Karoo, not high-altitude alpine grasslands. Occur over water and nests under dry overhangs.	Very common partial migrant													
Horus Swift *(Apus horus)*	Anywhere: common in more humid south and east. *Associated with high altitude grasslands.* Nests in sandbanks.	Common breeding intra African migrant													
White-rumped Swift (*Apus caffer*)	**Forage over open ground**. Cliffs. Anywhere: common in more humid south and east.	Very common breeding intra African migrant	CP												
Mousebirds															
White-backed Mousebird *(Colius colius)*	**Wooded drainage lines, woodland on sands.**	Common resident	CP												
Speckled mousebird *(Colius striatus)*	Forest, subtropical thicket and mesic woodland. Ecotones: **Edges of forests and closed woodland, wooded drainage lines and gardens.**	Common resident	CP												
Red-faced Mousebird *(Urocolius indicus)*	**Savannah woodlands, moist woodlands, shrubland.** Avoiding forest and open grassland.	Very common resident	CP												
Hoopoe and woodhoopoes															
African Hoopoe *(Upupa africana)*	**Catholic use of habitats**. Tall savannah thornveld. Woodland. Bare ground and short grass.	Sparse to common resident	CP												
Green Wood-Hoopoe (*Phoeniculus purpureus*)	Arboreal. Most **woodland types. Edges of evergreen forests.**	Common resident													
Common Scimitarbill (*Rhinopomastus cyanomelas*)	Tropical and subtropical **arid woodland**. Absent from closed canopy woodland.	Fairly common resident													
Kingfishers															
Half-collared Kingfisher *(Alcedo semitorquata)*	**Clear fast flowing perennial streams, rivers** and estuaries; clear water and well-wooded banks; often near rapids; narrow and secluded with dense marginal vegetation. Broken escarpment terrain. Well-vegetated lake shores and coastal lagoons.	**SA Red Data (Barnes 2000): Near-threatened; IUCN 2014 Status: Least concern.** Uncommon resident.													

Malachite kingfisher (*Alcedo cristata*)	**Strictly aquatic environments – availability of fish**. River and stream banks – flanked by trees, shrubs and recumbent riverine grasses and weedy vegetation. Prefer well-vegetated, slow-flowing rivers and streams, but not with canopy closed over river. Sheltered shores, coastal lagoons, tidal estuaries, mangrove swamps.	Common resident														
Brown-hooded Kingfisher (*Halcyon albiventris*)	**Edges of evergreen forests, woodland and riverine woodland.**	Common resident	CP													
Giant kingfisher *(Megaceryle maxima*)	**Any water body with sufficient food and overhanging branches to hunt from, - streams, rivers,** estuaries, seashores. Perch under canopy in trees alongside streams or at edges of pools. Large rivers and small streams.	Fairly common resident														
Pied kingfisher (*Ceryle rudis*)	**Aquatic environments – availability of fish**. Any water body with small fish, including large rivers and perennial streams, estuaries, lakes, temporarily flooded areas, rocky coasts and intertidal zone of coast. Less common along well-wooded, fast flowing streams.	Common resident														
Bee-eaters																
Swallow-tailed Bee-eater *(Merops hirundineus)*	Wide range: from semi-desert scrub to forest margins. Arid **Acacia savannah, riverine trees** and scrub, clearings and edges of **woodland.**	Locally common, usually resident, some seasonal movements														
Blue-cheeked Bee-eater *(Merops persicus)*	Desert edge, **near water. Arid woodland areas.**	Locally fairly common non-breeding Palaearctic migrant														
Little Bee-eater *(Merops pusillus)*	Semi-arid to high rainfall areas. **Open spaces to forage – low bushes or reeds. Savannah and light woodland.**	Common resident	CP													
White-fronted bee-eater *(Merops bullockoides)*	**Associated with watercourses.** Typically associated with vertical **sandy or lateritic riverbanks** and watercourses - in **woodlands** (broadleaved and mixed woodland) and in wooded grassland. Also at eroded gullies, **perennial rivers and seasonal streams with wooded banks. Need sandbanks** for nesting. Sandy river banks or erosion gully clear of vegetation.	Locally abundant resident	CP													
European Bee-eater (*Merops apiaster*)	**Variety of woodland and shrubby habitats,** avoids relatively mesic and arid conditions.	Common non-breeding Palaearctic migrant & breeding migrant	CP						6							
Rollers																

European Roller (*Coracias garrulus*)	**Woodlands, bushveld and grasslands. Open woodland.**	**IUCN 2014 NT: Near-threatened;** Fairly common non-breeding Palaearctic migrant. Population trend: decreasing.													
Lilac-breasted Roller *(Coracias caudatus)*	Ecotone between **light woodland** and open grassy areas. savannah and open woodland (broadleaved & Acacia)	Common resident													
Hornbills															
African Grey Hornbill (*Tockus nasutus*)	**Taller woodland** (broadleaved & Acacia) in dry and humid savannahs. Bushveld.	Common resident													
Barbets & tinker barbets															
Acacia Pied Barbet *(Tricholaema leucomelas)*	**Arid savannahs, soft-wooded trees (Acacia) present, wooded drainage lines in grassland.**	Common resident	CP												
Black-collared Barbet (*Lybius torquatus*)	Miombo, moist wooded areas, along east facing slopes of the Transvaal escarpment, eastern coastal areas. **Drier savannahs: restricted to riverine vegetation**. Coastal bush, woodland, forest edge, riverine forest, parks, gardens.	Very common resident	CP												
Crested Barbet (*Trachyphonus vaillantii*)	**Savannah, woodland and thickets** – broadleaved woodlands. Mixed woodland and Acacia habitats. Thornveld, thickets in woodland, riverine bushveld, exotic plantations, parks, gardens.	Common resident	CP												
Honeyguides & honeybirds															
Greater Honeyguide (*Indicator indicator*)	**Arid and moist woodland: Wide range of woodland types.**	Fairly common resident													
Lesser honeyguide *(Indicator minor)*	Wide range of **wooded habitats**: savannahs with scattered trees to forest fringes, **riverine woodland**; exotic plantations, gardens.	Locally common resident													
Brown-backed Honeybird *(Prodotiscus regulus)*	**Range of woodland habitats**; mesic areas. Open thornveld to forest edges.	Uncommon resident													
Woodpeckers															
Golden-tailed Woodpecker (*Campethera abingoni*)	**Wide spectrum of woodland and savannah types.**	Fairly common resident													
Cardinal Woodpecker (*Dendropicos fuscescens*)	**Wide variety of woodland and savannah.**	Common resident													
Wryneck															

Red-throated Wryneck *(Jynx ruficollis)*	Grassland biome: **Sour and Mixed grasslands**, not Alpine grasslands; needs trees for nesting. Only found in grassland **where trees are present**, even **exotics.** Forage on open ground, absent where trees are too dense or absent. Thornveld, open bushveld, exotic plantations, **farmyards,** gardens.	Locally fairly common; generally uncommon; migratory in south, resident in north.													
Larks															
Rufous-naped Lark (*Mirafra africana*)	Variety of habitats: **bare patches, sparse grass cover,** suitable perches. **Open grassland with termitaria** or scattered bushes and bare patches**, open savannah** woodland with sparse grass cover between trees, bare patches in fallow fields and cultivated lands.	Locally common resident. Common & conspicuous spp . No evidence of range contraction. Not threatened by habitat destruction.	CP			1						2	1		
Eastern Clapper Lark *(Mirafra fasciolata)*	**Grassland and open savannah.**	Common resident	CP		2		2	2	3		1	3			
Sabota Lark *(Calendulauda sabota*)	**Wide range of savannah habitats**; arid open shrubland on rocks and sands, semi-arid Acacia savannahs on clays, calcrete and sands, on **rocky slopes** with tall shrubs, bushes and trees, on edges of wooded drainage lines, mixed woodlands on stony soils.	Common resident													
Eastern Long-billed Lark *(Certhilauda semitorquata)*	**Grassland.**	SA Endemic. Fairly common resident.			1										
Spike-heeled Lark *(Chersomanes albofasciata)*	Wide range of vegetation types. Arid gravel plains, semi-arid sparse succulent and non-succulent shrublands, **high rainfall grasslands.**	Common resident, somewhat nomadic.	CP												
Chestnut-backed Sparrowlark *(Eremopterix leucotis)*	**Open savannah woodlands** with bare areas; recently burnt savannah and **grassland, croplands and fallow fields.** savannah and drier grassland habitats.	Common nomad													
Grey-backed Sparrowlark *(Eremopterix verticalis)*	**Arid gravelly or stony ground with sparse shrubs and grass, open short-grass plains, bare pans, burnt areas, fallow lands.**	Very common nomad													
Red-capped Lark *(Calandrella cinerea)*	**Short grasslands** – heavily grazed or burnt, **ploughed lands and fallow fields; dry pans** or dams. Moist grasslands around edges of endorheic and ephemeral pans.	Common nomad													
Pink-billed Lark *(Spizocorys conirostris)*	**Open short grassland** in highveld; tall grass in Kalahari sandveld**, cultivated lands.**	Common nomad								1					
Swallows & martins															

Sand Martin *(Riparia riparia)*	**Moist open grassveld,** inland waters, **reedbeds, irrigated pastures and crops.**	Fairly common non-breeding Palaearctic migrant, numbers increace 1950's													
Brown-throated Martin *(Riparia paludicola)*	**Associated with water: Streams, large rivers, dams, estuaries and open wetlands.** Forage over dryland habitats far from water. Wetlands in fairly open habitats.	Common resident													
Banded Martin *(Riparia cincta)*	**Natural grassland and cultivated or cleared land.** Open grassland, large floodplains, cultivated areas surrounded by woodland, arid areas. Associated with water but not restricted to wetland habitats. Breed in earthen banks and aardvark burrows.	Uncommon and local breeding intra-African migrant													
Barn Swallow (*Hirundo rustica*)	**All habitats**: more common in higher-rainfall eastern half: moister grassland, woodlands and fynbos.	Abundant non-breeding Palaearctic migrant	CP		46	6		50			7				
White-throated Swallow *(Hirundo albigularis*)	**Vicinity of wetlands, especially rivers** and other expanses of open water where suitable nesting sites are available.	Common , but localized breeding intra-African migrant	CP												
Pearl-breasted Swallow *(Hirundo dimidiata)*	Wide range of habitats: **broadleaved woodlands,** avoiding Acacia woodlands. **Wetland sites and open areas.**	Breeding intra-African migrant													
Greater Striped Swallow *(Cecropis cucullata)*	Wide variety of fairly open habitats: semi-arid Karoo, fynbos, **grassland and lightly wooded savannah.**	Common breeding intra-African migrant	CP												
Red-breasted Swallow *(Cecropis semirufa)*	**Open savannah; sweet grassveld.**	Scarce breeding intra-African migrant													
South African Cliff-Swallow *(Petrochelidon spilodera)*	**Fairly dry grasslands and lightly wooded savannahs: Forage over disturbed areas.**	Locally common breeding intra-African migrant													
Rock Martin *(Ptyonoprogne fuligula)*	**Habitats with rock formations: Rocky terrain. Rocky hills, cliffs, quarries.**	Common resident													
Common House-Martin *(Delichon urbicum)*	Wide variety of habitats: fynbos, **grassland, savannah woodland and cultivated areas.** Hilly open country.	Locally common non-breeding Palaearctic migrant													
Drongos															
Fork-tailed Drongo (*Dicrurus adsimilis*)	Wide range of vegetation types: **Open bush and woodland; edges of forest patches; Highveld – alien trees.**	Common resident													
Ostrich															
Common Ostrich *(Struthio camelus)*	**Arid savannah**	Common resident, somewhat nomadic at times.	CP					3							

Crows and ravens															
Cape Crow *(Corvus capensis)*	**Open habitats with scattered patches of trees or wooded watercourses. Croplands**. East: Montane grassland; West: Open arid areas.	Common resident													
Pied Crow (*Corvus albus*)	**Wide variety of biomes: unrelated to vegetation**, not in southern Kalahari.	Very common resident	CP					1	1		1				
Bulbuls															
Dark-capped Bulbul (*Pycnonotus tricolor)*	Wide range of habitats**: moister woodland and savannah, riverine bush,** forest edge & regenerating forest (not inside) dense montane scrub, scrubby vegetation, **alien plantations**. Not in open grassland.	Very common resident													
African Red-eyed Bulbul *(Pycnonotus nigricans)*	**Savannah, drier woodland, semi-arid shrub, riverine bush, farmyards, gardens, orchards, always near water.**	Very common resident	CP												
Tits															
Cape Penduline Tit *(Anthoscopus minutus)*	**Arid and semi-arid habitats. Thickets along water courses. *Acacia*.**	Fairly common resident													
Ashy Tit *(Parus cinerascens)*	**Acacia trees and thickets. Acacia woodland: dense thickets of Acacia scrub to open parkland savannah.**	Uncommon resident													
Tit-babbler															
Chestnut-vented Tit-Babbler *(Parisoma subcaerulea)*	**Scrub and thicket; Acacia. Thickets in savannah woodland and thornveld.**	Common resident	CP												
Rock thrush															
Groundscraper thrush *(Psophocichla litsitsirupa*)	**Open parkland woodlands**; broad-leaved and Acacia woodland – understorey poorly developed & patches of bare ground. Miombo, open overgrazed woodland, **plantations.**	Fairly common resident													
Karoo thrush (*Turdus smithi*)	**Mostly in riparian woodland** in semi-arid Karoo and introduced woodland on the Highveld; common garden bird.	Locally common resident.													
Chats															
African Stonechat *(Saxicola torquata)*	Grassland biome: High altitude grasslands down to sea level, moist, open country with **rank growth of grass and herbs**.	Common resident and altitudinal migrant	CP					1							

Mountain Wheatear *(Oenanthe monticola)*	**Rocky habitats in mountains, hills, koppies,** scarps and boulder strewn level ground. Scrub or grass. Rocky hills, slopes with boulders and bushes, small cliffs, old mine workings, rocky hillsides.	Locally common to fairly common resident.									1				
Capped Wheatear *(Oenanthe pileata)*	Open areas with bare ground. Open – burning, trampling, overgrazing.	Common breeding intra-African migrant	CP							1	1				
Familiar Chat *(Cercomela familiaris)*	**Broad range of open vegetation types, broken ground and rocky habitats.** Rocky mountain slopes, rocky hills and outcrops, valley slopes, eroded gullies, sparse woodland along drainage lines.	Common resident	CP												
Ant-eating Chat *(Myrmecocichla formicivora)*	Open habitats: some grass and some scrub. **Grassy habitats** in the east, and the Southern and Central Kalahari. Very rocky areas avoided.	Common resident	CP		1	1	1		1		4	1			
Mocking Cliff Chat (*Thamnolaea cinnamomeiventris*)	**Vicinity of rocky outcrops in wooded country**. Open well-faulted rock faces with scattered trees and shrubs. *Ficus* trees. Well-wooded rocky ravines, gullies, cliffs, boulder-strewn hillsides and along streams or rivers in valley bottoms where there are large boulders.	Locally common resident													
Robins															
Cape Robin-Chat *(Cossypha caffra)*	Afromontane forest fringe: **cover loving**. Wide range of habitats utilized: coastal fynbos, **farmstead woodlots**, *Leucosidea* scrub, alpine grassland. Bracken-brair fringe of Afromontane forest.	Common resident	CP												
White-throated Robin-Chat *(Cossypha humeralis)*	Thickets that lines dry water courses in the bushveld and thornveld. **Open woodland** – closed thickets under large shade trees. Termite mounds & fire-free places on rocky hills.	Locally common resident													
Scrub-Robin															
Kalahari Scrub Robin *(Erythropygia paena)*	Open Kalahari sandveld with **scattered bushes and trees. Bare ground and large tree or bush.**	Fairly common resident													
Warblers															
Little rush warbler *(Bradypterus baboecala)*	Associated with **tangled vegetation around wetlands**; not usually over open water.	Locally fairly common resident and nomad.	CP												
African reed-warbler (*Acrocephalus baeticatus*)	**Usually in moist or wet areas, including edges of reeds, bulrushes, sedges, tall herbs and forbs, and tall grass and shrubs along river banks.** Marshland: Outskirts of reed-beds where there is a mixture of grass, sedges, rushes and tall willow herbs.	Common breeding intra-African migrant	CP												

Marsh Warbler *(Acrocephalus palustris)*	Thickets and marshland: **Fringes of reedbeds, waterside weeds**, woody thickets on anthills and leafy vegetation along rivers. Dense lush thickets with rank herbaceous undergrowth, usually away from water.	Uncommon to fairly common non-breeding Palaearctic migrant														
Great reed warbler (*Acrocephalus arundinaceus*)	**Marshland: Phragmites and tall grass.**	Locally common non-breeding Palaearctic migrant	CP			1							1			
Lesser swamp warbler (*Acrocephalus gracilirostris*)	**Marshland: Phragmites over water.** Reeds and bulrushes in standing water in estuaries, lagoons, rivers, marshes.	Locally common resident														
Icterine warbler (*Hippolais icterina*)	**Thornveld: Canopy or mid-level.**	Fairly common non-breeding Palaearctic migrant														
Willow Warbler *(Phylloscopus trochilus)*	**Any woodland: edges of evergreen forests, savannahs, gardens, parks, exotic plantations.** Anywhere with trees and bushes ie adequate tree cover; Adequate tree cover.	Fairly common non-breeding Palaearctic migrant														
Garden warbler (*Sylvia borin*)	**Dense thickets: Inside thickets.**	Fairly common non-breeding Palaearctic migrant														
Apalis																
Bar-throated Apalis *(Apalis thoracica)*	Adaptable, catholic: **Wooded habitats.** Interior of evergreen or semi-evergreen forests, forest fringes, woodland, Karoo scrub, grassveld – where suitable woodland or bush occurs, e.g. along drainage lines.	Common resident														
Eremomela																
Yellow-bellied Eremomela *(Eremomela icteropygialis)*	**Woodland to low shrub.** Thornveld regions, scrub and low trees. Rather in broadleaved than *Acacia* woodland.	Fairly common resident														
Crombec																
Long-billed Crombec (*Sylvietta rufescens*)	**Woodland; scrubland. Catholic in use of different woodland** – not found in unwooded grassland and forest interiors.	Common resident														
Cisticolas																
Lazy Cisticola *(Cisticola aberrans)*	**Rocky slopes with grass**, dense scrub and occasional trees and thickets. Valley bottoms and in gullies. Rank grass, shrubs and bracken on damp ground, edges of forests.	Locally common resident														
Rattling Cisticola (*Cisticola chiniana*)	**Tree savannah – Acacia woodland** where grassland interspersed with trees & thickets or shrub. Fringes of dense woodland and in coastal scrub patches.	Very common resident	CP													

Wailing Cisticola *(Cisticola lais)*	Montane grasslands: **Long grass, hillsides**, patches of rank growth, some scrub, shrubs or bracken, rocky outcrops.	Common resident													
Levaillant's cisticola (*Cisticola tinniens*)	**Marshland:** Stream-side where there is short grass, sedges and rushes with clumps of taller growth. Marshy areas along rivers and streams, edges of reedbeds, moist grassland, and seasonally flooded endorheic ponds.	Very common resident	CP			3						1		
Neddicky (*Cisticola fulvicapilla*)	**Dune scrub, in scrub and rank grass on hill slopes, on the edges of woodlands and plantations, in secodary growth and in thornveld savannah**. Understorey of woodlands. Tolerant of alien vegetation. Avoid dense grassland – cannot feed on ground level. Especially Valley Bushveld.	Very common resident	CP								2			
Zitting Cisticola *(Cisticola juncidis)*	**Natural grasslands and weedy areas, edges of vleis, dams, pans, and salt marshes.** *Eragrostis* grass pastures, cereal cropland, edges of cultivation, fallow lands, and any open areas with rank grass. Associated with wetlands.	Common resident	CP					6	1		5	2		
Desert Cisticola *(Cisticola aridulus)*	**Open dry short grasslands** and savannah with low basal cover. Adjacent to natural grasslands, cultivated areas, fallow agricultural lands.	Fairly common resident	CP					2						
Cloud Cisticola *(Cisticola textrix)*	**Short grassland with low basal cover –** in grassland biome and Grassy Karoo. Does not tolerate invasion by scrub and trees. Common – Themeda triandra grassland on Highveld.	Common resident			1			2	4		1	1		
Wing-snapping Cisticola (*Cisticola ayresii)*	**Short moist and relatively dense grassland** on well-drained soils – Alpine, Sour and Mixed Grasslands.	Common resident	CP		1			1			1			
Prinias															
Tawny-flanked prinia (*Prinia subflava*)	**Marshland: In reeds and sedges in vleis.** Relatively tall and dense patches of vegetation: rank grass on edges of roads or farmlands, drainage lines and edges of dams and rivers, **scrubby patches within woodland savannahs, secondary thickets, reeds and sedges in wetlands,** ecotones between grassland and dense, tall woodlands and forests. **Suburban and rural gardens.**	Very common resident. Readily adapts to modified habitats. Distribution not changed.													

Black-chested Prinia *(Prinia flavicans)*	**Scrub, rank grass, low bushes and secondary growth in open woodlands or grasslands, along drainage lines, on the edges of cultivated lands or in abandoned fields.**	Common resident	CP		1	2		3			1			
Flycatchers															
Fairy Flycatcher *(Stenostira scita)*	Woody components; intermittent scrub, **riverine Acacia, dense thorny tree** or bush for breeding.	Common local migrant.													
African Paradise Flycatcher (*Terpsiphone viridis*)	Woodlands: evergreen forests and broadleaved woodlands. **Riverine strips, riparian vegetation.**	Common breeding intra-African migrant													
Marico Flycatcher *(Bradornis mariquensis)*	**Acacia bushveld and woodland.**	Common resident													
Fiscal Flycatcher *(Sigelus silens)*	**Fairly open vegetation with trees or intermittent scrub.**	Common resident	CP												
Spotted Flycatcher *(Muscicapa striata)*	**Open woodland;** habitat where bare branches alternate with open space. Open habitat with less well-structured middle and lower stratum.	Common non-breeding Palaearctic migrant	CP												
Batis															
Chinspot Batis *(Batis molitor)*	Major woodland types. Acacia spp. Valley bushveld, thornveld and karroid brokenveld.	Common resident													
Wagtails															
African pied wagtail (*Motacilla aguimp*)	Along margins, **rocky patches and sandbanks of large rivers, pans and dams**. Usually near water, preferring wide rivers and open water bodies with sandy banks or exposed rocks and boulders. In drier areas restricted to perennial rivers.	Common to scarce; mostly resident; non-breeding migrant to much of Transvaal in winter.													
Cape wagtail *(Motacilla capensis)*	**Almost anywhere where there is water with open ground nearby.** Wide range of natural environments: require merest trickle of water; open streams in forest habitats, rivers and waterfalls.	Common resident													
Longclaws															
Cape Longclaw *(Macronyx capensis)*	**Variety of grassland types** at fairly high elevations. Not in bushveld; may occur in grassveld adjacent to woodland. In association with wetlands. Moist grassveld: near vleis and dams. Open countryside with thick grass.	Common resident	CP			3		1							
Pipits															

African Pipit *(Anthus cinnamomeus)*	**Grasslands: open stretches fringing pans, lightly wooded savannah, dry floodplains with short vegetation and recently burnt open veld**. Avoids dense rank growth. Fallow fields.	Common resident	CP	1		2		1	1		1			
Plain-backed Pipit (*Anthus leucophrys*)	**Mesic grasslands: edges of well-wooded country, around waterbodies and marshes. Recently burnt grasslands.**	Fairly common resident													
Buffy Pipit *(Anthus vaalensis)*	**Open grassy plains**, bare ground, well grazed. Veld dotted with anthills and low scrub. **Fallow pastures.**	Uncommon resident													
Long-billed Pipit *(Anthus similis)*	Slopes in relatively arid and eroded, **broken veld, often steppe-like with erosion scars, stones and outcrop rock interspersed with grass clumps and low** scrub. Low trees and light woodland on stony ground.	Locally common resident													
Shrikes															
Red-backed Shrike *(Lanius collurio)*	**Medium dense thornveld.** Open habitats with fewer smaller trees for males; females – skulk in taller woodland. Fallow land with coppicing Acacia bushes, pockets of scrub.	Fairly common non-breeding Palaearctic migrant	CP												
Lesser Grey Shrike *(Lanius minor)*	**Acacia thornveld**. Arid open Acacia bushveld - low bushes and tall trees (or dead) alternating with open grassy space. Fallow land with coppicing Acacia bushes.	Fairly common non-breeding Palaearctic migrant	CP												
Common Fiscal *(Lanius collaris)*	**Open spaces with exposed perches, short or sparse ground cover and trees for nesting.** Scarce in Arid Woodland, Marula and Knobthorn savannah, Alpine Grassland.	Common resident	CP			2	3				1			
Brubru *(Nilaus afer)*	**Savannah woodlands.** Acacia and broadleaved woodland. From tall, well-developed, mixed woodlands, forest edges, scattered scrubby areas.	Common resident	CP												
Brown-crowned Tchagra *(Tchagra australis)*	**Woodland and scrub** – restricted to undergrowth. Acacia-, mopane- and broadleaved woodland.	Common resident	CP												
Southern Boubou *(Laniarius ferrugineus)*	**Dense tangled undergrowth, thickets along watercourses** in wide range of woodland types; all woodlands and forest types. Forests and exotic plantations. Grasslands - thickets along watercourses.	Common resident.													
Crimson-breasted Shrike *(Laniarius atrococcineus)*	**Acacia bushveld and woodland.**	Common resident	CP												

Bokmakierie *(Telophorus zeylonus)*	Karoo, Fynbos and grassland biomes: **Scrubby habitat, low bushes in association with rocky outcrops.** Avoid woodland types except Valley Bushveld. Edges of range: light mixed woodland and thorn savannah on stony ground.	Common resident over most of range.				1		1							
Starlings																
Red-winged Starling *(Onychognathus morio)*	Cliffs and rocky areas. Common in highland areas; less common on plains. **Rocky outcrops** and gorges in highland grassland, visits forests to feed on fruit.	Common resident													
Cape Starling *(Lamprotornis nitens)*	**Wide range of vegetation types:** Not a grassland or forest bird. Depends on trees or tall vegetation for nests. Woodland species.	Common resident	CP												
Pied Starling *(Lamprotornis bicolor)*	Open Karoo and grassland habitats. Open fields. Not found in wooded areas. **Areas of broken ground.**	**SA endemic.** Very common resident.	CP	3											
Wattled Starling *(Creatophora cinerea)*	**Dry grasslands and dry open country; nests in thorn trees.**	Locally abundant nomad	CP					1							
Common Myna *(Acridotheres tristis)*	**Urban and cultivated areas.**	Abundant resident, introduced	CP												
Sunbirds																
Amethyst Sunbird *(Chalcomitra amethystina)*	**Broadleaved woodland types. Gardens and stands of alien trees.**	Common resident													
Malachite Sunbird *(Nectarinia famosa)*	Fynbos, **grassland,** Karoo and open savannah: Scrubby hillsides and forest edge. Alpine Grassland, Karoo and Fynbos vegetation types. Abundance determined by food plants and their flowering phenology.	Common; resident in lower-lying areas; seasonal migrant from higher regions in winter.													
Greater Double-collared Sunbird *(Cinnyris afer)*	**Moist habitats with trees or tall scrub;** not into forests – edge or top of canopy. Coastal, montane and riverine scrub, Protea savannah. Mountainous or hilly country. Afromontane and Valley Bushveld.	Common resident													
White-bellied Sunbird *(Cinnyris talatala*)	Wide range of woodland and bush types – moist woodlands. **Open savannah.**	Common resident													
Marico Sunbird *(Cinnyris mariquensis)*	**Acacia thornveld. Woodlands dominated by Acacia. Aloe.**	Common resident													
White-eyes																

Cape white-eye *(Zosterops capensis)*	Catholic choice of habitat: Evergreen and coastal forests, fynbos, **riverine bush, thickets. Drainage lines. Wooded areas in grassland and alien plantations.**	Very common resident and local migrant	CP												
Sparrows															
House Sparrow *(Passer domesticus)*	**Human dwellings.**	Very common resident, introduced													
Cape Sparrow *(Passer melanurus)*	Arid Karoo and **grassland biomes: Woody vegetation along drainage lines. Gardens, farms, parks.**	Very common resident				2	3				5				
Southern Grey-headed Sparrow *(Passer diffusus)*	Various woodland types: **broadleaved and *Acacia*.** Alien tree populations.	Common to abundant resident and nomad	CP												
Yellow-throated petronia *(Gymnoris superciliaris*)	Broadleaved woodland and savannah.	Mostly common resident													
Weavers															
White-browed Sparrow-Weaver *(Plocepasser mahali)*	**Dry woodland and savannah.** Nests in trees in ecotone – reduced ground cover and good grass cover.	Locally common resident	CP				3	2			2				
Cape weaver (*Ploceus capensis*)	**Nests in reeds and bulrushes along rivers and dams.**	Common resident													
Southern Masked weaver (*Ploceus velatus*)	**Nests in reeds, bushes and trees along watercourses.** Also in trees near **homesteads** and in other vegetation away from water.	Common resident	CP			16	1	1		1					
Quelea															
Red-billed Quelea *(Quelea quelea)*	**Most vegetation types. Woodlands and grasslands. Annual grasses and surface water.**	Abundant nomad. Expanded range and increased in numbers.	CP					8							
Widows															
White-winged Widowbird *(Euplectes albonotatus)*	Woodland and grassland: rank growth on the margins of **open grassy areas, usually near water.** Overgrown edges of cultivated areas. Seasonally inundated floodplains and tall grasslands.	Locally fairly common resident and nomad	CP												
Red-collared Widowbird *(Euplectes ardens)*	**Mosaic of grass and bush: typical of grassland with scattered trees or bushes.**	Locally common resident and nomad	CP												
Long-tailed Widowbird *(Euplectes progne)*	Open grassland habitats: Mixed, **Sweet and Sour grasslands.** Alpine grassland less.	Locally common resident and nomad	CP	2	1	4		3	1		7	1			
Bishops															

Yellow-crowned bishop (*Euplectes afer*)	Grassland birds: When breeding, closely associated with **marshes or seasonally flooded** areas.	Locally common resident and nomad	CP												
Southern red bishop (*Euplectes orix*)	**Primarily grassland birds: Nests in reedbeds**. Rarely found far from water; strikingly absent from areas without permanent surface water. Found in areas cleared for cultivation. Typically where there is access to perennial water.	Very common resident and nomad. Artificial wetlands increased numbers. Common to abundant.	CP	4		2			1	8	1	1		
Finches															
Cuckoo Finch *(Anomalospiza imberbis)*	**Open grasslands and extensive, heavy vegetated vleis, also lightly wooded savannah.**	Generally uncommon summer breeding visitor; locally common; probably resident but nomadic in Zimbabwe.													
Scaly-feathered Finch *(Sporopipes squamifrons)*	Low open thornbush particularly **Acacia** interspersed with grassy patches. Low thickets.	Common resident and nomad	CP					2			2				
African Quail-finch *(Ortygospiza fuscocrissa)*	**Open areas of short grassland, floodplains, vleis and surrounding sedges. Grassland close to water.**	Common resident and nomad	CP			8									
Red-headed Finch *(Amadina erythrocephala)*	Dry open grassland with scattered trees and bushes. **Densely wooded thornbush to open grassland.**	Common resident and nomad													
Pytilia															
Green-winged Pytilia *(Pytilia melba)*	**Acacia savannah;** open grassland close to cover; mixed thorn and broadleaved savannah with thickets. Broadleaved woodland with grassy patches and thickets or thorny shrubs.	Fairly common resident	CP												
Mannikin															
Bronze Mannikin *(Lonchura cucullata)*	**Edge habitats; dependent on water. Moist wooded areas.**	Very common resident													
Firefinches & bluebills															
Red-billed Firefinch *(Lagonosticta senegala)*	**Woodland, savannah, riverine and thicket vegetation – near water.**	Common resident and nomad													
African Firefinch (*Lagonosticta rubricata*)	Moist, wooded habitats. Forest margins and bracken-briar. **Riverine forest, bush and thickets.**	Common resident													
Jameson's Firefinch *(Lagonosticta rhodopareia)*	**Broadleaved woodlands – open grassy areas with thickets; watercourses.** Rank grass, edges of thickets, secondary growth, cultivated lands, edges of riverine forest, bushy gullies and rocky hillsides.	Common resident.	CP												
Waxbills															

Common Waxbill (*Estrilda astrild*)	**Rank grasslands, reedbeds,** croplands, coastal estuaries, inland wetlands and dams, along ephemeral and permanent rivers.	Common resident	CP												
Blue Waxbill (*Uraeginthus angolensis*)	**Arid thorn savannahs.** Reliable on availability of surface water.	Common resident. No changes from past distribution; common	CP												
Violet-eared Waxbill *(Granatina granatina)*	**Shrubland. Acacia,** Grewia thickets. Acacia woodland. Open broadleaved woodland with thickets.	Locally common resident													
Black-faced Waxbill *(Estrilda erythronotos)*	**Thornbelt. Dependent on surface water. Dry Acacia thornveld.**	Locally common resident													
Orange-breasted Waxbill *(Amandava subflava)*	Moist grasslands, **grassy savannahs, and marshes** of the Afrotropical region. Fallow lands. Mixed, Sweet and Sour grasslands.	Locally common resident and nomad	CP												
Indigobirds															
Village Indigobird *(Vidua chalybeata)*	**Thorn savannah, edges of broadleaved woodland, riverine scrub and woodland.**	Common nomad													
Dusky Indigobird *(Vidua funerea)*	Edge habitats. **savannah & open woodland.** Edges of montane and **riverine forests**. Moist areas with forest.	Locally common nomad													
Whydahs															
Pin-tailed Whydah (*Vidua macroura*)	**Wide range of open mesic habitats. Edge habitats with man. Wetlands.**	Very common resident and nomad	CP												
Long-tailed Paradise-Whydah *(Vidua paradisaea)*	Semi-arid woodlands and savannahs – **thorn savannah.** Open Acacia savannah with large grassy areas. Prominent trees.	Very common resident and nomad													
Canaries															
Black-throated Canary *(Crithagra atrogularis)*	Dry country: **grassland, savannah, lightly wooded areas,** Acacia thornveld, edges of miombo woodland. Riparian thickets and alien plantations.	Locally common resident	CP												
Yellow-fronted Canary *(Crithagra mozambicus*)	Wide variety of **woodland** habitats: lightly wooded thornveld, moist broadleaved woodlands, **along river courses**. Avoid *Acacia* woodlands. Alien plantations.	Common resident	CP												
Yellow Canary *(Crithagra flaviventris)*	Montane shrub and **grassland,** karoo, arid savannah and scrub, fynbos, schrubby desert plains and hills, **rocky hillsides with scattered bushes, farmyards, gardens.**	Common resident; nomadic in winter.	CP												

Streaky-headed Seedeater *(Crithagra gularis)*	Vegetation associated with mountains and hilly topography: Fynbos, wooded valleys. **Well-wooded areas; drier deciduous woodland** and miombo. Avoids open grassland, arid *Acacia* woodland. Edges of evergreen forests and scrub on mountain slopes.	Fairly common resident and nomad													
Buntings															
Lark-like Bunting *(Emberiza impetuani)*	**Arid savannah**, Karoo, **rocky slopes of koppies and dry water courses; usually not far from water.**	Common to very common, highly nomadic													
Cinnamon-breasted Bunting *(Emberiza tahapisi)*	**Rocky ridges and hillsides**, eroding stony slopes and gullies, bare stony areas. Mountain sides, granite and dolerite outcrops with scattered bushes or trees, almost bare rocky and stony patches in woodlands on hills and plains, eroding stony slopes and gullies, dry watercourses.	Locally common resident	CP												
Cape Bunting *(Emberiza capensis)*	**Dwarf shrublands on plains and on rocky ridges**. Hilly and mountainous areas.	Common to fairly common resident.													
Golden-breasted Bunting (*Emberiza flaviventris*)	**Open broadleaved and mixed woodlands and savannah.**	Common resident													

Appendix 5: MAMMALS: Available habitat, expected occurrence and observed presence of mammal species during surveys (Friedman & Daly 2004).
Different biotopes surveyed:

1. Pan Wetland 2. Valley-bottom Wetlands 3. Acacia karoo Woodland 4. Acacia erioloba Woodland 5. Clay Grassland – Diabase and Andesitic lava 6. Dolomite and Chert Grassland	7. Sandy Grassland 8. Secondary Grassland 9. Secondary Wetland 10. Alien trees 11. Infrastructure

Mammals expected to occur in the available natural habitats on the MWS project area, are listed below. The words in **bold font** represent qualifying habitat (preferred habitat), and *underlined italics* disqualifying habitat (the reason why the organism will not occur in the area). The

shaded cells indicate land types that incorporate preferred habitat, and the number inside a cell gives the number of individuals or definite signs detected during surveys.

CP = Confirmed presence – North West Province (Power, 2014); Previous surveys Clean Stream (2005 to 2015)

MAMMAL	HABITAT	Status (SA) 2014	CP	1	2	3	4	5	6	7	8	9	10	11
Order: Insectivora														
Family: Soricidae														
Least dwarf shrew (*Suncus infinitesimus*)	**Commonly associated with termitaria. Terrestrial.**	Intermediate												
Lesser dwarf shrew (*Suncus varilla*)	**Reliant on termite mounds.**	Data deficient												
Swamp musk shrew (*Crocidura mariquensis)*	**Moist habitats, thick grass along riverbanks**, in reedbeds and in swamp. Tangled masses of semi-aquatic grasses along fringes of water. Litter piles deposited by receding floods. Runways of vlei rats. Nests deep in clumps of tussock grasses on slightly raised patches of ground on fringes of swamp.	Data deficient	CP											
Tiny musk shrew (*Crocidura fuscomurina)*	All latitudes, wide tolerance. Terrestrial. Cover such as debris, **fallen trees, wood piles or dense grass clumps.**	Data deficient												
Reddish-grey musk shrew (*Crocidura cyanea*)	Dry terrain: Among rocks, in dense scrub and grass. **Grassland and thick shrub bordering streams. Wet vleis with good grass cover.**	Data deficient												
Lesser red musk shrew (*Crocidura hirta*)	**In damp situations along rivers and streams.** Low bushes, dense undergrowth, piles of debris and fallen logs.	Data deficient												
Family: Erinaceidae														
South African hedgehog (*Atelerix frontalis*)	**Temperate: Vegetable debris in shady places; dry cover. Dry habitats with ground cover for nesting.**	IUCN (2014): Least concern. Population trend: Stable.												
Family: Rhinolophidae														
Darling's horseshoe bat (*Rhinolophus darlingi*)	**Woodland savanna: Caves, and amongst piles of loose boulders.** It roosts in caves and subterranean habitats (mine adits) in medium-sized colonies.	IUCN (2010): Least concern. SA Red Data (2004): Near-threatened. Population trend: Unknown												

Geoffroy's horseshoe bat (*Rhinolophus clivosus*)	**Savannah woodland**: Forest fringes. Caves, **rock crevices.** Riparian forests and savanna woodlands. Temperate species. Riverine conditions and with well-watered terrain. Cave dweller. It roosts in caves and subterranean habitats (mine adits) in large colonies.	IUCN (2010): Least concern. SA Red Data (2004): Near-threatened. Population trend: Unknown													
Family: Nycteridae															
Egyptian slit-faced bat (*Nycteris thebaica*)	**Open savannah woodland**; karoo; avoids open grassland: caves, hollow large trees or holes in the ground. Caves (not deep) and subterranean habitats (aardvark burrows); temperate savanna and shrubland. Man-made structures. Need tree cover.	IUCN (2010): Least concern. SA Red Data (2004): Least concern.													
Family: Molossidae															
Egyptian free-tailed bat (*Tadarida aegyptiaca*)	**Open grassland: Rock crevices, exfoliating rocks, caves, hollow trees, behind loose bark of trees.** Areas with permanent water bodies.	IUCN (2010): Least concern. SA Red Data (2004): Least concern.													
Family: Vespertilionidae															
Natal long-fingered bat (*Miniopterus natalensis*)	Temperate of sub-tropical. **Savannas and grassland.** Cave dependent. Migrate between caves.	IUCN (2016): Least concern. SA Red Data (2016): Least concern**.**													
Yellow-bellied house bat (*Scotophilus dinganii*)	**Savanna woodland & mixed bushland**; coastal forests; lower altitudes: **Narrow crevices, holes and in hollow trees.** Tied to presence of trees. Avoid open habitat - grassland and karoo scrub.	IUCN (2010): Least concern. SA Red Data (2004): Least concern.													
Cape serotine *(Neoromicia capensis*)	Very broad habitat tolerance, from forest to desert. Low-lying hot **savannas;** from arid semi-desert to montane **grasslands, forests: Under bark of trees, base of aloe leaves.** Crevices in rocks. Suburban situations.	IUCN (2010): Least concern. SA Red Data (2004): Least concern.													
Family: Lorisidae															
Southern lesser bushbaby (*Galago moholi*)	**Woodland:** Nocturnal; arboreal – holes in trees, thick foliage, disused bird nests. Degraded open forest	Least cocern													
Family: Cercopithecidae															
Chacma baboon (*Papio ursinus*)	Widespread, diurnal: At night - **Cliffs & high trees**	Least concern													
Vervet monkey (*Cercopithecus aethiops*)	**Woodland, diurnal:** At night – Heavy foliage in high trees, rocky cliffs	Least concern	CP												

Family: Protelidae															
Aardwolf (*Proteles cristatus*)	**Savannah** woodland and in scrub, **grassland.** Open country, nocturnal, and solitary. Rests in hole in ground. Independent on **water.** Dependant on availability of termites.	Least concern	CP												
Family: Hyaenidae															
Brown hyaena (*Parahyaena brunnea*)	Semi-desert, **open scrub and open woodland savanna.** Nocturnal, holes in ground.	**IUCN 2014: Near threatened; SA Red Data (2016): Near threatened; NEMBA (TOPS 2007): Protected species.** Population trend: Decreasing.													
Family: Felidae															
Caracal (*Felis caracal*)	**Widespread – open scrub & woodland, open vleis and open grassland**. Nocturnal & solitary. Litters born in holes in ground.	Least concern													
Black-footed cat (*Felis nigripes*)	**Dry open shrub country.**	**IUCN (2014): VU Vulnerable; SA Red Data (2016): Vulnerable; NEMBA (TOPS 2007): Protected species.**													
African wild cat (*Felis lybica*)	Widespread – Wide habitat tolerance. **Rocky hillsides, underbush, reedbeds, stands of tall grass.** Litters born dense underbrush or other substantial cover.	Least concern													
Family: Canidae															
Bat-eared fox (*Otocyon megalotis*)	**Short grass or scattered shrub habitat** - visibility for detecting predators.	Least concern													
Cape fox (*Vulpes chama)*	Widespread. **Open country, open grassland.** Nocturnal & solitary. Holes in ground, in cover, underbrush.	**NEMBA (TOPS 2007): Protected species;** IUCN (2014) Least concern; SA Red List 2016: Least concern.													
Black-backed jackal (*Canis mesomelas*)	Widespread. **Wide habitat tolerance. Open terrain**. Litters born in holes in ground.	Least concern	CP										2		
Family: Mustelidae															
Cape clawless otter (*Aonyx capensis*)	Predominantly aquatic; freshwater an essential requirement: **Rivers, lakes, swamps and dams**. Widespread. Tributaries of rivers into small streams - habitat with food. Litters born in holes in banks of rivers. Estuarine and sea water.	IUCN (2014) Least concern. Population trend: Stable.	CP												
Spotted-necked otter (*Lutra maculicollis*)	Aquatic, confined to **larger rivers, lakes, swamps and dams** with extensive areas of open water. Stay close to water edge. Lie up in holes of river banks, in rock crevices or in dense reed.	IUCN (2014) Least concern. Population trend: Decreasing.	CP												

African striped weasel (*Poecilogale albinucha*)	**Savannah: Moist grassland. Litters born in burrows.**	Least concern													
Striped polecat (*Ictonyx striatus*)	**Widespread. Wide habitat tolerance. Scrub cover, open grassland, and savannah woodland. Holes in the ground.**	Least concern													
Honey badger (*Mellivora capensis*)	Widespread. Not in desert. **Use crevices in rocky areas, will also dig refuges. Rocky koppies, scrub sandveld, open grassland, open woodland, riverine woodland and floodplain grassland.**	IUCN (2014) Least concern. Population trend: Decreasing.													
Family: Viverridae															
Small-spotted genet / Common genet (*Genetta genetta*)	Widespread. Open arid: **Woodland,** open scrub and dry grassland or dry vlei areas. Trees. Nocturnal – nests in holes in the ground or in hollow trees.	Least concern	CP												
Large-spotted genet (*Genetta tigrina*)	Better watered parts: **Woodland**, open scrub and dry grassland or dry vlei areas. Trees. Nocturnal – nests in holes in the ground or in hollow trees.	Least concern	CP												
Suricate (*Suricata suricatta*)	**Open arid: hard or stony substrate.**	Least concern	CP												
Yellow mongoose *(Cynictis penicullata*)	**Open country: Open grasslands and vleis.**	Least concern	CP										1		
Slender mongoose (*Galerella sanguinea*)	Widespread. Open areas. **Underbrush or holes in the ground, holes in termitaria.**	Least concern	CP												
Water mongoose (*Atilax paludinosus*)	Well-watered terrain: **Rivers, streams, marshes,** swamps, wet **vleis, dams** and tidal estuaries - adequate cover of reed beds or dense stands of semi-aquatic grasses. Coastally in mangrove swamps in brackish water.	Least concern	CP											1	
Dwarf mongoose (*Helogale parvula*)	Widespread. **Dry open woodland and on grassland** where there is substrate litter and termitaria. Lives in permanent holes – termitaria, burrows deeply.	Least concern													
Family: Rhinocerotidae															
South western black rhinoceros (*Diceos bicornis bicornis)*	**Adequate food supply and shade to rest.**	**IUCN (2012): Critically endangered. NEMBA (TOPS 2015): Endangered species**													
Family: Equidae															
Plains zebra *(Equus quagga)*	Open plains to heavily wooded savannas. Reintroduced.	**IUCN (2014) Near-threatened;** SA Red List 2016:	CP												

		Least concern; NEMBA (TOPS 2007): None**.**													
Family: Orycteropodidae															
Aardvark (*Orycteropus afer*)	**Widespread. Wide habitat tolerance. Open woodland, scrub and grassland. Nocturnal. Lives in extensive burrows.**	IUCN (2014) Least concern; SA Red List 2016: Least concern; NEMBA (TOPS 2015): None.													
Family: Procaviidae															
Rock dassie (*Procavia capensis*)	Widespread where there is rocky habitat. Outcrops of rock – rocky crevices. Krantzes**, rocky koppies,** hillsides, piles of loose boulders – accompanied with bushes and trees to provide browse. Crannies and crevices provide shelter. Granite formations with piles of huge boulders, from which overlying soil has been washed away. Sandstone krantzes with loose, rocky, overhanging slabs. Erosion gulleys.	Least concern													
Family: Suidae															
Warthog (*Phacochoerus aethiopicus*)	**Open areas of grassland, floodplain, vleis and around waterholes and pans**. Deserted antbear holes. Linear forest.	Least concern	CP												
Family: Giraffidae															
Giraffe (Giraffa camelopardalis)	Most savanna habitats. Reintroduced.		CP												
Family: Bovidae															
Blue wildebeest (*Connochaetes taurinus*)	**Open short grass plains** or lightly **wooded open savanna** habitats. Reintroduced.	IUCN (2014) Least concern; SA Red List 2016: Least concern; NEMBA (TOPS 2007): None.	CP												
Black wildebeest (*Connochaetes gnou*)	**Open plains: grassveld and highveld.** Reintroduced.	**NEMBA (TOPS 2015): Protected species.** IUCN (2014): Least concern; Population trend: Increasing.	CP												
Red hartebeest (*Alcelaphus caama*)	**Open grassland and arid scrub. Avoids woodland.** Reintroduced.	Least concern	CP												
Blesbok (*Damaliscus dorcas phillipsi*)	**Grasslands: Highveld grasslands where water is available.** Reintroduced.	IUCN (2014) Least concern; SA Red List 2016: Least concern; NEMBA (TOPS 2007): None.	CP												
Cape common duiker (*Sylvicapra grimmia grimmia*)	Widespread. Presence of bush. **Woodland** with ample underbush, grassland of medium and tall grass. Rest in bushes or tall grass.	Least concern	CP												

Klipspringer (*Oreotragus oreotragus*)	**Restricted to rocky areas.** Mountainous areas with krantzes, rocky hills or outcrops, extensive areas of rocky koppies, gorges with rocky sides. Rocky shelter and steep rock faces. Boulder-strewn river beds.	Least concern														
Steenbok (*Raphicerus campestris)*	Widespread. **Open country: Open grassland** with stands of tall grass, scattered bushes or scrub and forbs. Avoid densely wooded areas.	Least concern	CP								1		2			
Springbok (*Antidorcas marsupialis*)	Arid regions and dry open **grassland savanna**, karoo plains. Reintroduced.	Least concern	CP													
Kudu (T*ragelaphus strepsiceros*)	Widespread in **savanna woodland**. Areas of broken, rocky terrain with woodland cover & open water. Reintroduced.	Least concern	CP													
Gemsbok (Oryx gazella)	Arid savanna species. Reintroduced.		CP													
Eland (*Taurotragus oryx*)	Arid semi-desert areas as well as better-water environments, montane situations and in various **types of woodland**. Avoid forests and open grasslands. Reintroduced.	Least concern	CP													
Order: Rodentia																
Family: Hystricidae																
Cape Porcupine *(Hystrix africaeaustralis)*	**Widespread:** All types of country apart from swampy areas, very moist forests and barren desert areas. Nocturnal. Shelter - resting in caves, rock cavities, holes in ground. Absent from forest. Use abandoned antbear and other types of holes in the ground or lie up under the roots of trees exposed by erosion.	Least concern	CP				1									
Family: Pedetidae																
Springhare **(***Pedetes capensis***)**	**Widespread on sandy soils:** Nocturnal – resting in burrows. Avoid hard ground or heavy clay soils. Savanna.	Least concern	CP													
Family: Sciuridae																
Cape Ground squirrel (*Xerus inauris*)	**Open drier country,** on hard ground with scrub cover. Colonies in warrens.	Least concern	CP		1		2				1					
Family: Thryonomyidae																

Greater Canerat *(Thryonomys swinderianus)*	Forest belts and open woodland wherever there is tall and matted grass or reeds growing in **damp or wet places.** Reedbeds or areas of dense tall grass with thick reed or cane-like stems. In vicinity of rivers, lakes and swamps - never found far from water. Resting place densest part of reed bed. Cover - matted tussock grasses, holes in stream banks, under root systems of trees adjacent to grass and reeds. Use existing holes ore simply use matted vegetation.	Least concern													
Family: Bathyergidae															
Common Molerat *(Cryptomys hottentotus)*	**Loose sandy soils to stony soils and hills** to montane and escarpment conditions. Tendency to loose sandy soil - especially alluvial soils along **major rivers and streams**. Karroid veldtypes, coastal rhenosterbushveld, coastal forests, thornveld, mopaneveld, savanna and pure grassveld, as well as temperate and transitional forests, scrub and bushveld.	Least concern	CP								2				
Family: Cricrtidae															
Bushveld gerbil (Gerbilliscus leucogaster)	Widespread – Survives regardless of vegetation type or degree of cover present, having been recorded in **open grasslands, Acacia woodland or scrub**, and mopane woodland. Commonly encountered on old cultivated lands. Occur on hard ground, but prefer light sandy soils or sandy alluvium. Nocturnal and terrestrial.	Data deficient	CP												
Brants' (Highveld) Gerbil *(Gerbilliscus brantsii brantsii)*	Widespread **– light sandy soils or sandy alluvium substrate** with some scrub or grass cover. Peaty soils around marshes and pans. Prefer sandy soils, irrespective of the type of vegetation cover. Nocturnal – lives in burrows under low bushes	Least concern	CP								1				
Vlei Rat *(Otomys irroratus)*	**Grass-covered ground in proximity to streams and marshes.** Associated with wet habitat. Lush grasses, sedges, herbaceous vegetation associated with damp soil in vleis; similar habitat along streams and rivers or on fringes of swamps. Nests: seldom burrow; nest of rising dry ground or in clump of grass	Least concern													
Angoni Vlei Rat *(Otomys angoniensis)*	Savanna woodlands and grasslands – in **drier areas in wet vleis, swamps and swampy areas along rivers.** Fringes of rivers with reed beds, sedges and semi-aquatic grasses. Nests in tussock grass near permanent water; above water level on raised ground.	Least concern													

Family: Muridae														
Striped mouse (*Rhabdomys pumilio*)	Widespread – grass cover: Diurnal – **burrows under grass.** Wide variety of habitat types (broad niche species). Prefers **grassland, habitat includes bushy and semi-dry vlei** country as well as dry riverbeds, high grassveld areas, the edges of forests and the bases of hills.	Least concern	CP											
Pouched mouse (*Saccostomus campestris*)	**Widespread and catholic, wide habitat tolerance:** In burrows, sandy soil or sandy alluvium, open short grass fringes of pans, rocky koppies, fringes of lowland forests. Exclusively terrestrial, predominantly solitary and nocturnal.	Least concern												
Grey climbing mouse (*Dendromus melanotis*)	**Grassland with high grass.**													
Kreb's fat mouse (*Steatomys krebsii*)	Sandy substrate, occurring in dry, **sandy grassveld and sandy alluvium.**	Least concern						1						
Tete Veld Rat *(Aethomys ineptus)*	**Check:** Widespread – Grassland with open shrub association, open woodland, fringes of pans. Temperate grassland and savanna: Rocky crevices and piles of boulders. Sandy ground or sandy alluvium, or hard ground – holes or rock crevices and piles of boulders. Associated with cover: rocky crevices, piles of debris, clumps of grass or fallen trees.	Least concern												
Bushveld Namaqua rockmouse *(Micaelamys namaquensis subsp. alborarius)*	Widespread – where there are **rocky koppies,** outcrops or boulder-strewn hillsides - preferred areas. Cracks and rock crevices of rocky koppies or outcrops (prefers crevices and does not burrow), or on piles of stones in the veld, low lying ridges and stony country and is often plentiful in old ruins. In the absence of outcrops, may nest in holes or forks in trees or under bushes. Piles plant debris over the entrances to its shelters. Calcareous outcrops. Nocturnal, terrestrial and communal.	Least concern	CP											
Multimammate mouse (*Mastomys coucha*)	**Wide habitat tolerance** (pioneer species - drought, burn, ploughing), fond of grassland where there is some cover of low scrub. In dry watercourses or fringes of swamps. In riverine associations running westwards into arid country. Frequents the fringes of pans where there are calcareous outcrops nearby. Partial to sandy ground, overgrown with scrub and grass. Under fallen logs, crevices between rocks, cavities inside pile of stones or debris or even holes in termite mounds. Nocturnal.		CP											

Desert pygmy mouse (*Mus indutus*)	**Wide tolerance; Arid scrub savanna and woodland. Semi-arid savannas**. It generally avoids open microhabitats.	Least concern	CP												
Family: Gliridae															
Woodland Dormouse *(Graphiurus murinus)*	Widespread in woodland. **Wooded areas**. Large trees provide holes for shelter. Live in holes in trees or under loose bark.	Least concern													
Family: Leporidae															
Scrub hare (*Lepus saxatilis*)	**Savannah woodland and in scrub, tall grass**. Absent from forest, desert and open grass. Open forest, savanna.	Least concern	CP												
Jameson's red rock rabbit (*Pronolagus randensis*)	**Rocky habitat: Rocky terrain**; krantzes, rocky kloofs, gorges or boulder-strewn areas – rest deep in rock crevices. Granite and sandstone formations. Shelter - boulders; cover of thick patches of grass in rocky areas.	Least concern													
Cape hare (*Lepus capensis*)	**Grassland.** Dry open country, **open woodlands and especially round cultivated ground.**	Least concern	CP	1						2					
Family: Macroscelididae															
Rock elephant shrew (*Elephantulus myurus*)	**Rocky areas: Rocky koppies or piles of boulders** – sufficient holes crannies and crevices in rocks for shelter. Absent on granite domes. Needs broken and exfoliated granite. Prefer rocky habitat with overhanging ledges or vegetation. Cover from aerial predation. Keep to shady cover of overhanging rocks or bushes/trees.	Least concern													
Large-eared mouse *(Malacotrhrix typica)*	**Drier western parts; hard ground with short grass cover.** Excavates deep burrows.														