Mobile: Sam - 072 437 1742
Mobile: Luke - 083 784 1997
Email: info@enviro-insight.co.za
Website: www.enviro-insight.co.za

Appendix F3:

Terrestrial Ecology Assessment

Mobile: Sam - 072 437 1742
Mobile: Luke - 083 784 1997
Email: info@enviro-insight.co.za
Website: www.enviro-insight.co.za

Terrestrial Ecological Assessment
Proposed Dunbar Coal Mine
Mpumalanga Province

SEPTEMBER 2019

For

Vandabyte (Pty) Ltd

Bjorn Goosen

info@insacoal.co.za

PREPARED BY

Enviro-Insight CC

Sam Laurence *(Pr. Sci. Nat.)*

sam@enviro-insight.co.za

Alex Rebelo (M.Sc.)

alex@enviro-insight.co.za

Marco Balducci (M.Sc.)

marco@enviro-insight.co.za

Luke Verburgt (*Pr. Sci. Nat.*)

luke@enviro-insight.co.za

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 PROJECT DETAILS AND BACKGROUND

Enviro-Insight CC was commissioned by Vandabyte (Pty) Ltd to perform a Terrestrial Ecological Assessment for the proposed Dunbar Coal Mine located between Meerlus, Komati and Hendrina, Mpumalanga Province, South Africa (Figure 1-1). The properties included in the Mining Right (MR) application include: Portion of Portion 1, Portion 2 and the remaining extent of the Farm Dunbar 189 IS, Portion 1 of the Farm Middelkraal 50 IS and Portion 6 of the Farm Halfgewonnen 190 IS (Figure 1-2). This report was developed to conform to the requirements of an Appendix 6 level specialist assessment (NEMA 2014, as amended on 7 April 2017).

1.2 STUDY AREA

The MR application falls in the Steve Tshwete Local Municipality located in the Nkangala District Municipality and in the Govan Mbeki Local Municipality located in the Gert Sibande District Municipality, Mpumalanga Province. The MR application is located approximately 4.1 km south of Meerlus, 8.93 km southeast of Komati and 13.76 km west of Hendrina. The R35 is located west, R542 is located north and the R38 is located south-east of the study area. The Environmental Authorisation (EA), proposed mining blocks and associated infrastructure (mine footprint /mining activities) for the proposed Dunbar Coal Mine is located only in the western portion of the MR, specifically on Portion 2 of the Farm Dunbar 189 IS, with the haul road extending onto Portion 6 of the Farm Halfgewonnen 190 IS (Figure 1-2).

The Project Area of Influence (PAOI) is based on the footprint of the activity as wells as the extent of the anticipated impacts. The PAOI was divided into the Primary PAOI, including the footprint of the mine pits, roads and any infrastructure; and the Secondary PAOI, which includes areas that are likely to be indirectly impacted by the proposed activities. Impacts usually associated with coal mines, such as windblown dust and coal dust, acid mine drainage as well as hydrocarbon spills, have the potential to negatively affect adjacent habitat and also spread and affect riparian habitats downstream. Therefore the Secondary PAOI was defined as a 200 m buffer from the Primary PAOI and any adjacent and downstream watercourses (within the MR) buffered by 100 m to include riparian vegetation (Figure 1-3).

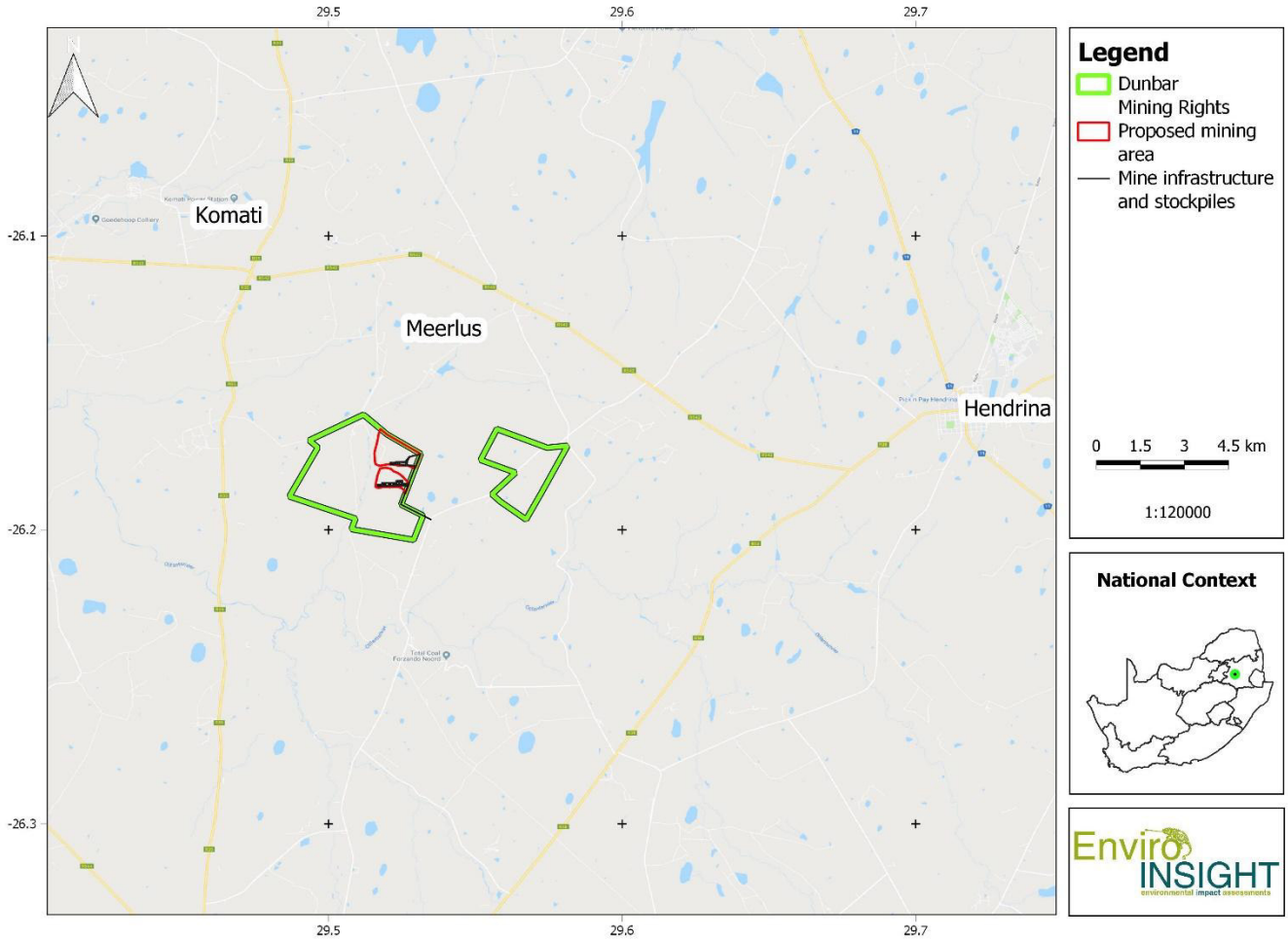


Figure 1-1: Location of the Dunbar Mining Right application areas and proposed mine infrastructure.

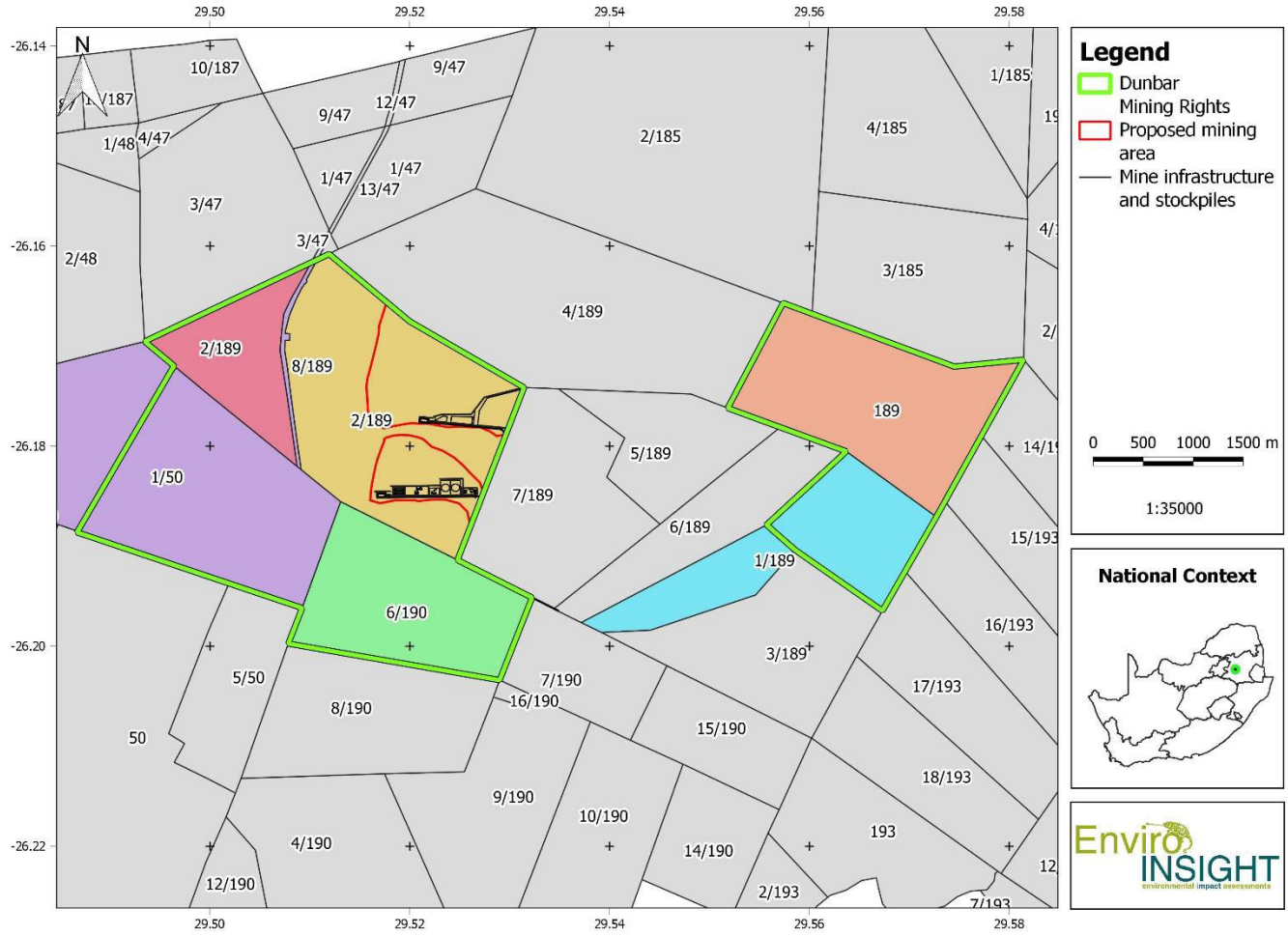


Figure 1-2: Location of the Dunbar Mining Right application areas and proposed mine infrastructure in relation to the farm portions.

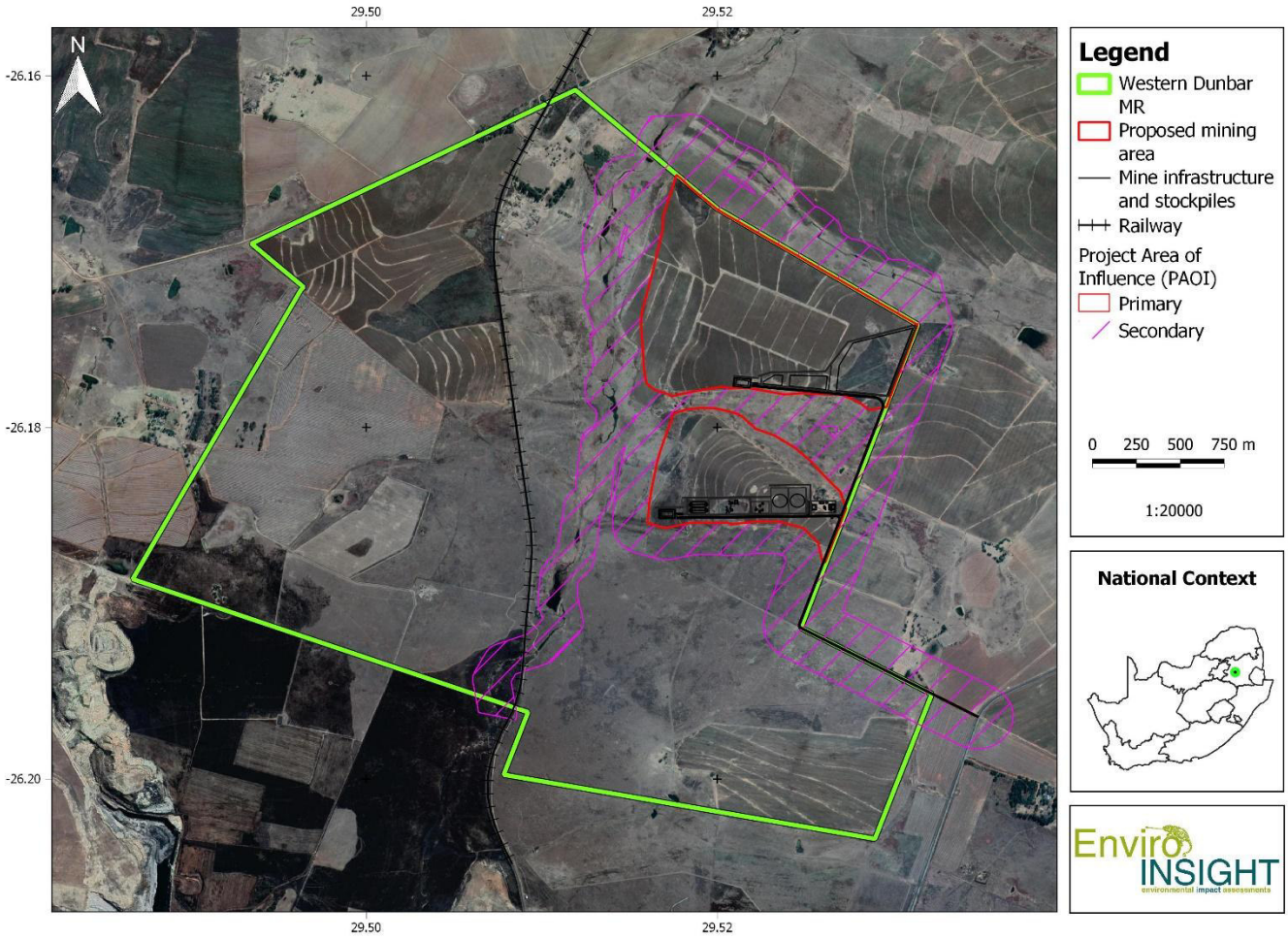


Figure 1-3: Location of the Project Are of Influence (PAOI) and proposed mine infrastructure in relation to the western portion of the Dunbar Mining Right application area.

1.3 STUDY LIMITATIONS

- It is assumed that all third party information acquired is correct (e.g. GIS data and scope of work);
- Due to the nature of most biophysical studies, it is not always possible to cover every square metre of a given PAOI. Due to factors such as thick vegetation stands and suboptimal seasonality it is conceivable that small individual plant species of conservation concern (SCC) may have been overlooked;
- Access to adjacent habitat in farm Portion 4/189 (Figure 1-2) was prevented by electric fencing, and will need to be surveyed during the wet season supplementary survey; and
- The initial ecological survey was carried out during suboptimal, early and late dry season conditions. A wet season supplementary study should take place using the methods described below.

2 METHODS

2.1 DESKTOP SURVEY

2.1.1 GIS

Existing data layers were incorporated into a GIS to establish how the proposed mine layout and associated activities interact with these important terrestrial entities. Emphasis was placed on the following spatial datasets:

- Vegetation Map of South Africa, Lesotho and Swaziland (SANBI, 2018);
- Important Bird Areas (Marnewick *et al*., 2015);
- Protected and Conservation areas of South Africa (South Africa Protected Areas Database-SAPAD; South Africa Conservation Areas Database-SACAD)[1]; and
- National List of Threatened Ecosystems (National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, G 34809, GoN 1002, 9 December 2011).

All mapping was performed using open source GIS software (QGIS[2]).

2.1.2 Habitat delineation

A structural habitat map was created based on a recent cloudless Sentinel 2A satellite image (2018/12/18; 10 m resolution) for the western portion of the mining right area which contains the proposed mine infrastructure. Habitats were manually delineated using QGIS due to the relatively small area and distinct land use patterns that were easily discernible using satellite imagery. Eight broad habitat categories were identified within this area: agriculture, alien trees, coal mine, Intact Grassland, Disturbed Grassland, Infrastructure, Watercourse and Water-bodies. Habitats were ground-truthed during site visits and were found to be sufficiently accurate to draw broad-scale conclusion of the general land use and activities in the MR area and allow for the allocation of ecological sensitivity to certain habitat types.

2.1.3 Flora Assessment

A literature review was conducted as part of the desktop study to identify the potential habitats and flora species of conservation concern (SCC) present within the PAOI. The South African National Biodiversity Institute (SANBI) provides an electronic database system, namely the Botanical Database of Southern Africa (BODATSA) (SANBI, 2019)[3], to access distribution records on southern African plants[4]. This is a new database which replaces the old Plants of Southern Africa (POSA) database. The POSA database provided distribution data of flora at the quarter degree grid cell (QDGC) resolution; however, the BODATSA database provides distribution data as point coordinates. The literature study therefore, focussed on querying the database to

[1] https://egis.environment.gov.za/protected_and_conservation_areas_database
[2] http://qgis.osgeo.org/en/site/
[3] http://newposa.sanbi.org/
[4] Data are obtained from the National Herbarium in Pretoria (PRE), the Compton Herbarium in Cape Town (NBG & SAM) and the KwaZulu-Natal Herbarium in Durban (NH)

generate species lists for the xMin, yMin 29.20°, -26.00° : xMax, yMax 30.00°,-26.40° extent (WGS84 datum) in order to increase the likelihood of obtaining a representative species list for the proposed PAOI.

The Red List of South African Plants website (SANBI, 2017 & 2019)[5] was utilized to provide the most current account of the national status of flora. Relevant field guides and texts consulted for identification purposes in the field during the surveys included the following:

- Guide to grasses of Southern Africa (Van Oudtshoorn, 2014);
- Field Guide to the Wild Flowers of the Highveld (Van Wyk & Malan, 1998);
- Field guide to trees of southern Africa (Van Wyk & Van Wyk, 2013);
- Orchids of South Africa: A Field Guide (Johnson & Bytebier, 2015) and
- Problem plants and alien weeds of South Africa (Bromilow, 2010).

Additional information regarding ecosystems, vegetation types, and SCC included the following sources:

- The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2010; SANBI, 2018); and
- Red List of South African Plants (Raimondo *et al*., 2009).

2.1.4 Avifauna Assessment

A desktop study was undertaken to assess which bird species could potentially occur in the vicinity of the proposed Dunbar MR application using data from the second South African Bird Atlas Project (SABAP 2; [SABAP2, 2019]). SABAP 2 records were developed based on records per pentad (i.e., 5' X 5'). To account for the high mobility of birds (inherent to linked habitats such as linear watercourses), and the fact that atlas efforts are generally lower in remote areas, particularly away from public roads. A list of species potentially occurring within the PAOI was developed from SABAP 2 data for the pentads within which the PAOI falls (2605_2930 & 2610_2930) and those in close proximity (2605_2925 & 2610_2925). This species list is therefore based on an area much larger than the actual PAOI and was subsequently refined to be more applicable to the PAOI. This approach was adopted to ensure that all species potentially occurring within the PAOI, whether resident, nomadic, or migratory, are identified.

The following main literature sources have been consulted for the avifauna study:

- Information relating to avifauna SCC was obtained from Hockey *et al.* (2005) and Taylor *et al.* (2015);
- del Hoyo *et al.* (1992) and Hockey *et al.* (2005) were consulted for general information on the life history attributes of relevant bird species;
- Distributional data (apart from those obtained during the surveys) was sourced from the Southern Africa Bird Atlas Project (SABAP 2, 2019), del Hoyo *et al.* (1992) and Sinclair & Ryan (2010);
- Nomenclature and taxonomy followed the IOC World Bird Names unless otherwise specified (see www.worldbirdnames.org; Gill & Donsker, 2012); and

[5] http://redlist.sanbi.org/

- The conservation status of bird species is categorised according to Taylor *et al.* (2015) and the IUCN Red List of threatened species (IUCN, 2019).

2.1.5 Mammal Assessment

The list of mammal species predicted to occur in the region and their respective likelihood of occurrence within the PAOI was generated based on known distributions and habitat suitability, sourced from online and literature sources. The literature study focussed on querying the database to generate species lists for the 2629BA and 2629AB QDGCs and surrounding QDGCs (2529CD, 2529DC, 2529DD, 2629BB, 2629BD, 2629BC, 2629AD, 2629AA). The predicted list is heavily influenced by factors other than just distribution or biome type. Factors such as habitat suitability, current land use, current levels of disturbance and structural integrity of the habitats all influence the potential for a species to occur in the PAOI. The key literature sources used during the mammal literature review included:

- The online Virtual Museum (VM) facility of the FitzPatrick Institute of African Ornithology of the University of Cape Town (http://vmus.adu.org.za) was queried for mammal observations within the QDGCs in and surrounding the PAOI (MammalMAP, 2019);
- Mammal SCC information was obtained from Child *et al.* (2017);
- Lists of nationally protected species according to NEMA (2014);
- Liebenberg *et al.* (2010) and Stuart & Stuart (1998) were consulted to aid with identification of tracks and signs; and
- Geographic distribution and general data were acquired from the MammalMap (2019) and from Skinner & Chimimba (2007).

Finally, the very nature of mammals is that they occupy several different niches and are represented by a vast diversity of body size/ types that perhaps exceed other vertebrate types (birds, reptiles etc.). For example, rodents will occupy entirely different niches to apex predators (leopard/ caracals) and must therefore be evaluated in different ways. In addition, there is a high likelihood that not all mammal species known to occur within the PAOI and surrounding areas will be located during a particular survey. Therefore, a 'Likelihood of Occurrence' (LOO) and a 'Species of Special Consideration' review was applied to any potential omissions in the list of predicted species and specifically in reference to identified habitats. The relevant species of special consideration were addressed separately based on the data collected during the fieldwork studies, in context with the proposed development and the potential effects on the species.

Likelihood of occurrence was based upon:

- Habitat suitability;
- Overlap with known distributions;
- Rarity of the species; and
- Current impacts.

2.1.6 Herpetofauna Assessment

Relevant databases, field guides and texts were consulted for the desktop and literature study included the following:

- The online Virtual Museum (VM) facility of the FitzPatrick Institute of African Ornithology of the University of Cape Town (http://vmus.adu.org.za) was queried for the presence of reptile (ReptileMAP, 2019) and amphibian (FrogMAP, 2019) species within the QDGC in which the proposed development resides (2629BA), the nearby QDGC (2629AB), as well as the eight surrounding QDGCs (2529CD, 2529DC, 2529DD, 2629BB, 2629BD, 2629BC, 2629AD, 2629AA);
- Reptile and amphibian SCC information was obtained from IUCN (2019); and
- Additional amphibian SCC information was obtained from Du Preez & Carruthers (2017).

Species nomenclature follows the aforementioned online references throughout this document as new distribution data and taxonomic changes have already occurred since publication of Bates *et al.* (2014). The use of these online facilities is justified as it not only includes the latest verified publicly contributed data but also a complete record of the museum material in South Africa and attempts to keep current with the latest taxonomic changes. Drawing expected species lists for the surrounding QDGCs decreases the likelihood of underestimating the number of species present within the focal QDGCs but also artificially inflates the total number of species likely to occur within the focal QDGCs (some habitats may be present in adjacent QDGCs that are not present in the focal QDGC). Therefore, the resulting species list drawn from the ten QDGCs was heavily refined to exclude those species unlikely to occur within the PAOI, based on habitat availability and knowledge of habitat selection by particular species. As a precautionary measure, species with a low probability of occurrence within the PAOI were included in the predicted list.

2.2 FIELD SURVEYS

Several site visits were undertaken, with two main field studies taking pace on the 10 July 2019 (representing the early dry season) and on the 19 September 2019 (representing late dry season) by a botanist, herpetologist, mammalogist, and avifaunal specialist where the botanical and the faunal aspects of the PAOI were rapidly evaluated. The timing of the surveys represented early dry season and late dry season which is sub-optimal for the detection of some SCC. During the field surveys performed, the habitats were evaluated on foot and a series of georeferenced photographs were taken of the habitat attributes. The field surveys focused on a classification of the observed fauna and flora, habitats as well as the actual and potential presence of SCC (either classified as Threatened[6] by the IUCN (2019), protected by NEMBA (2014). An analysis of the diversity and ecological integrity of the habitats present in the study area was also performed.

2.3 DRY SEASON METHODS

2.3.1 Flora assessment

The dry season survey was conducted on foot through a "timed meander survey" as described by Goff *et al.,* (1982). The timed meander method is a highly efficient method for conducting floristic analysis specifically in detecting flora SCC and maximising floristic coverage. In addition, the method is time and cost effective and highly suited for compiling flora species lists and

[6] Critically Endangered (CR), Endangered (EN) or Vulnerable (VU)

therefore gives a rapid indication of flora diversity. Suitable habitat for SCC were identified according to Raimondo et al. (2009) and targeted as part of the timed meanders.

2.3.2 Avifauna

2.3.2.1 Mackinnon list sampling

As defined within the limitations section, the timing of the survey was wholly suboptimal for the purposes of robust data collection and application of the Mackinnon list sampling method (MacKinnon & Phillips, 1993). Therefore, the focus was on conducting surveys within the more sensitive natural habitats within the PAOI, represented both by a focus on the area adjacent to the Leeufonteinspruit as well as all relevant watercourses, *Imperata* stands and associated mesic / moist grassland and reed beds that occur within the PAOI.

However, given the seasonal limitations, this sampling must be repeated at least two weeks after the commencement of the wet season rains. During the survey, the avifauna will be sampled continuously until escalating ambient temperature significantly reduces avifaunal activity and reduced detectability to sub-optimal levels (usually around 10 am). Additional *ad hoc* avifauna sampling will be performed in the same locations and indeed, throughout the entire PAOI throughout the day (as was carried out within the dry season survey). Binoculars and high powered cameras are used to visually observe birds and sound recording equipment is used to record birdsong. Walk-throughs of habitats showing the presence of *Imperata cylindrica* will be performed in order to detect the presence of African Grass Owls by flushing them, an activity that can only be performed once the burnt, dry season habitat stands have adequately regrown and have thus been subjected to seasonal recolonisation by target SCC. Lastly, photographic evidence of selected representative species is obtained.

2.3.2.2 Direct Observation

During the dry season survey and to obtain a more complete inventory of bird species, all bird species observed while moving between sample points were identified and noted. In addition to visual observations, bird species were identified by means of their calls and other signs such as nests and feathers.

2.3.3 Mammals

The following methods are considered to be the standard operating procedure for mammal surveys and were applied during the mammal surveys or will be in the recommended wet season supplementary survey.

2.3.3.1 Spoor tracking

Spoor tracking is considered to be the world's oldest science, enabling detailed sampling of mammalian species without the need for trapping or direct observation. All spoor, including footprints, den sites, burrows, hairs, scrapings and diggings were (and will be) recorded and documented by detailed geo-referenced photography. Spoor tracking took place during general dry season fieldwork, during specific timed spoor tracking drives/transects and at carefully chosen locations such as roads and other areas with highly trackable substrates.

2.3.3.2 Camera trapping

The use of camera trapping has long been considered as a valuable ecological census tool in the field of African Mammalogy and although this method was not a primary focus of the field study, it will be vital during both the wet season supplementary survey as well as during the pre-construction surveys and monitoring. It must be stated that due to security concerns, poor habitat availability as well as adequate results stemming from the utilisation of other methods, no cameras were deployed for the dry season study. However and as suggested, cameras will be deployed for the supplementary wet season survey and the method should be applied during both the pre-construction and monitoring phases of the project when sufficient security has been established to ensure the low likelihood of camera theft.

2.3.3.3 Scats

Small predator scats were noted and identified and taken to indicate the presence of that species within the PAOI.

2.3.3.4 Daytime observations

All mammals observed during the sampling period were recorded, the surrounded habitat noted and photographed where possible. This data was used to supplement the overall habitat analysis to give context to the area. Animals were encountered through driving, normal routine movement through the PAOI and active searching of refugia.

2.3.4 Herpetofauna

Due to the short timeframe of the surveys, suboptimal seasonality and lack of trappable SCC, no herpetofauna traps were deployed. Instead, active searching was conducted, which is more productive over short periods.

One morning survey was conducted at the end of the dry season (19 September 2019). Reptiles were searched for on foot within the PAOI during the day. Active searching for reptiles entailed the following:

- Photographing active reptiles from a distance with a telephoto lens;
- Lifting up and searching under debris or rocks (rocks were returned to their original positions);
- Scanning for any signs of reptiles such as shed skins, the positive identification of which was taken as an observation of that species;
- Catching any observed active reptile by hand. All captured reptiles were photographed and released unharmed.

Active searching was opportunistic along a meander, due to the paucity of potential refugia to search under. Every reptile or amphibian was identified and enumerated, in order to obtain species-specific densities per sample site (capped at a maximum of 5 individuals per species), in addition to habitat and geographic coordinates being recorded.

Reptiles, especially snakes, are incredibly illusive and difficult to observe. Therefore, the road and road verge were constantly scanned for active and killed (road collisions) reptiles while driving in and to the PAOI. Driving speed was slower than normal to increase the likelihood of a successful observation and to be able to stop safely when a reptile was encountered. Once a reptile was observed the vehicle was rapidly (but safely) brought to a halt and the observed reptile was identified and photographed where possible / necessary.

A wet season herpetofauna survey is planned for after the first rainfall event (November). This will verify if any of the water-

bodies are suitable for the breeding of Giant Bullfrogs and determine the frog community present in the PAOI.

2.4 SPECIES OF CONSERVATION CONCERN

The Red List of threatened species generated by the IUCN (http://www.iucnredlist.org/) provided the global conservation status of terrestrial fauna and flora. However, where regional conservation status assessments performed following the IUCN criteria were more recent than the global assessments, these were considered to be the most relevant and sourced for each group as follows:

- Plants: Red List of South African plants version 2017.17 and Raimondo *et al*. (2009);
- Amphibians: Du Preez & Carruthers (2017);
- Mammals: Child *et al.* (2017); and
- Avifauna: Taylor *et al*. (2015).

The conservation status categories defined by the IUCN, which are considered here to represent SCC, are the "threatened" and "near-threatened" categories defined as follows:

- **Critically Endangered (CR)** - Critically Endangered refers to species facing immediate threat of extinction in the wild;
- **Endangered (EN)** - Endangered species are those facing a very high risk of extinction in the wild within the foreseeable future;
- **Vulnerable (VU)** - Vulnerable species are those facing a high risk of extinction in the wild in the medium-term; and
- **Near Threatened (NT)** – Near Threatened species are those facing the risk of upgrade to Vulnerable.

2.5 IMPACT ASSESSMENT

The following lists of impacts were evaluated in relation to the data captured during the fieldwork to identify relevance to the PAOI. The relevant impacts were then subjected to a prescribed Impact Analysis methodology which is also described below. Mitigation measures were only developed for impacts deemed relevant on the basis of the Impact Analysis.

2.5.1 Potential Flora and Fauna Impacts

1. Loss, destruction and/or eradication of critically endangered/endangered plant and animal species;
2. Impact on natural communities of particular scientific, conservation or education value;
3. Impact on sensitive plant ecological systems;
4. Impact on natural movement of species (flight pathways etc.);
5. Disturbance of non-resident or migrant species (birds overwintering, breeding);
6. Decrease in diversity of natural animal and plant communities;
7. Decrease in availability and reliability of food sources for animal communities;
8. Possibility to introduce and/or enhance the spread of invasive and/or alien animal and plants;

[7] http://redlist.sanbi.org/index.php

9. Threat to the ecological functioning of natural terrestrial and plant communities due to:
    - Isolation of animal and plant communities by destruction of habitat;
    - Reduction in the effective size of habitat/community; and
    - Physical destruction of the habitat.
10. Degradation of plant habitat through:
    - Compaction of the topsoil through trampling, vehicles, machinery etc.;
    - Introduction and/or spread of invasive alien species - creation of dispersal sites; and
    - Potential for bush encroachment through disturbance of topsoil.

2.5.2 Impact Analysis

Direct, indirect and cumulative impacts of the issues identified during the specialist investigations were assessed in terms of these six rating scales to determine their significance. The rating system used for assessing impacts (or when specific impacts cannot be identified, the broader term issue should apply) is based on six criteria, namely:

- **Status** of impacts (
- Table 2-1) – determines whether the potential impact is positive (positive gain to the environment), negative (negative impact on the environment), or neutral (i.e. no perceived cost or benefit to the environment). Take note that a positive impact will have a low score value as the impact is considered favourable to the environment;
- **Spatial extent** of impacts (Table 2-2) – determines the spatial scale of the impact on a scale of localised to global effect. Many impacts are significant only within the immediate vicinity of the study area or within the surrounding community, whilst others may be significant at a local or regional level. Potential impact is expressed numerically on a scale of 1 (study area-specific) to 5 (global);
- **Duration** of impacts (
- Table 2-3) – refers to the length of time that the aspect may cause a change either positively or negatively on the environment. Potential impact is expressed numerically on a scale of 1 (project duration) to 5 (permanent);

Frequency ***of the activity (***

- Table 2-4) – The frequency of the activity refers to how regularly the activity takes place. The more frequent an activity, the more potential there is for a related impact to occur;
- **Severity** of impacts (Table 2-5) – quantifies the impact in terms of the magnitude of the effect on the baseline environment, and includes consideration of the following factors:
    - The reversibility of the impact;
    - The sensitivity of the receptor to the stressor;
    - Whether the aspect is controversial or would set a precedent;
    - The threat to environmental and health standards and objectives;

- **Probability** of impacts (Table 2-6) – quantifies the impact in terms of the likelihood of the impact occurring on a percentage scale of <5% (improbable) to >95% (definite).

Table 2-1: Status of Impacts

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment (positive impact)	+
Neutral	No determined cost or benefit to the receiving environment	N
Negative	At cost to the receiving environment (negative impact)	-

Table 2-2: Extent of Impacts

Rating	Description	Quantitative Rating
Very Low	**Study Area Specific** – impacts confined within the project study area boundary	1
Low	**Proximal** – impacts extend to within 1 km of the project study area boundary	2
Medium	**Local** – impacts extend beyond to within 5 km of the project study area boundary	3
High	**Regional** – impacts extend beyond the site boundary and have a widespread effect - i.e. > 5 km from project study area boundary	4
Very High	**Global** – impacts extend beyond the site boundary and have a national or global effect	5

Table 2-3: Duration of Impacts

Rating	Description	Quantitative Rating
Very Low	One day to one month	1
Low	One month to one year	2
Medium	One year to ten years	3
High	Life of operation	4
Very High	Post closure	5

Table 2-4: Frequency of Activity

Rating	Frequency	Quantitative Rating
Very Low	Annually or less	1
Low	6 monthly	2

Medium	Monthly	3
High	Weekly	4
Very High	Daily	5

Table 2-5: Severity of Impacts

Rating	Description	Quantitative Rating
Very Low	Insignificant/non-harmful	1
Low	Small/potentially harmful	2
Medium	Significant/slightly harmful	3
High	Great/harmful	4
Very High	Disastrous/extremely harmful	5

Table 2-6: Probability of Impacts

Rating	Description	Quantitative Rating
Very Low	Almost never/almost impossible	1
Low	Very seldom/highly unlikely	2
Medium	Infrequent/unlikely/seldom	3
High	Often/regularly/likely/possible	4
Very High	Daily/highly likely/definitely	5

Determination of Impact Significance

The information presented above in terms of identifying and describing the aspects and impacts is summarised in below in Table 2-7 and significance is assigned with supporting rationale.

.

Table 2-7: Consolidated Table of Aspects and Impacts Scoring

Spatial Scale	Rating	Duration	Rating	Severity	Rating
Activity specific	1	One day to one month	1	Insignificant/non-harmful	1
Area specific	2	One month to one year	2	Small/potentially harmful	2
Whole site/plant/mine	3	One year to ten years	3	Significant/slightly harmful	3
Regional/neighbouring areas	4	Life of operation	4	Great/harmful	4
National	5	Post closure	5	Disastrous/extremely harmful	5

Spatial Scale	Rating	Duration	Rating	Severity	Rating
Frequency of Activity		Rating	Probability of Impact		Rating
Annually or less		1	Almost never/almost impossible		1
6 monthly		2	Very seldom/highly unlikely		2
Monthly		3	Infrequent/unlikely/seldom		3
Weekly		4	Often/regularly/likely/possible		4
Daily		5	Daily/highly likely/definitely		5
Significance Rating of Impacts			Timing		
Very Low (1-25)					
Low (26-50)			Pre-construction		
Low – Medium (51-75)			Construction		
Medium – High (76-100)			Operation		
High (101-125)			Decommissioning		
Very High (126-150)					
Adjusted Significance Rating					

Significance will be classified according to the following:

- Very Low to Low - it will not have an influence on the decision;
- Medium to Medium-High - it should have an influence on the decision unless it is mitigated;
- High to Very High- it would influence the decision regardless of any possible mitigation. Alternative options including project relocation, rehabilitation and/or offset should be investigated

The environmental significance rating is an attempt to evaluate the importance of a particular impact, the consequence and likelihood of which is assessed by the relevant specialist. The description and assessment of the aspects and impacts is presented in a consolidated table with the significance of the impact assigned using the process and matrix detailed above (Table 2-7).

The sum of the first three criteria (spatial scope, duration and severity) provides a collective score for the consequence of each impact. The sum of the last two criteria (frequency of activity and impact probability) determines the likelihood of the impact occurring. The product of consequence and likelihood leads to the assessment of the significance of the impact, shown in the significance matrix below in Table 2-8.

Table 2-8: Significance Assessment Matrix. See meaning of significance colours in Table 2-7.

Likelihood (Frequency + Probability) \ Consequence (Severity + Spatial Scope + Duration)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	4	6	8	10	12	14	16	08	20	22	24	26	28	30
3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

The model outcome is then assessed in terms of impact certainty and consideration of available information. Where a particular variable rationally requires weighting or an additional variable requires consideration the model outcome is adjusted accordingly.

3 RESULTS

3.1 SITE COVERAGE

The specialist GPS tracks as well as the location of the georeferenced photos taken during the field surveys are shown in Figure 3-1. The georeferenced photographs (Appendix 1) serve to assist in both the site characterisation as well as the sensitivity analysis and provide lasting evidence for future queries. The specialist surveys did not cover the entire PAOI, specifically the southern Leeufonteinspruit watercourse and the minor watercourse to the north. Nonetheless, SCC within these riparian habitats were unlikely to be detected during the dry season and need to be revisited during the wet season supplementary survey. All other areas of the PAOI were clearly visible.

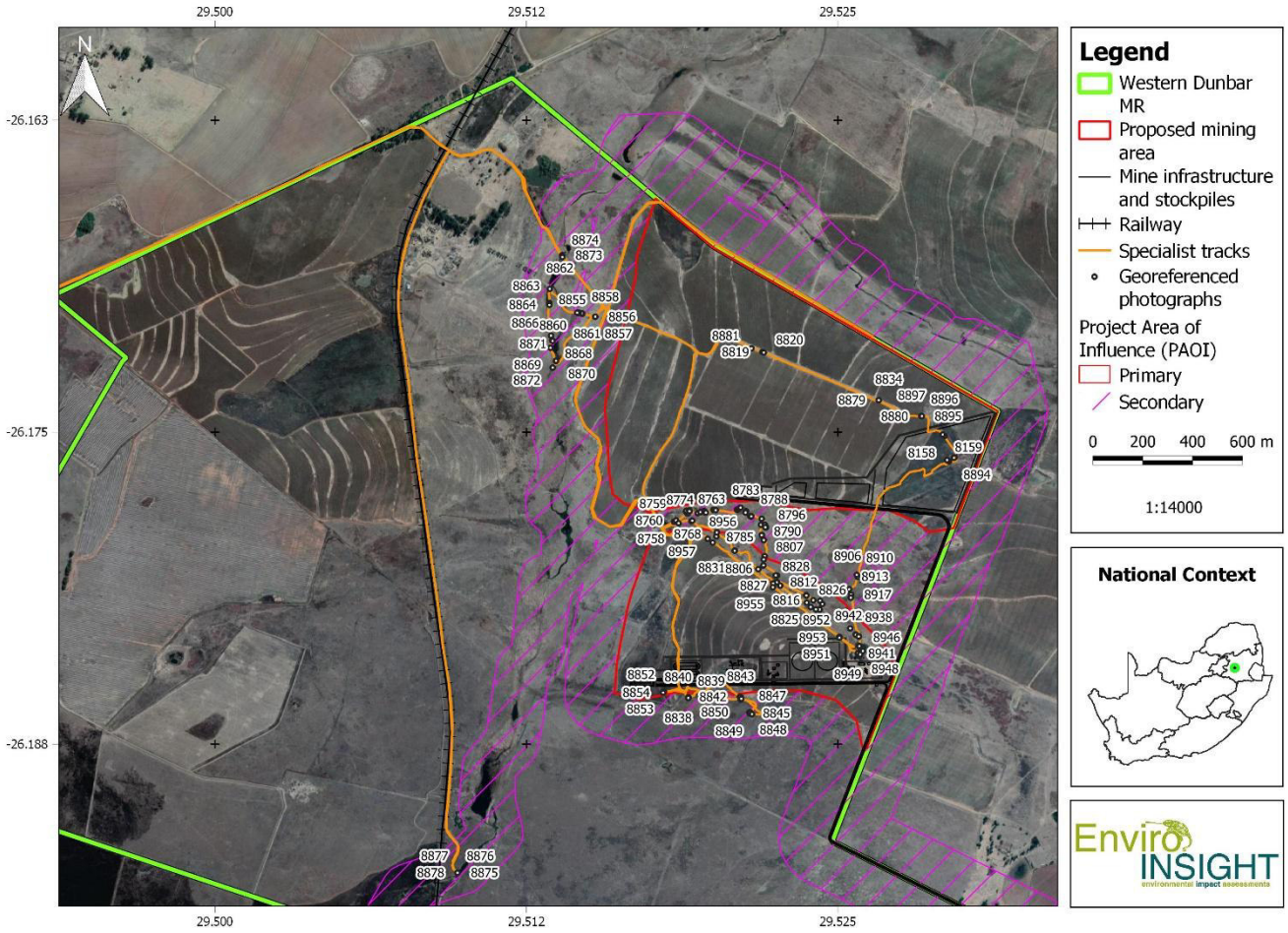


Figure 3-1: Specialist coverage (GPS tracks) and location of georeferenced photographs taken during the field surveys. Photograph numbers correspond to those presented in Appendix 1.

3.2 REGIONAL VEGETATION

The Eastern Highveld Grassland (Gm12) occurs on plains in the Mpumalanga and Gauteng Provinces (Table 3-1; Figure 3-2). This vegetation type extends from Johannesburg in the West to Belfast in the East and Bethal and Ermelo in the South. This vegetation type is classified as Endangered (EN) with a conservation target of 24%, while only a small fraction conserved on statutory (Nooitgedacht Dam Nature Reserve and Jericho Dam Nature Reserves) and private reserves (Holkranse, Kransbank and Morgenstond). In 2010, approximately 44% of this vegetation type was classified as transformed primarily by cultivation (most extensive impact), plantations, mining, urbanisation and by building of dams (Mucina & Rutherford, 2010). The landscape features consist of slightly to moderately undulating plains with some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual highveld grass composition, including species from the genera *Aristida*, *Digitaria*, *Eragrostis*, *Themeda* and *Tristachya*, with small, scattered rocky outcrops of wiry, sour grasses and some woody species such

as *Senegalia caffra*, *Celtis africana*, *Diospyros lycioides* subsp *lycioides*, *Parinari capensis*, *Protea caffra*, *P. welwitschii* and *Englerophytum magalismontanum* (Mucina & Rutherford, 2010) (refer to Table 3-2 for a list of common and characteristic plant species).

Table 3-1: Attributes of the Eastern Highveld Grassland regional vegetation unit

Name of vegetation type	Eastern Highveld Grassland
Code as used in the Book (Mucina & Rutherford, 2010)	Gm12
Conservation Target (percent of area) from NSBA[8]	24%
Protected (percent of area) from NSBA	0.3%
Remaining (percent of area) from NSBA	56%
Description of conservation status from NSBA	Endangered
Description of the Protection Status from NSBA	Hardly protected
Area (km^2) of the full extent of the Vegetation Type	12669.037
Name of the Biome	Grassland Biome

Table 3-2: Characteristic Plant Species of the Eastern Highveld Grassland.

Plant form	Species
Graminoids (grasses and sedges)	*Aristida aequiglumis, A. congesta, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, Elionurus muticus, Eragrostis chloromelas, E. curvula, E. plana, E. racemosa, Heteropogon contortus, Sporobolus africanus, Loudetia simplex, Microchloa caffra, Setaria sphacelata, Sporobolus africanus, Themeda triandra, Trachypogon spicatus and Tristachya leucothrix.*
Herbs	*Berkheya setifera, Haplocarpha scaposa, Justicia anagalloides, Pelargonium luridum, Acalypha angustata, Dicoma anomala, Euryops gilfillanii, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides, Selago densiflora, Senecio coronatus, Vernonia oligocephala, Wahlenbergia undulata.*
Geophytic bulbs	*Gladiolus crassifolius, Haemanthus humilis, Hypoxis rigidula, Ledebouria ovatifolia.*
Succulent herbs	*Aloe ecklonis.*
Low shrubs	*Anthospermum rigidum subs. pumilum, Seriphium plumosum.*

[8] National Spatial Biodiversity Assessment

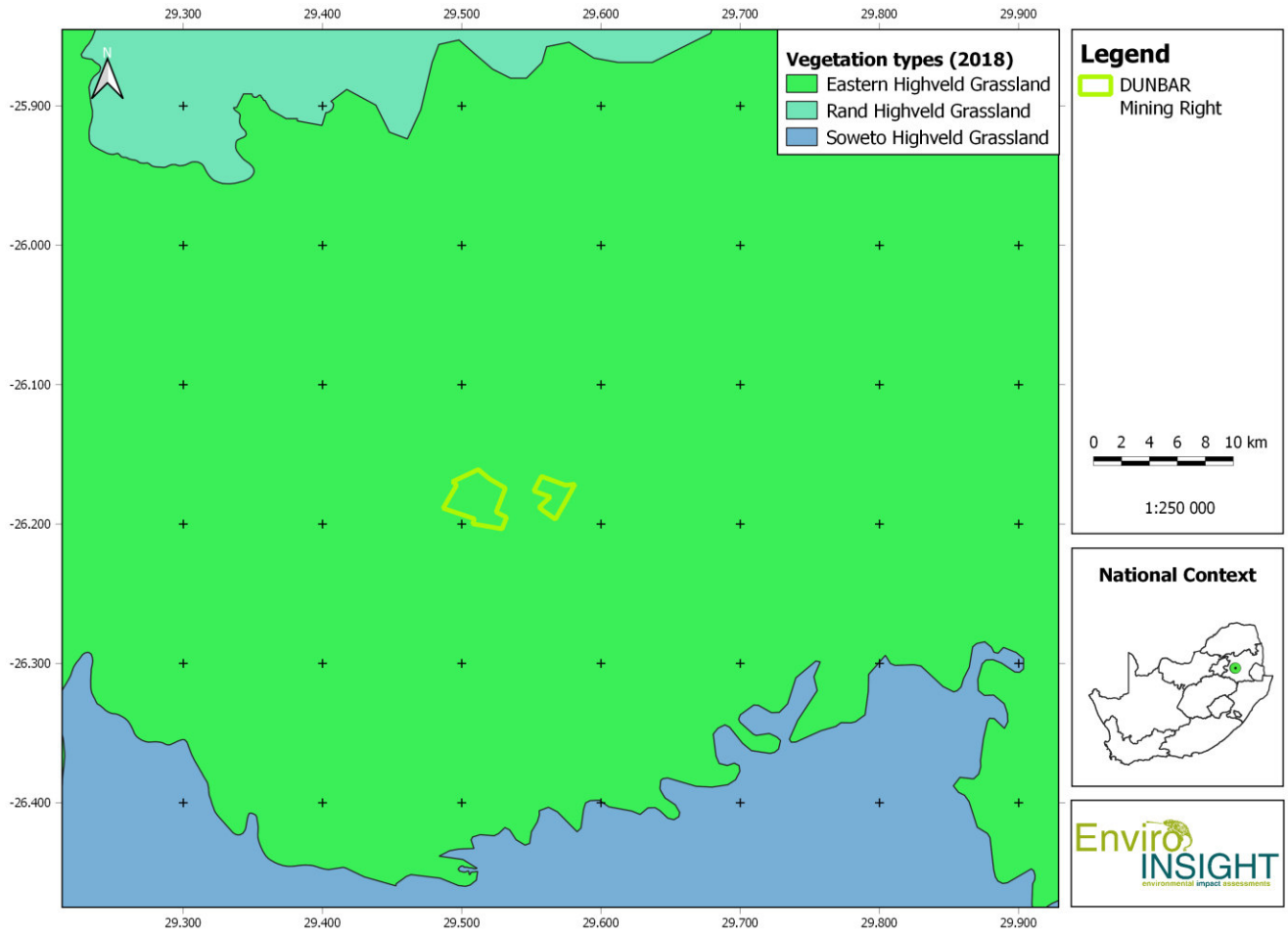


Figure 3-2: The MR application areas in relation to the regional vegetation types .

3.3 THREATENED ECOSYSTEM

The MR areas are located in the Eastern Highveld Grassland (Figure 3-3), which has been listed as a threatened ecosystem (National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, G 34809, GoN 1002, 9 December 2011) with a status of Vulnerable. Two highly localized forbs of conservation concern, *Gladiolus robertsoniae* (Near-Threatened) and *Nerine gracilis* (Vulnerable), are found in the remaining grassland patches.

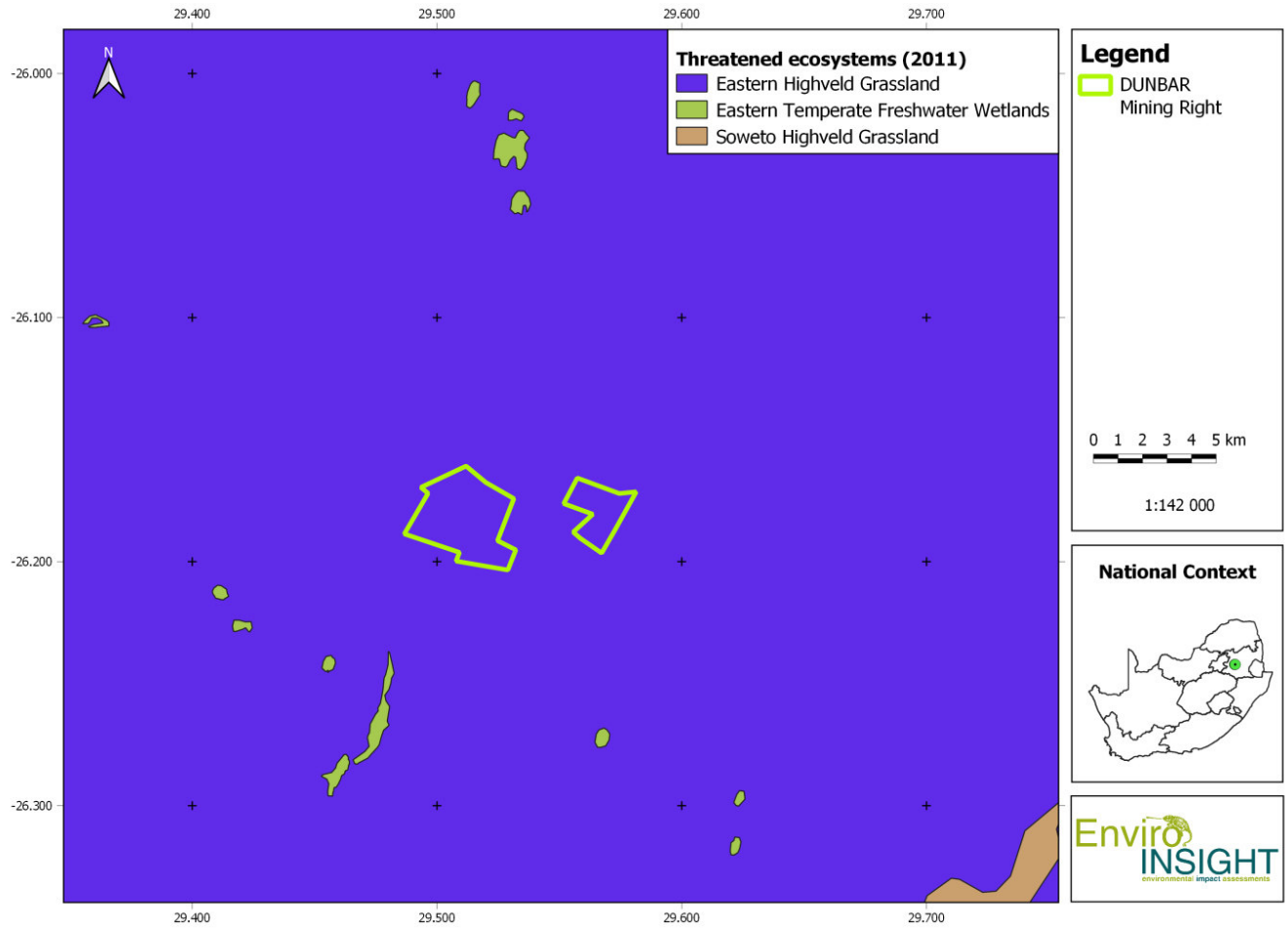


Figure 3-3: The MR application areas in relation to threatened ecosystems.

3.4 MPUMALANGA BIODIVERSITY SECTOR PLAN

The Mpumalanga Biodiversity Sector Plan (MBSP) maps the distribution of Mpumalanga's Provinces known biodiversity into six categories (Ferrar & Lötter, 2007). These are ranked according to ecological and biodiversity importance and their contribution to meeting the quantitative targets set for each biodiversity feature. Classification of the six categories is as follows:

1. Protected areas – already protected and managed for conservation;
2. Irreplaceable areas – no other options available to meet targets – protection crucial;
3. Highly Significant areas – protection needed, very limited choice for meeting targets;
4. Important and Necessary areas – protection needed, greater choice in meeting targets;
5. Areas of Least Concern – Natural areas with most choices, including for development; and
6. Areas with No Natural Habitat Remaining – transformed areas that make no contribution to meeting targets.

According to the MBSP, the MR application areas intersect with "Other Natural Areas", "Heavily or moderately modified" and

"Critical Biodiversity Area" (Figure 3-4).

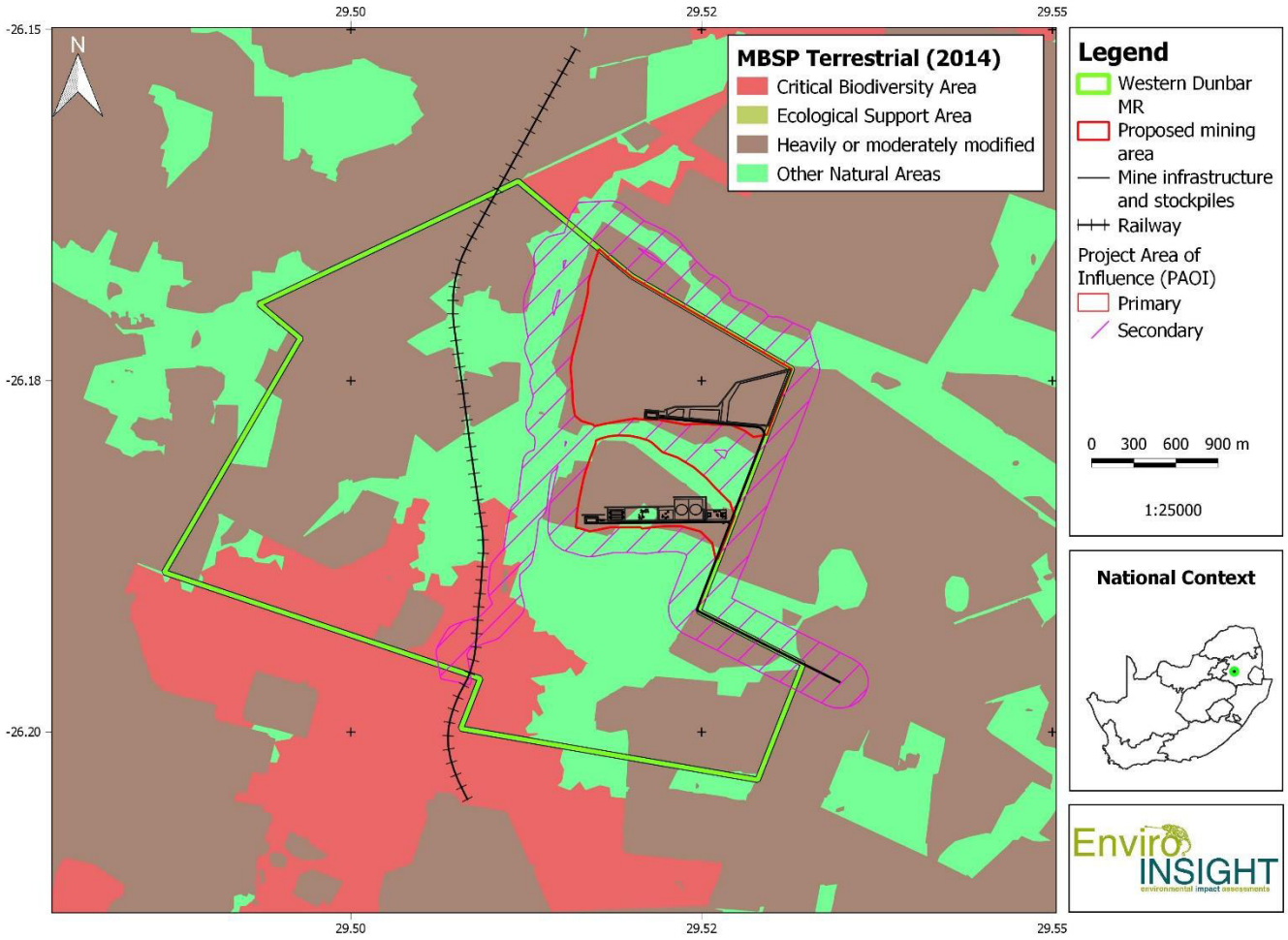


Figure 3-4: The western portion of the MR application area in relation to Mpumalanga Terrestrial Biodiversity Sector Plan (MBSP, 2014).

3.5 PROTECTED AREAS AND IMPORTANT BIRD AREAS

There are no Protected Areas or Important Bird Areas intersecting with the PAOI. The Amersfoort-Bethal-Carolina IBA is situated 11 km away which can potentially be influenced by an increase in traffic and coal dust blown from trucks, and downstream migration of birds (watercourse pollution) (Figure 3-5). However, the prevailing wind conditions are east-northeast and therefore windblown dust or coal dust from the mine is highly unlikely to have a negative affect on the IBA to the Southeast.

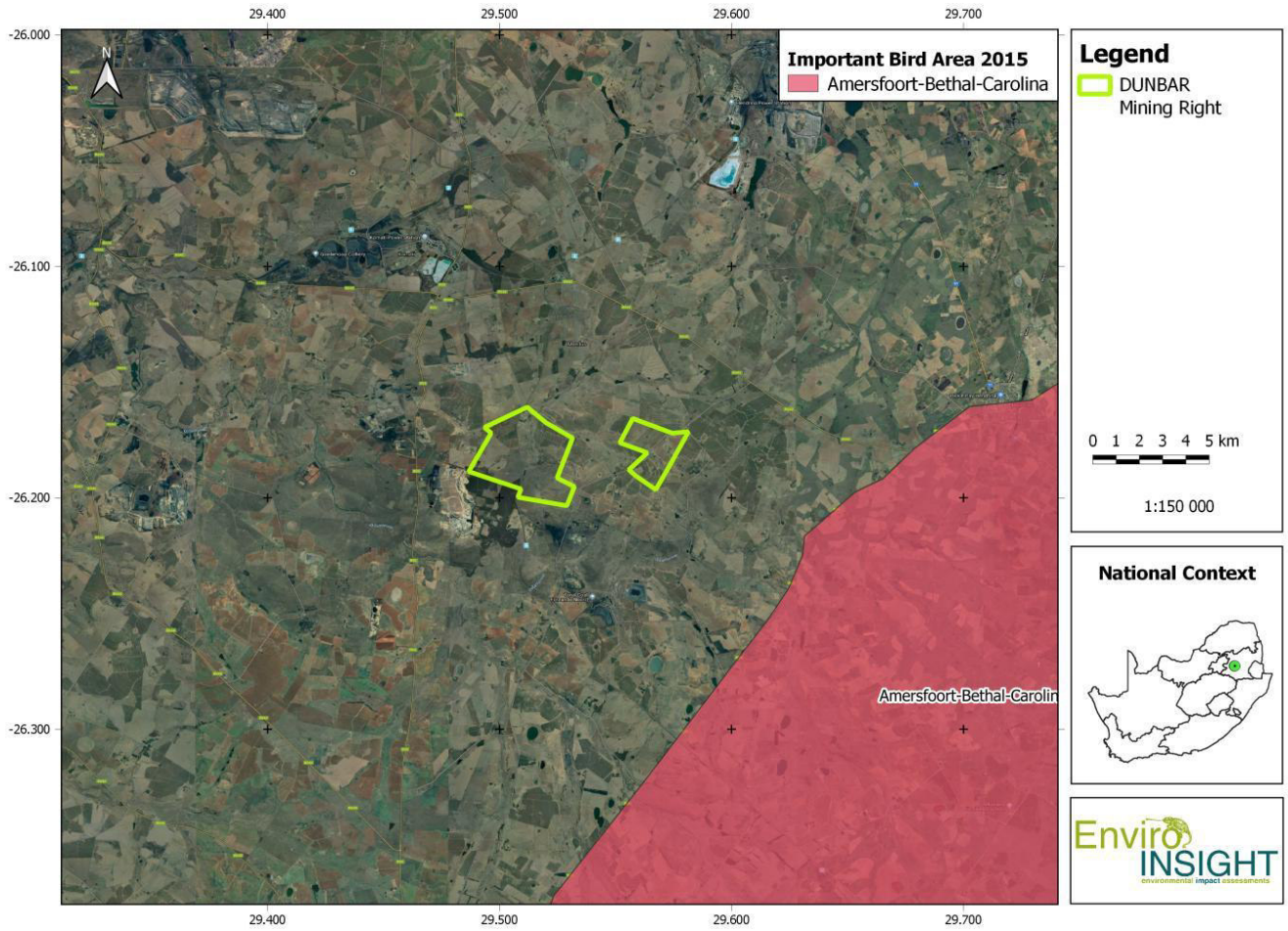


Figure 3-5: The MR application areas in relation to nearby Important Bird Areas.

3.6 MINING AND BIODIVERSITY

In 2012, the South African Mining and Biodiversity Forum in partnership with the Department of Environmental Affairs and the Department of Mineral Resources, and with technical input and coordination of South African National Biodiversity Institute (SANBI), produced a guideline to highlight areas of high biodiversity risk in relation to mining for South Africa titled: Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector (DEA *et al*., 2013; SANBI, 2012). This study was very comprehensive at the time of publication but could not benefit from key datasets that were developed thereafter e.g. the updated National landcover (2013/2014) dataset. The Mining and Biodiversity Guideline (SANBI, 2012) used "biodiversity priority areas" to develop their final dataset and defined these as follows:

- Protected areas;
- World heritage sites and their legally proclaimed buffers;
- Critically endangered and endangered ecosystems;

- Critical biodiversity areas;
- River and wetland freshwater ecosystem priority areas (FEPAs), and 1 km buffer of river and wetland FEPAs;
- RAMSAR sites;
- Protected area buffers;
- Transfrontier Conservation Areas (remaining areas outside of formally proclaimed PAs);
- High water yield areas;
- Coastal protection zone;
- Estuarine functional zones; and
- Ecological support areas.

The Mining and Biodiversity Guideline (SANBI 2012) shows that large sections of the western portion of the MR application area is located in category B (highest biodiversity importance) and D (moderate biodiversity importance) (refer to Table 3-3), which indicates that there is a highest possible to moderate risk to biodiversity from mining activities (Figure 3-6). The PAOI is predominantly situated in category D (moderate biodiversity importance) or has no biodiversity importance. Only a small area to the Southwest and along the non-perennial Leeufonteinspruit, associated wetlands and watercourses are in category B (highest biodiversity importance).

Table 3-3: Four categories of biodiversity priority areas in relation to their biodiversity importance and implications for mining.

Category	Biodiversity priority areas	Risk for mining	Implications for mining
A. Legally protected	• Protected areas (including National Parks, Nature Reserves, World Heritage Sites, Protected Environments, Nature Reserves) Areas declared under Section 49 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002)	Mining prohibited	Mining projects cannot commence as mining is legally prohibited. Although mining is prohibited in Protected Areas, it may be allowed in Protected Environments if both the Minister of Mineral Resources and Minister of Environmental Affairs approve it. In cases where mining activities were conducted lawfully in protected areas before Section 48 of the Protected Areas Act (No. 57 of 2003) came into effect, the Minister of Environmental Affairs may, after consulting with the Minister of Mineral Resources, allow such mining activities to continue, subject to prescribed conditions that reduce environmental impacts.
B. Highest biodiversity importance	• Critically endangered and endangered ecosystems • Critical Biodiversity Areas (or equivalent areas) from provincial spatial biodiversity plans • River and wetland Freshwater Ecosystem Priority Areas (FEPAs) and a 1km buffer around these FEPAs • Ramsar Sites	Highest risk for mining	Environmental screening, environmental impact assessment (EIA) and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, and to provide site-specific basis on which to apply the mitigation hierarchy to inform regulatory decision-making for mining, water use licences, and enviromental authorisations. If they are confirmed, the likelihood of a fatal flaw for new mining projects is very high because of the significance of the biodiversity features in these areas and the associated ecosystem services. These areas are viewed as necessary to ensure protection of biodiversity, environmental sustainability, and human well-being. An EIA should include the strategic assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. This assessment should fully take into account the environmental sensitivity of the area, the overall environmental and socio-economic costs and benefits of mining, as well as the potential strategic importance of the minerals to the country. Authorisations may well not be granted. If granted, the authorisation may set limits on allowed activities and impacts, and may specify biodiversity offsets that would be written into licence agreements and/or authorisations.

C. High biodiversity importance	• Protected area buffers (including buffers around National Parks, World Heritage Sites* and Nature Reserves) • Transfrontier Conservation Areas (remaining areas outside of formally proclaimed protected areas) • Other identified priorities from provincial spatial biodiversity plans • High water yield areas • Coastal Protection Zone • Estuarine functional zone *Note that the status of buffer areas of World Heritage Sites is subject to a current intra-governmental process.	High risk for mining	These areas are important for conserving biodiversity, for supporting or buffering other biodiversity priority areas, and for maintaining important ecosystem services for particular communities or the country as a whole. An EIA should include an assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. Mining options may be limited in these areas, and limitations for mining projects are possible. Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorisations.
D. Moderate biodiversity importance	• Ecological support areas • Vulnerable ecosystems • Focus areas for protected area expansion (land-based and offshore protection)	Moderate risk for mining	These areas are of moderate biodiversity value. EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, identifying features (e.g. threatened species) not included in the existing datasets, and on providing site-specific information to guide the application of the mitigation hierarchy. Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorisations.

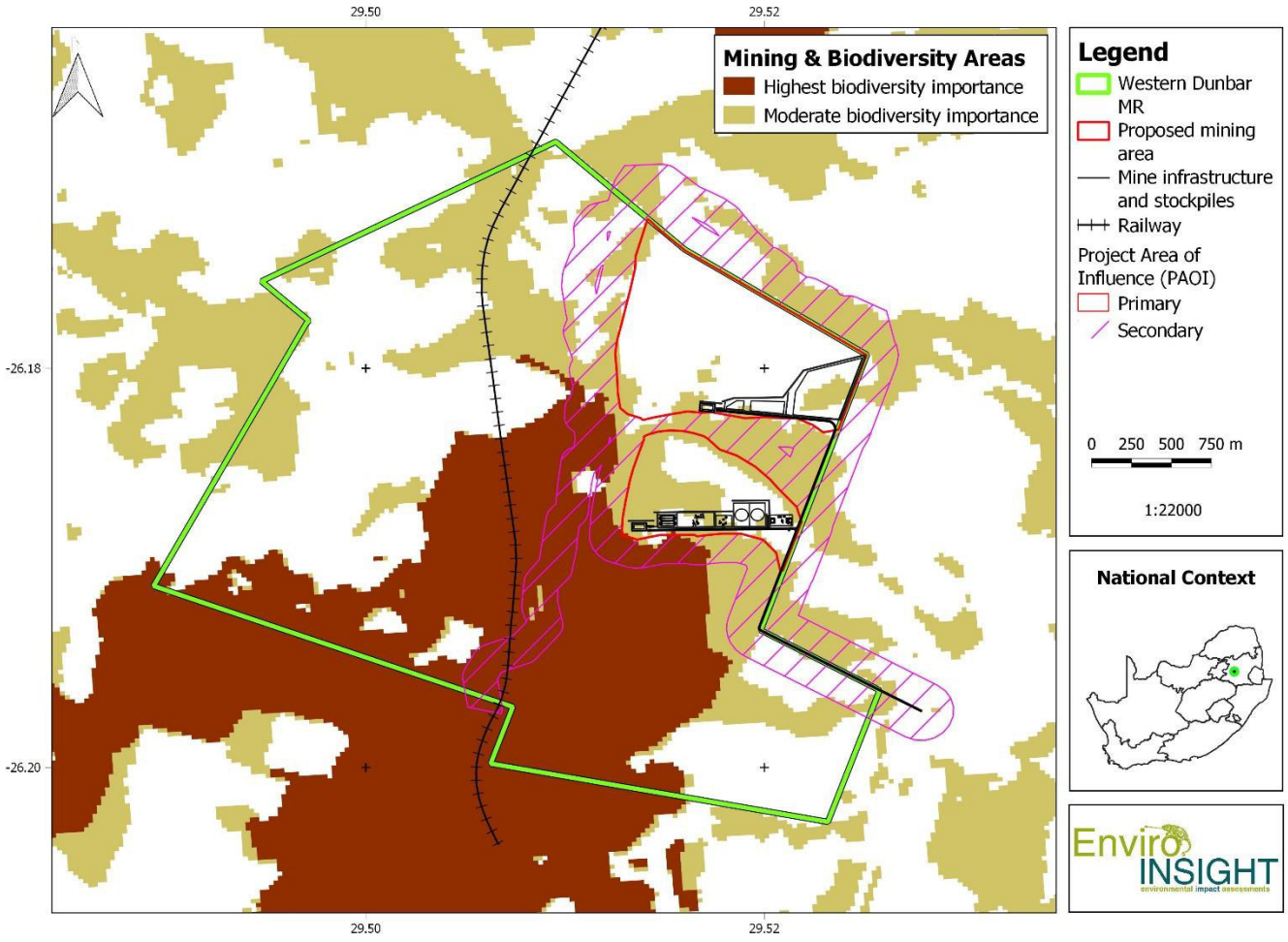


Figure 3-6: The western portion of the MR application area in relation to Mining and Biodiversity Areas (SANBI, 2012).

3.7 HABITATS

Satellite imagery was manually classified into eight distinct and discernible habitat/land use types (Figure 3-7; Figure 3-8): Intact Grassland, Disturbed Grassland, Agriculture, Watercourses, Water-bodies, Infrastructure, Alien Trees and Mines which are discussed in detail below. Grassland was categorised by checking for signs of disturbance using historical satellite imagery. From this map it is clear that approximately half of the western portion of the MR application area is utilised for crop agriculture and the other half is grassland. Surface areas for each habitat type in the western portion of the MR application area are presented in Table 3-4. The habitat surrounding pans, wetlands and watercourses is predominantly Intact Grassland.

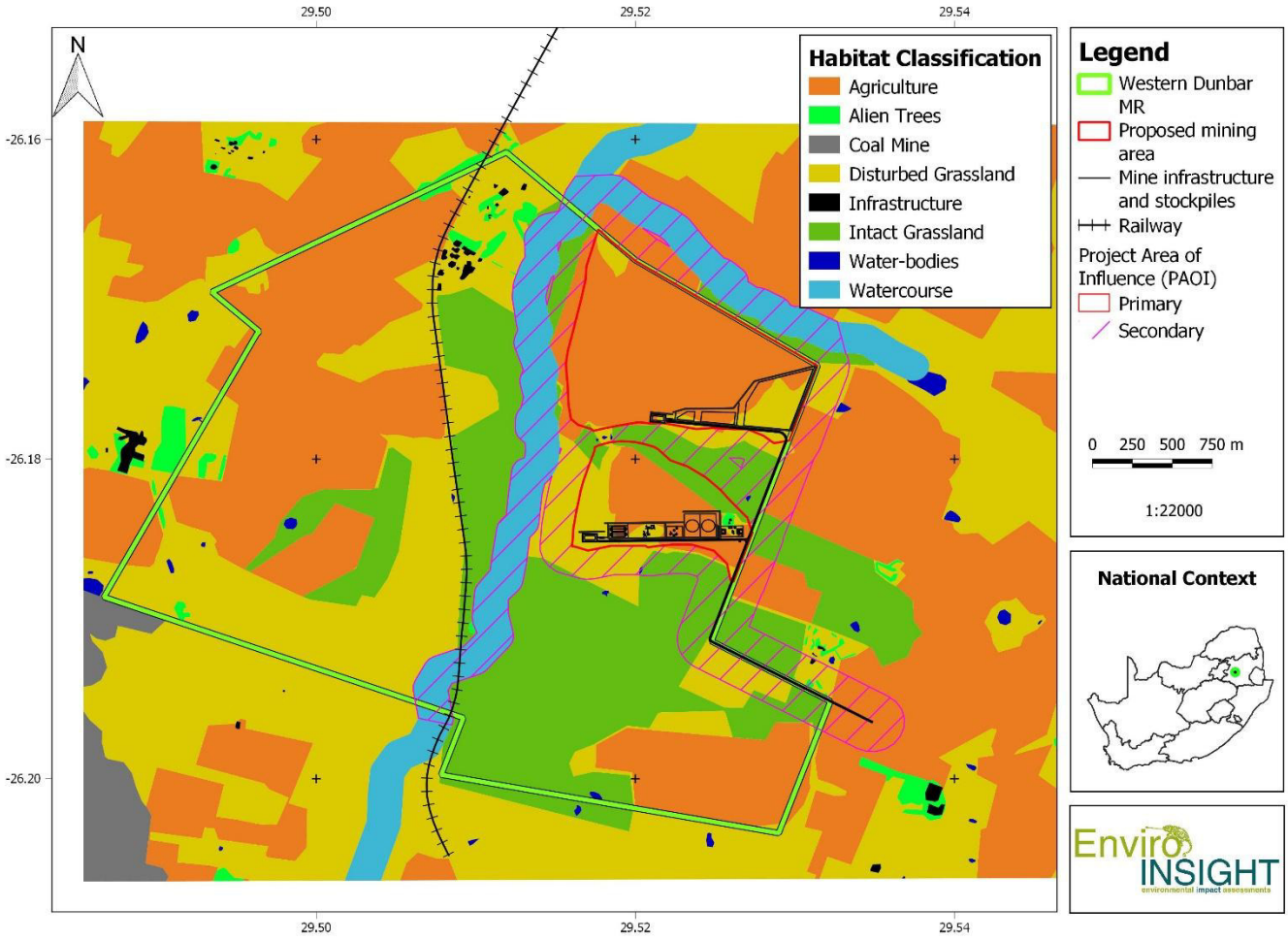


Figure 3-7: Habitats identified within the western portion of the MR application area and PAOI with layout and open cast pits indicated.

Table 3-4: Habitat types and their respective surface areas (ha) for the western portion of the MR application area.

Habitat	Area (ha)
Agriculture	489.02
Alien Trees	12.61
Grassland	783.51
Infrastructure	2.75
Water-bodies	7.83
Watercourses	6.03
Total	**1301.75**

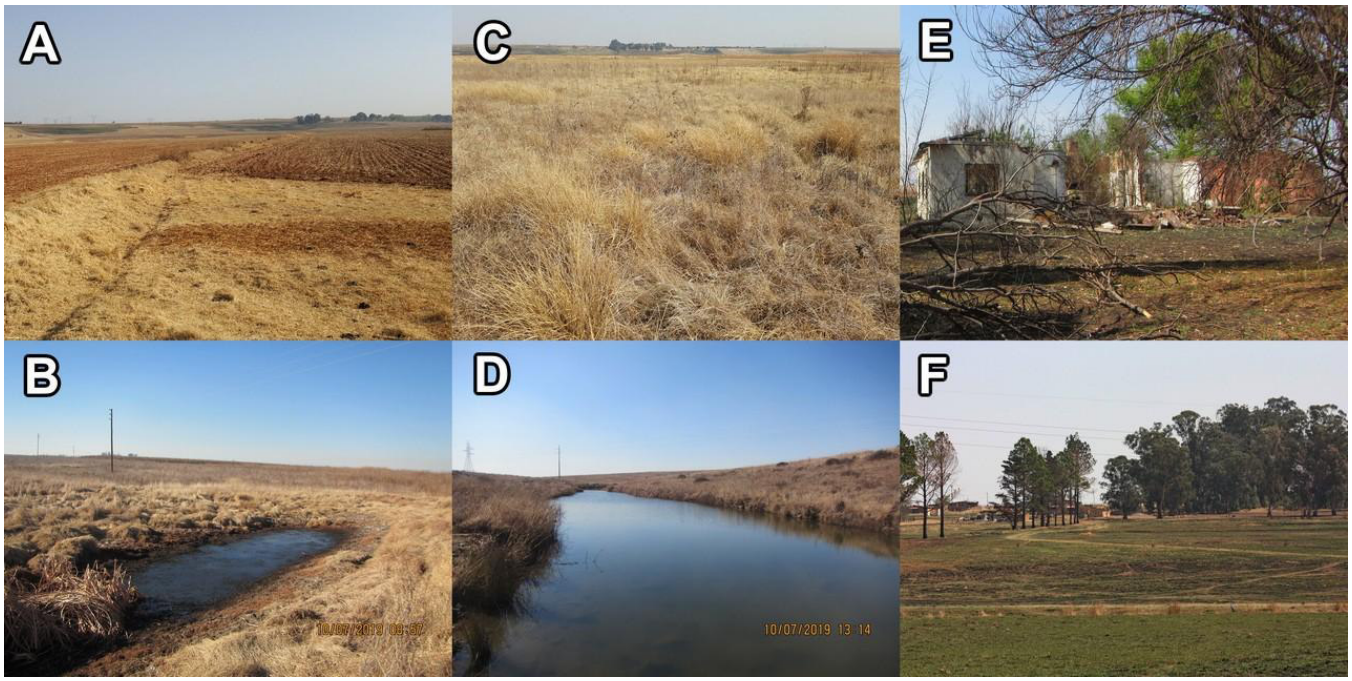


Figure 3-8: Photographs of the main habitat types identified in the PAOI taken prior to and during the dry season survey[9].

[9] A: Agriculture (Maize); B: Water-bodies; C: Disturbed Grassland; D: Watercourses; E: Infrastructure; F: Alien Trees

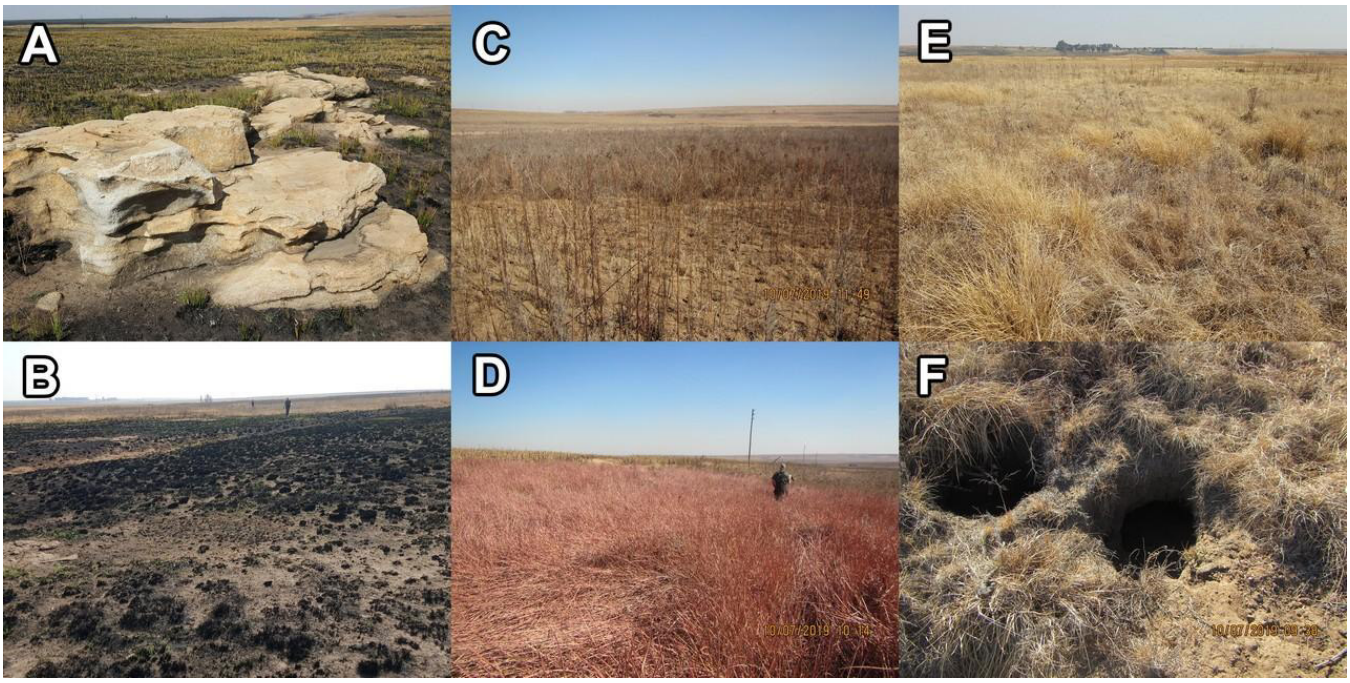


Figure 3-9: Habitat features of Grassland[10]

3.7.1 Intact Grassland

3.7.1.1 Flora specific analysis

Intact Grassland patches were found in-between Agriculture and Disturbed Grassland, and patches are located between the two mining pits and adjacent to the haul road. It is defined by having an intact grass assemblage and low intensity impacts, such as grazing and alien vegetation, and shows no evidence using satellite imagery of ploughing in the last 10 years. Some feature of this habitat can be seen in Figure 3-9.

A comprehensive list of flora species could not be compiled due to a combination of burnt grassland and dry season conditions. Sufficient rain had not fallen yet and grass identification is optimal in January-February. Nonetheless, despite these limitations and the current impacts, there was a moderate diversity of graminoids (grasses and sedges) and some forbs, particularly members of the Asteraceae family. Conspicuous grasses such as *Eragrostis* species dominated the area including species from the genera *Aristida*, *Hyparrhenia*, and the identifiable species *Cynodon dactylon, Schoenoplectus corymbosus* and *Themeda triandra.*

3.7.1.2 Avifauna specific analysis

The Grassland Habitats have been almost completely burnt through late dry season controlled fires which belies the fact that these habitats are excellent examples of complex grassland systems that exhibit sound forage and habitat potential. It is

[10] A: Rocky outcrops; B: Burnt grassland; C: Overgrown area of *Bidens pilosa*; D: *Imperata cylindrica* patches; E: Typical grassy matrix; F: Abundance of rodent burrows

predicted that the potential small mammal density (and possibly diversity) will be very high providing excellent forage potential for carnivorous bird species (raptors and owls) while the good grass cover provides refugia for ground dwelling birds such as francolins and quails. Finally, large bodied species such as Blue Korhaan (*Eupodotis caerulescens*), Black Stork (*Ciconia* nigra), Southern Bald Ibis (*Geronticus calvus*) and Secretary Bird (*Sagittarius serpentarius*) are expected to occur/ forage within the habitat. Blue Korhaan were observed on-route to the PAOI (3 km).

3.7.1.3 Mammal specific analysis

These habitats provide excellent refugia and forage for small mammal species, which in turn form an important part of the basis for the trophic food chain. These areas comprise a large percentage of the overall habitat in the western portion of the MR application area and are extremely important breeding and foraging sites for mammal species. Threatened species such as serval, as well as other meso-predators are strongly represented within these areas. Recorded and predicted mammals within the grassland habitat include: Serval, brown hyaena, leopard, honey badger, black-backed jackal, aardwolf, striped polecat, caracal, yellow mongoose, slender mongoose, African wild cat, Cape fox, Common duiker, bushpig, warthog, Common mole-rat, Highveld golden mole, forest shrew, musk shrews, dwarf shrews, multiple rodent species, scrub hare, striped weasel, porcupine and South African hedgehog.

3.7.1.4 Herpetofauna specific analysis

These habitats generally have low densities of herpetofauna but provide excellent refugia and forage potential for snake species that prey on rodents, such as mole snakes. The rocky outcrops were sparsely distributed and barely protruded from the ground. No rupicolous[11] specialists were observed on the rocks, probably due to the lack of crevices and cracks for these species to utilise as refugia or breeding habitat. This habitat is not as important for herpetofauna as the aquatic habitats (watercourse and wetland pan habitats) but nevertheless represents a habitat of moderate overall sensitivity, especially when considering the limited patches of good quality grassland remaining in the region and their fragmented nature.

3.7.2 Disturbed Grassland

3.7.2.1 Flora specific analysis

Disturbed Grassland patches occur in a mosaic of agricultural fields throughout the western portion of the MR application area, and is intersected by the proposed development footprint. Previous agriculture activities such as ploughing and the invasion of alien plants and grazing by cattle has resulted in a disturbed grassland habitat (Figure 3-9).

A comprehensive list of flora species could not be compiled due to dry season conditions. Sufficient rain had not fallen yet and grass identification is optimal in January-February. Nonetheless, despite these limitations and the current impacts, areas that were left intact showed a moderate diversity of graminoids (grasses and sedges) and some forbs, particularly members of the Asteraceae family. Conspicuous grasses such as *Eragrostis* species were present in the area including species from the genera *Aristida*, *Hyparrhenia*, and *Themeda triandra.* Owing to disturbances and exposed bare areas within the habitat, an abundance

[11] Rock-living

of forbs, including alien species, were observed such as *Bidens pilosa*, *Datura ferox*, *Helichrysum* spp., *Tagetes minuta*, *Verbena aristigera* and *Verbena brasiliensis*.

3.7.2.2 Avifauna specific analysis

The Disturbed Grassland is predicted to have very high potential small mammal density, providing excellent forage potential for carnivorous bird species (raptors and owls) while the sparse grass cover provides some refugia for ground dwelling birds such as francolins and quails. Finally, large bodied species such as Blue Korhaan (*Eupodotis caerulescens*), Black Stork (*Ciconia* nigra), Southern Bald Ibis (*Geronticus calvus*) and Secretary Bird (*Sagittarius serpentarius*) are expected to forage within the habitat. Blue Korhaan were observed on-route to the PAOI (3 km).

3.7.2.3 Mammal specific analysis

These habitats provide excellent refugia and forage for small mammal species, which in turn form an important part of the basis for the trophic food chain. These areas comprise a large percentage of the overall habitat in the western portion of the MR application area and are extremely important breeding and foraging sites for mammal species. Threatened species such as serval, as well as other meso-predators are strongly represented within these areas. Recorded and predicted mammals within the grassland habitat include: Serval, brown hyaena, leopard, honey badger, black-backed jackal, aardwolf, striped polecat, caracal, yellow mongoose, slender mongoose, African wild cat, Cape fox, Common duiker, bushpig, warthog, Common mole-rat, Highveld golden mole, forest shrew, musk shrews, dwarf shrews, multiple rodent species, scrub hare, striped weasel, porcupine and South African hedgehog.

3.7.2.4 Herpetofauna specific analysis

These habitats generally have low densities of herpetofauna but provide excellent refugia and forage potential for snake species that prey on rodents, such as mole snakes. Indeed, the density of rodent burrows were remarkably high and two snakes were observed within a short space of time in this habitat (*Hemachatus haemachatus* and *Psammophylax rhombeatus*). The rocky outcrops were sparsely distributed and barely protruded from the ground. This habitat is not as important for herpetofauna as the aquatic habitats (watercourse and wetland pan habitats) but nevertheless represents a habitat of moderate overall sensitivity, especially when considering the limited patches of good quality grassland remaining in the region and their fragmented nature.

3.7.3 Watercourses

3.7.3.1 Flora specific analysis

The Watercourse consists of the non-perennial river Leeufonteinspruit which bisects the western block of the mining right application (Figure 3-7). Typical aquatic plants such as *Typha capensis* and *Cyperus* spp. are located in the watercourse, while the embankments are dominated by a grassland layer comprising species such as *and Cynodon dactylon, Imperata cylindrica* and *Themeda triandra* with the predominant alien *Datura ferox*. It should be noted that a comprehensive list of species could not be provided as the survey took place in the dry season when flowering conditions were not optimal.

3.7.3.2 Avifauna specific analysis

Depending on their surface area and available forage, the watercourse habitats often provide corridors and foraging habitat for wader and waterfowl species belonging to the Anatidae (ducks & geese), Podicipedidae (grebes), Ardeidae (herons), Phalacrocoracidae (cormorants), Threskiornithidae (ibises & spoonbills), Anhingidae (Darters) and lastly Palaearctic migrant waders (Scolopacidae). Red-chested Flufftail (*Sarothrura rufa*), the Near Threatened Half Collard Kingfisher (*Alcedo semitorquata)* and the Endangered Marsh Harrier (*Circus ranivorus*) are expected within this habitat type. The Watercourse habitat type includes the actual waterway as well as associated (reeds or moist grasslands) riparian vegetation. The associated vegetation is very diverse and structurally complex providing excellent forage and refugia habitat for a large diversity and density of avifaunal species, including nesting habitat for Passerines and piscivorous species such as kingfishers and darters.

3.7.3.3 Mammal specific analysis

Although the actual waterway habitats are very specific (excluding all species other than aquatic or semi-aquatic species), the associated riparian vegetation is very diverse and complex providing excellent forage and refugia habitat for mammal species. Recorded and predicted mammals for the watercourse habitat include: spotted-neck otter (transient), African clawless otter, serval, black-backed jackal, slender mongoose, porcupine, African wild cat, common duiker, bushpig, warthog, Highveld golden mole, forest shrew, musk shrews, dwarf shrews, water rat and multiple rodent species. The expected mammal diversity is expected to be high. However, due to the extensive burning and sub-optimal seasonality, it is currently not possible to determine the likelihood of occurrence until after the completion of the supplementary wet season survey.

3.7.3.4 Herpetofauna specific analysis

As with the other faunal groups, this habitat provides structural complexity and potential breeding/foraging habitat for a diverse assemblage of herpetofauna species and requires more detailed assessment prior to construction, after significant rainfall has occurred to initiate breeding activities. Furthermore, the linear nature of this habitat and its associated riparian vegetation provides important ecological corridors in the landscape and connects many different adjoining habitat types, an important aspect for the dispersal and migration of herpetofauna, which are generally poor dispersers. High densities of amphibian species (none of conservation concern) are expected along the shallow shores of the watercourse. This abundant and predictable food source attracts many predators (snakes, birds, mammals, fish) that rely heavily on this food source while the adjacent dense vegetation provides ample refugia potential. River frogs (*Amietia sp.*), Platannas (*Xenopus laevis*) and toads (*Sclerophrys sp.*) are expected to be the most abundant amphibians with Water Monitors (*Varanus niloticus*), Rinkhals (*Hemachatus haemachatus*), Herald snakes (*Crotaphopeltis hotamboeia*) and Brown water snakes (*Lycodonomorphus rufulus*) expected to be the most common reptilian predators, which in turn are important prey for mammals and bird species.

3.7.4 Water-bodies

3.7.4.1 Flora specific analysis

Several artificial dams were identified within the PAOI along the Leeufonteinspruit. These waterbodies have been subjected to

various edge effects from the surrounding environment, including heavy trampling by cattle and the presence of alien species such as *Bidens pilosa, Datura ferox* and *Verbena brasiliensis.* The ecological integrity of most of these water bodies is in an acceptable condition as species such as *Imperata cylindrica* and *Themeda triandra* create favourable shoreline habitat for grass owls (*Tyto capensis*) and other small mammals, reptiles and birds (Figure 3-8). It should be noted that a comprehensive list of flora species could not be provided as the survey took place in the dry season when flowering conditions were not optimal.

3.7.4.2 Avifauna specific analysis

Wetlands and pans occur naturally and represent one of the more sensitive avifaunal habitats located within the PAOI. The diversity and density of avifauna within these habitats are extremely high due to the obvious forage and breeding potential as well as the structural complexity of the habitat (water associated trees, water, moist grassland, reeds etc.). Depending on their surface area and available forage, the habitats often provide foraging habitat for wader and waterfowl species belonging to the Alcedinidae (kingfishers), Anatidae (ducks & geese), Podicipedidae (grebes), Ardeidae (herons), Phalacrocoracidae (cormorants), Threskiornithidae (ibises & spoonbills), Anhingidae (Darters) and lastly Palaearctic migrant waders (Scolopacidae). The Endangered African Marsh Harrier and the African Grass Owl are predicted to occur within this habitat type while the Near Threatened Pallid Harrier (*Circus macrourus*) was observed. The supplementary wet season assessment will inform the level to which pans and wetlands with adequate coverage of tall reed beds or *Imperata cylindrical* may provide refuge, foraging habitat or breeding habitat for SCC.

3.7.4.3 Mammal specific analysis

Refer to watercourses (3.7.3.3).

3.7.4.4 Herpetofauna specific analysis

The majority of the water-bodies are artificial dams, of which the smaller ones are ephemeral (they dry out for a large portion of the year) and therefore may provide breeding habitat for the Giant Bullfrog. However, the larger dams along the Leeufonteinspruit have permanent water and are likely to have fish which would make them unsuitable breeding habitat for the Giant Bullfrog. This aspect alone raises the sensitivity of this habitat type to Very High as Giant Bullfrog are considered to be "Near Threatened" (Du Preez & Carruthers, 2017) but will likely undergo an escalation in conservation status soon as cryptic diversity within this species (revealed through genetic studies) will result in the splitting of *Pyxicephalus adspersus* into up to five new species, each with a much reduced geographical distribution range (Du Preez, pers comm.). Therefore, it is strongly advised that the precautionary approach is followed and that this species should be considered as a SCC. Furthermore, many other amphibian species preferentially breed in lentic (still) water systems such as pans and this seasonally reliable source of food for predators is of great importance.

3.7.5 Agriculture areas

3.7.5.1 Flora specific analysis

Agricultural crop production is the main land use within the PAOI, and consists mostly of maize crops. Several alien species and weeds such as *Bidens bipinnata, Conyza* spp., *Datura stramonium* and *Verbena brasiliensis* are present in this habitat type due to ongoing agricultural practices.

3.7.5.2 Avifauna specific analysis

This habitat type is widely distributed on the region and generally shows a low diversity (albeit high density) of bird species due to the monospecific nature of the basal layer. However, the tall structure (e.g. of maize fields) should allow for good foraging potential for terrestrial species (e.g. Blue Korhaan, Secretary bird and Francolins) as well as smaller Larks and Cisticola.

3.7.5.3 Mammal specific analysis

In many old agricultural land areas livestock and planted grasslands will be the prevailing landuse on previously disturbed areas in order to maximise the productivity potential of the land. Monospecific basal or vegetative layers serve to reduce overall habitat quality and foraging potential greatly. The soft substrate within the PAOI is however highly optimal for fossorial or burrowing species such as mole rats, mongooses, golden moles, Suids (pig species) and porcupines.

3.7.5.4 Herpetofauna specific analysis

Fallow and in-use agricultural fields provide limited habitat for herpetofauna as the majority of naturally occurring refugia (rocks, dense grass tufts) are removed. However, the soft substrate and food potential attracts rodents and therefore snake predators, especially Mole snakes (*Pseudaspis cana*) and Brown House Snakes (*Boaedon capensis*), which in turn attract avian predators. Consequently, a limited/reduced ecosystem is expected. Because the agricultural fields surround the potential breeding habitat of Giant Bullfrogs (wetland pans), many frogs migrate through and forage in these fields also.

3.7.6 Peripheral habitats (Alien Trees/Infrastructure/Mines)

The deserted infrastructure habitat within the PAOI may serve to act as either refugia and foraging habitat for some predatory avifauna (specifically owls), some mammal species (mostly small mammals) and certain herpetofauna (synanthropic skinks and geckos); or as a "roost" habitat for raptors (including Red-Listed species).

The existing mine is adjacent to the PAOI (to the Southwest; Figure 3-7) and therefore was not assessed in terms of terrestrial ecology.

Clumps of various alien tress including *Acacia mearnsii*, *Eucalyptus* and *Pinus* were present in the habitat.

3.8 OBSERVED AND EXPECTED FAUNA

3.8.1 Avifauna

The PAOI is surrounded by the 2605_2925, 2605_2930, 2610_2925 and 2610_2930 pentads (Figure 3-10). The avifauna species list derived from SABAP2 records is presented in Appendix 3: Expected Avifauna species list. A photographic collage of some observed species is shown in Figure 3-11.

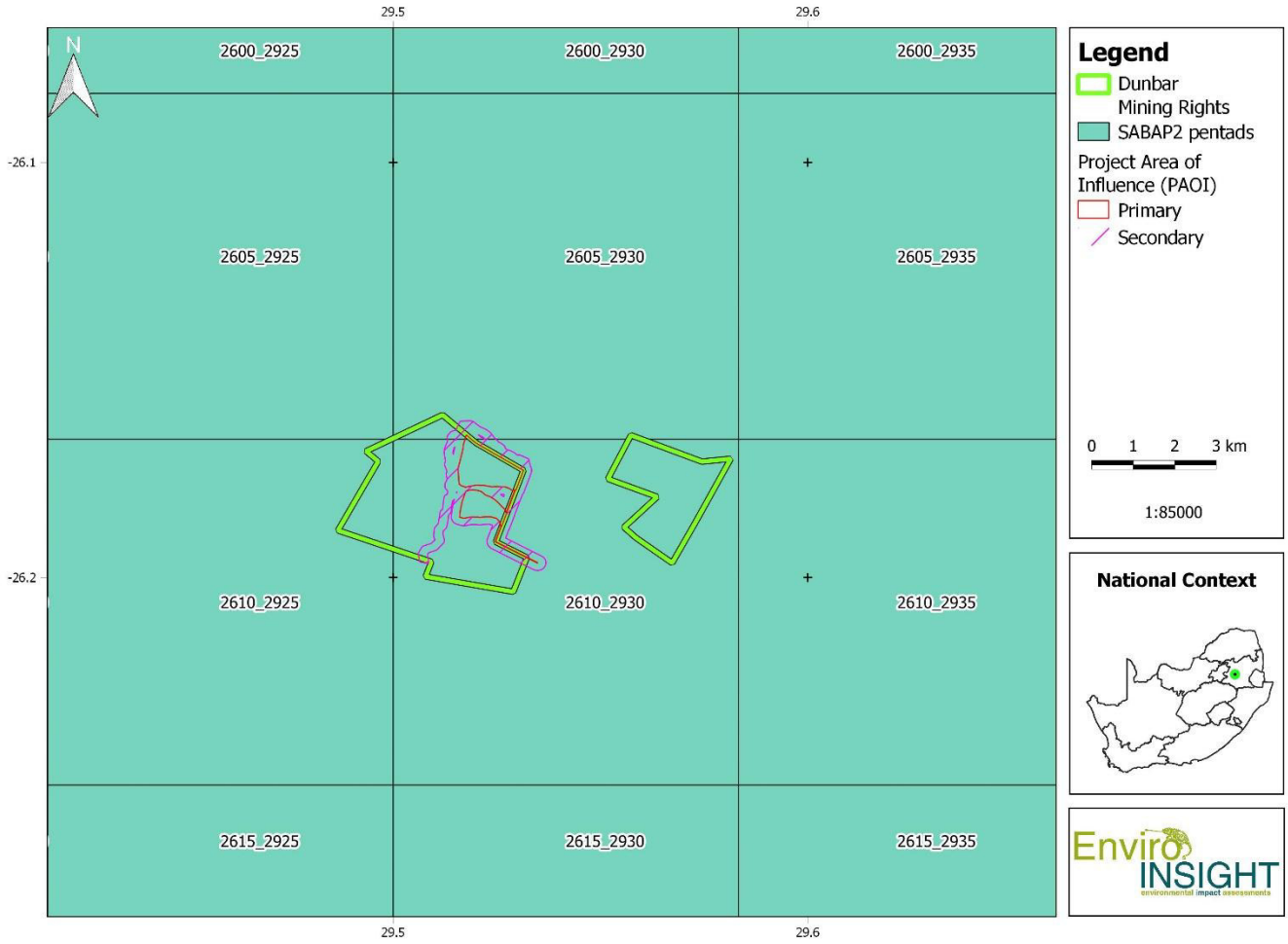


Figure 3-10: The MR areas and PAOI in relation to the SABAP2 pentads.

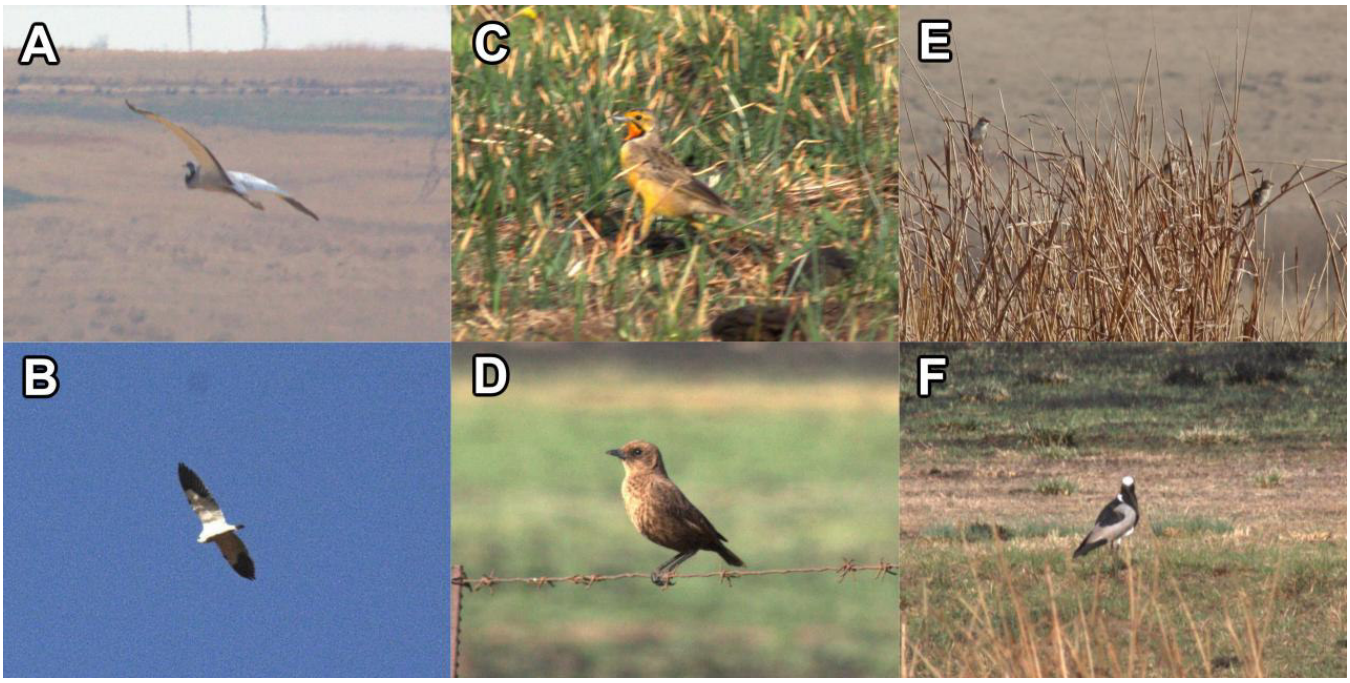


Figure 3-11: Photographic collage of some bird species recorded during the dry season survey[12].

3.8.2 Mammals

The PAOI resides on the 2629BA and is adjacent to 2629AB QDGC. These QDGCs along with adjacent cells were considered to represent similar habitats and therefore the predicted species list was derived from observation records from these QDGCs.

The mammal species list derived from records collected for the QDGCs is presented in Appendix 4: Expected Mammal species list.. Seven SCC are either confirmed or strongly expected to occur within the PAOI and are discussed in detail in section3.10 Faunal SCC.

Opportunistic diurnal sightings did not reveal many species due to the lack of available foraging or breeding habitat due to the extensive localised burning and the suboptimal seasonality of the assessment. Road kill potentially provides an alternative source of data but did not provide additional information during the dry season survey period either. However, within a road drainage area within 3 km of the PAOI, evidence of a leopard kill (porcupine) was recorded showing evidence of typical Highveld predator behaviour which implies periodic foraging by apex carnivores.

Given the fact that the vast majority of the surface area of the PAOI is dominated by agricultural activity, the number of mammal species observed and expected is low. The system within the PAOI is not conducive to a high mammal diversity, with the exception of the watercourse and wetland habitats on the periphery, combined with moist and primary grasslands. All SCC discussed in detail are assumed to be present on site (Precautionary Principle), with appropriate mitigation measures applied.

A) Black-headed Heron (*Ardea melanocephala*); B) Pallid Harrier (*Circus macrourus*); C) Cape Longclaw (*Macronyx capensis*); D) Female Ant-eating Chat (*Myrmecocichla formicivora*); E) Red-billed Quelea (*Quelea quelea*); F) Blacksmith Lapwing (*Vanellus armatus*).

3.8.3 Herpetofauna

The PAOI resides on the 2629BA quarter degree grid cell (QDGC), and is adjacent to 2629AB. These QDGCs along with eight adjacent cells (2529CD, 2529DC, 2529DD, 2629BB, 2629BD, 2629BC, 2629AD, 2629AA) were considered to represent similar habitats and therefore the predicted species list was derived from observation records from these ten QDGC's (Figure 3-12). Expected species lists derived in this manner may therefore represent an overestimation of the diversity expected as very specific habitat types may be required by a species which may be present in a QDGC but not necessarily on the study site within the QDGC. Conversely, many large areas in South Africa are poorly sampled for herpetofauna and expected species lists derived from a single QDGC may therefore underestimate the species diversity. Drawing expected species from surrounding QDGC's therefore increases the likelihood of obtaining a species list that suffers less from poor sampling in the area but it also artificially inflates the expected number of species because many different habitats in the surrounding QDGCs may not be present on the study site. To counteract this, all possible attempts were made to refine the expected species list based on species-specific habitat requirements and a good understanding of the habitat types and quality of the study site. Species that are unlikely to occur on the study site but that do occur in the surrounding QDGCs were kept in the expected species list but struck through and species with a high probability of occurrence on the study site were added to the list even if ReptileMAP and FrogMAP did not have a record for the selected QDGCs.

The herpetofauna species list derived from records collected for the ten QDGCs is presented in Appendix 5: Expected Herpetofauna species list. A total of 42 reptile and 20 amphibian species are expected to occur within the PAOI, representing relatively low herpetofauna diversity characteristic of the Highveld grassland habitats. Six reptile species were confirmed (4 snakes, 2 lizards; Figure 3-13) and no amphibians were observed during the dry season. One SCC could be expected to occur within the PAOI, namely the Giant Bull Frog (*Pyxicephalus adspersus*; Near Threatened). This species is discussed in detail in section 3.10: Faunal .

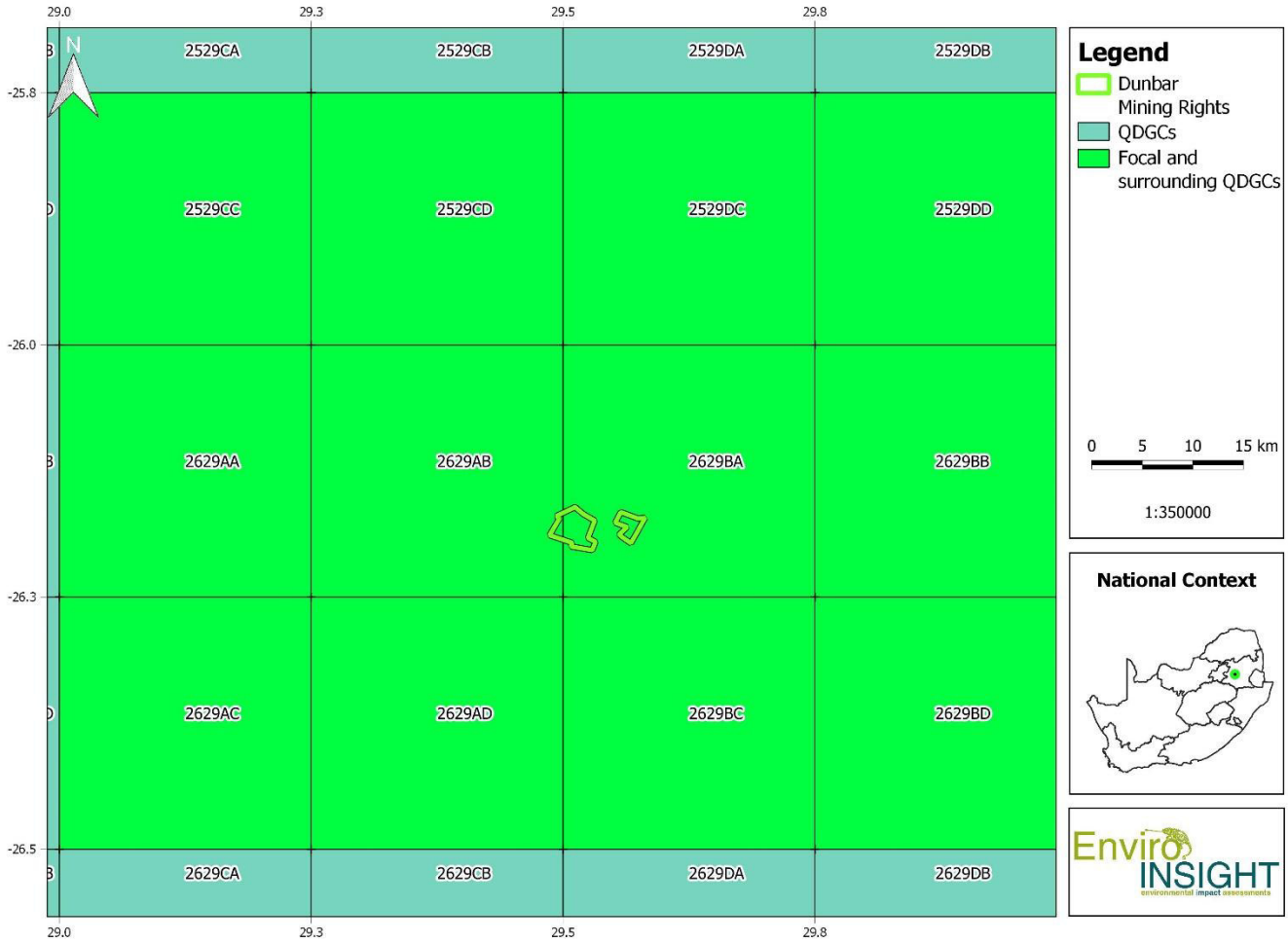


Figure 3-12: The MR areas and PAOI in relation to the quarter degree grid cells (QDGCs).

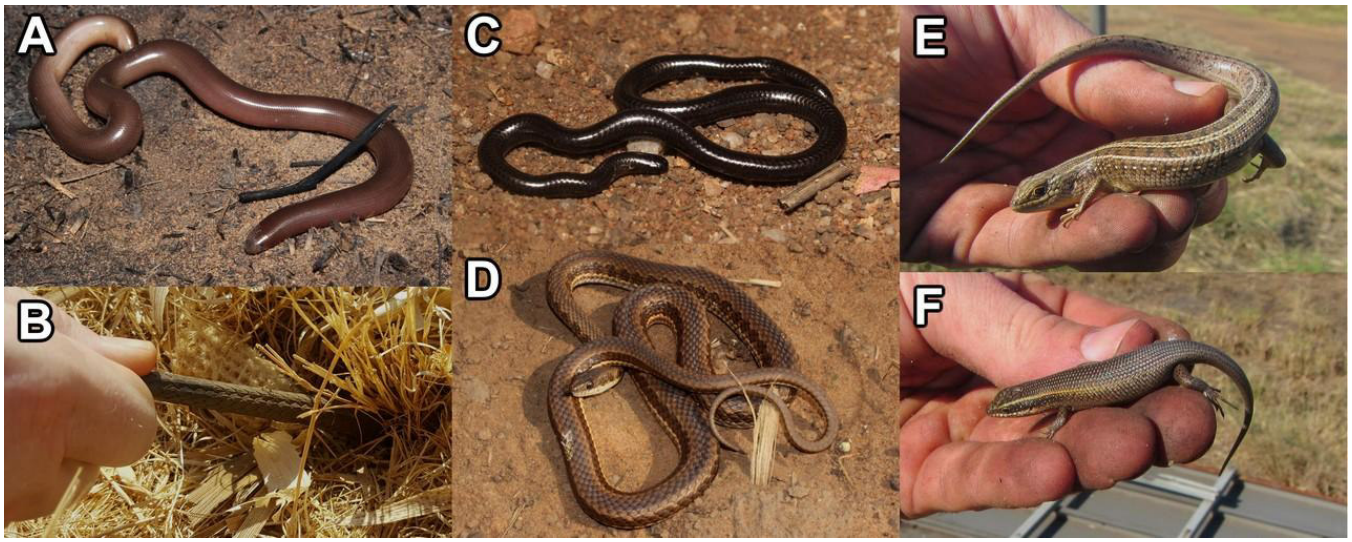


Figure 3-13: Photographic collage of the herpetofauna observed during the site surveys[13].

3.9 FLORAL SCC

No Flora SCC were recorded within the PAOI. A list of potential Flora SCC are indicated in Table 3-5 below. The presence of these species will be confirmed during the wet season survey.

Table 3-5: Potential Red and Orange Listed plant species

Species	Conservation Status	Habitat Description	Present on site
Aspidoglossum xanthosphaerum	Vulnerable - decline in habitat due to agriculture and trampling from livestock	Montane grassland and marshy sites at around 1800 m. (Flowering period: January-April)	Not recorded yet - Will be confirmed during the wet season survey
Gladiolus paludosus	Vulnerable - loss of habitat in Mpumalanga due to Agriculture and expansion of mines	Occurring in marsh and vlei habitats (Flowering period-October-November)	Not recorded yet - Will be confirmed during the wet season survey
Gladiolus robertsoniae	Near Threatened – Habitat degradation as a result of mining and overgrazing by livestock	Moist highveld grasslands, found in wet, rocky sites, mostly dolerite outcrops, wedged in rock crevices (Flowering period:October-November)	Not recorded yet - Will be confirmed during the wet season survey
Khadia carolinensis	Vulnerable - Threatened by current and future open cast mining in the distribution range	Well-drained, sandy loam soils among rocky quartzitic outcrops, or at the edges of sandstone sheets, Highveld Grassland, 1700 m. (Flowering period: October-March)	Not recorded yet - Will be confirmed during the wet season survey

[13] A: *Afrotyphlops bibronii*; B: *Hemachatus haemachatus*; C: *Leptotyphlops conjunctus*; D: *Psammophylax rhombeatus*; E: *Trachylepis capensis*; F: *Trachylepis punctatissima*

Kniphofia typhoides	Near Threatened – extensive declining due to habitat loss to coal mining, overgrazing by cattle, urban expansion and crop cultivation	Low-lying wetlands and seasonally wet areas in climax Themeda triandra grasslands on heavy black clay soils, tends to disappear from degraded grasslands. (Flowering period: February - March)	Not recorded yet - Will be confirmed during the wet season survey
Nerine gracillis	Vulnerable - currently threatened by ongoing degradation and habitat loss due to overgrazing and urban development.	Undulating grasslands in damp, moist areas; the plants grow in full sun in damp depressions, near pans or on the edges of streams; grassland, riverbanks, vleis. (Flowering period: February - March)	Not recorded yet - Will be confirmed during the wet season survey

3.10 FAUNAL SCC

3.10.1 Avifauna

A list of avifauna SCC previously recorded in the pentads surrounding the PAOI is provided in Table 3-6. A total of nine SCC could occur on site, of which four are listed as nationally Near-Threatened and two species as nationally Vulnerable. Specific species are discussed in below.

Table 3-6: Avifauna SCC previously recorded in the PAOI pentads

Species	Common Name	Global Conservation Status*	National Conservation Status**	Average SABAP2 Reporting rate (n cards)	Preferred Habitat	Potential Likelihood of Occurrence on PAOI
Circus macrourus	Pallid Harrier	Near Threatened	Near Threatened	5.13%	Prefers dry to damp grasslands associated with open pans or floodplains.	Confirmed over grassland / agriculture fields.
Eupodotis caerulescens	Blue Korhaan (Bustard)	Near Threatened	Near Threatened	66.67%	Prefers extensive open short grassland and cultivated land.	A common foraging visitor to PAOI.
Geocolaptes olivaceus	Ground Woodpecker	Near Threatened	-	9.09 – 16.67%	Rocky slopes. Preferably very steep. Sometimes along water courses but rock imperative.	Unlikely to occur.

Glareola nordmanni	Black-winged Pratincole	Near Threatened	-	9.09%	Black-winged pratincoles are wetland migrants that may nest alongside non-perennial watercourses.	Unlikely to occur although may form nesting colonies from year to year.
Oxyura maccoa	Maccoa Duck	Near Threatened	Near Threatened	28.57%	Large saline pans and shallow impoundments.	Likely to occur within farm dams within the PAOI.
Phoenicopterus minor	Lesser Flamingo	Near Threatened	Near Threatened	33.33%	Open, eutrophic, shallow saline and alkaline wetlands.	Unlikely to occur.
Phoenicopterus ruber	Greater Flamingo	-	Near Threatened	21.70%	Restricted to large saline pans and other inland water bodies.	Unlikely to occur.
Sagittarius serpentarius	Secretarybird	Vulnerable	Vulnerable	38.67%	Prefers open grassland or lightly wooded habitat.	Regular to uncommon foraging visitor
Tyto capensis	African Grass-owl	-	Vulnerable	12.50 – 21.57%	Prefers rank moist grassland that borders drainage lines or wetlands.	Regular to Uncommon resident. Historical resident prior to the introduction of cattle/livestock. Likely present in areas where *Imperata* grass is present.

3.10.1.1 Pallid Harrier (*Circus macrourus*) Near-Threatened

The Pallid Harrier is a migratory raptor that will readily forage within the PAOI but is not considered dependent on the local habitats and at best, will be a temporary visitor. It does not represent a fatal flaw.

3.10.1.2 Maccoa Duck (*Oxyura maccoa*) Near-Threatened

The species is a permanent resident within the suitable dams within the area of influence of the study area, albeit in very small numbers. The species is in decline due to water pollution and loss of habitat, which is axiomatic to Highveld grasslands influenced by agriculture and mining. The species is not expected to occupy habitats immediately within the PAOI but will occur in adjacent suitable farm dams.

3.10.1.3 Secretarybird (*Sagittarius serpentarius*) Vulnerable

This species is often observed in open areas, including cultivated and old agricultural lands and has been frequently recorded by the specialist in areas surrounding the PAOI, albeit when conducting different surveys.

3.10.1.4 African Grass-owl (*Tyto capensis*) Vulnerable

The African Grass-owl is categorised as Vulnerable with the southern African population numbering less than 5 000 individuals. Suitable grass-owl habitat was searched for and was found within the PAOI. The presence of dense, tall *Imperata cylindrica* grassland is a requirement of this species and if the mine operations exclude the presence of cattle (and recolonisation takes place), this species may find sanctuary in the Grassland habitats. However, the extant of the suitability cannot be assessed until after the commencement of the November rains when regrowth of the burnt *Imperata* stands will occur. A more comprehensive analysis regarding impacts on this species will take place once the supplementary wet season study is complete.

3.10.2 Mammals

3.10.2.1 South African Hedgehog (*Atelerix frontalis*) Near-Threatened

Although hedgehogs were not recorded during the dry season survey, the species has been recorded by the specialist in nearby areas adjacent to the PAOI. Hedgehogs are listed as Near-Threatened and although the species is common in urban environments and is affected by development, it is also found on rural grasslands of varying degrees of quality, especially in the absence of dogs and other feral predators. With a loss of grassland habitat, it is likely that local hedgehog populations will be displaced or eradicated. The best course of action will be to mitigate against roadkills, to which this species is very susceptible as well as to allow for worker induction, which will report hedgehog presence and allow individuals to be safely relocated to more undisturbed areas (see mitigations).

3.10.2.2 Water Rat (*Dasymys incomtus*) Near-Threatened

This species may occur within the riparian zones but this was not confirmed during the dry season survey and must be confirmed by the specialist during the wet season supplementary survey. The species is not considered to be a fatal flaw given adequate avoidance and mitigation (especially of wetland environments).

3.10.2.3 Serval (*Leptailurus serval*) Near-Threatened

This meso-predator cat species has frequently been recorded by the specialist in nearby areas adjacent to the PAOI and the species has been confirmed through identifiable scats, defecated in the small unburnt patches of grassland. It is anticipated that a significant resident population persists within the PAOI, given the predicated high density of rodents and the suitable habitat. The species is a relatively common wetland associate in grassland areas and although the Near-Threatened status warrants due consideration, the species is not considered to be a fatal flaw given adequate avoidance and mitigation (especially of wetland environments).

3.10.2.4 Honey Badger (*Mellivora capensis*) TOPS Protected

Honey badgers will most likely persist on a permanent basis (based upon previous studies in the region by the specialist). The species is often associated with bushveld and primary grassland habitats although it is often subject to snaring and persecution due to its penchant for raiding commercial honey farms and chicken breeding facilities. The potential presence of honey badgers within the PAOI should be considered as a healthy ecological indicator. The NEMBA/TOPS protection does not represent a fatal flaw.

3.10.2.5 African Leopard (*Panthera pardus*) Vulnerable

Leopards will most likely not persist on a permanent basis (based upon previous studies in the region by the specialist) but will frequently utilise the PAOI as a foraging resource. The species is often associated with bushveld and primary grassland habitats although it is often subject to snaring and persecution due to its penchant for livestock killings. Although the species has been confirmed near the PAOI (during the survey period) and is listed as Vulnerable, it's extremely large home range size and propensity for avoiding areas of excessive disturbance preclude it from being considered as a fatal flaw.

3.10.2.6 Brown Hyaena (*Parahyaena brunnea*) Near-Threatened

Brown Hyaena is an essential component of the ecosystem and act as important scavengers in the region, clearing carcases that can potentially spread diseases to wild mammal populations. This species may use maize fields in the PAOI as migratory corridors however this is currently speculative. Although the species was confirmed through scats within the PAOI, it is unlikely to be resident.

3.10.2.7 Cape fox (*Vulpes chama*) TOPS Protected

Although this species is TOPS protected, its presence within the study is not considered to be of great concern due to the penchant for the species to colonise areas in association with humans.

3.10.2.8 African Clawless Otter (*Aonyx* capensis) and Spotted-Necked Otter (*Hydrictis maculicollis*) Near-Threatened

It was apparent that some potentially suitable migratory/dispersal habitat persists within the PAOI; especially within the watercourse habitat. However, most of the PAOI is sub-optimal for spotted-neck otters which prefer deep, clear pools which support large populations of fish. During the dry season survey, conditions within the PAOI were highly sub-optimal due to lack of water but the habitat may become far more conducive to supporting both species after the commencement of wet season rains. The areas of potential otter habitat are currently being highly affected by unrestrained cattle grazing which may cause temporary sedimentation, all but (locally) eliminating previously optimal spotted neck-otter habitat due to the fact that the species hunts fish by sight in clear deep pools. The conclusion for the spotted-neck otter (which the likelihood of occurrence is considered to be almost definite but transitory in all the relevant PAOI habitats exhibiting flowing water) requires mitigation measures through buffering of all flowing water courses from the development infrastructure and buffering of heavy cattle grazing in water courses. The Near-Threatened status of the spotted-necked otter does not warrant fatal flaw allocation. Concerning the African clawless otter, the species is much more terrestrial and the watercourse habitat is considered to be

optimal. The species was confirmed through scats within the PAOI and the same buffering mitigations apply as for the spotted-neck otter.

3.10.2.9 Highveld Golden Mole (*Amblysomus septentrionalis*) Near-Threatened

The "turned" earth of much of the PAOI is ideal for burrowing. Its Near-Threatened status is not considered as a fatal flaw and mitigation of agricultural areas is considered to be unnecessary.

3.10.3 Herpetofauna

3.10.3.1 Giant Bullfrog (*Pyxicephalus adspersus*) – Least Concern/ Near-Threatened

The Giant Bullfrog is listed by Minter *et al*. (2004) as Near-Threatened. However, the IUCN (2019) considers this species to be of Least Concern across its global distribution, but as discussed above (3.7.4.4 Herpetofauna specific analysis), this species will likely undergo an escalation in conservation status soon and must pre-emptively be considered to be of conservation importance. This species has been recorded in the QDGCs surrounding the PAOI (FrogMAP, 2019) and although the species is unlikely to breed in the dams along the Leeufonteinspruit drainage line, it may breed in the scattered smaller temporary pans and use the general area as foraging habitat or for dispersal. The proposed development can be expected to impact negatively on this species through destruction and alteration of potential foraging areas, dispersal corridors and breeding habitat and through direct mortality from excavations and particularly, vehicle traffic (e.g. road kill on haul roads). Mitigation of potential impacts will need to occur and will include appropriate education of staff for the detection and relocation of any excavated specimens, prevention of roadkills and avoidance of breeding habitats.

4 CURRENT IMPACTS

Not all current impacts require highly detailed discussion although some of the more significant impacts must receive a contextual summary, as provided below. Photographic evidence of a selection of these impacts are shown in Figure 4-1.

The current impacts observed during the field survey were:

- Alien vegetation;
- Agriculture (commercial crops);
- Cattle grazing and trampling of wetlands;
- Damming of watercourse;
- Fires;
- Fences;
- Infrastructure (farmsteads);
- Local settlement (township);
- Overhead cables;

- Roads and railways (roadkill and disturbance).

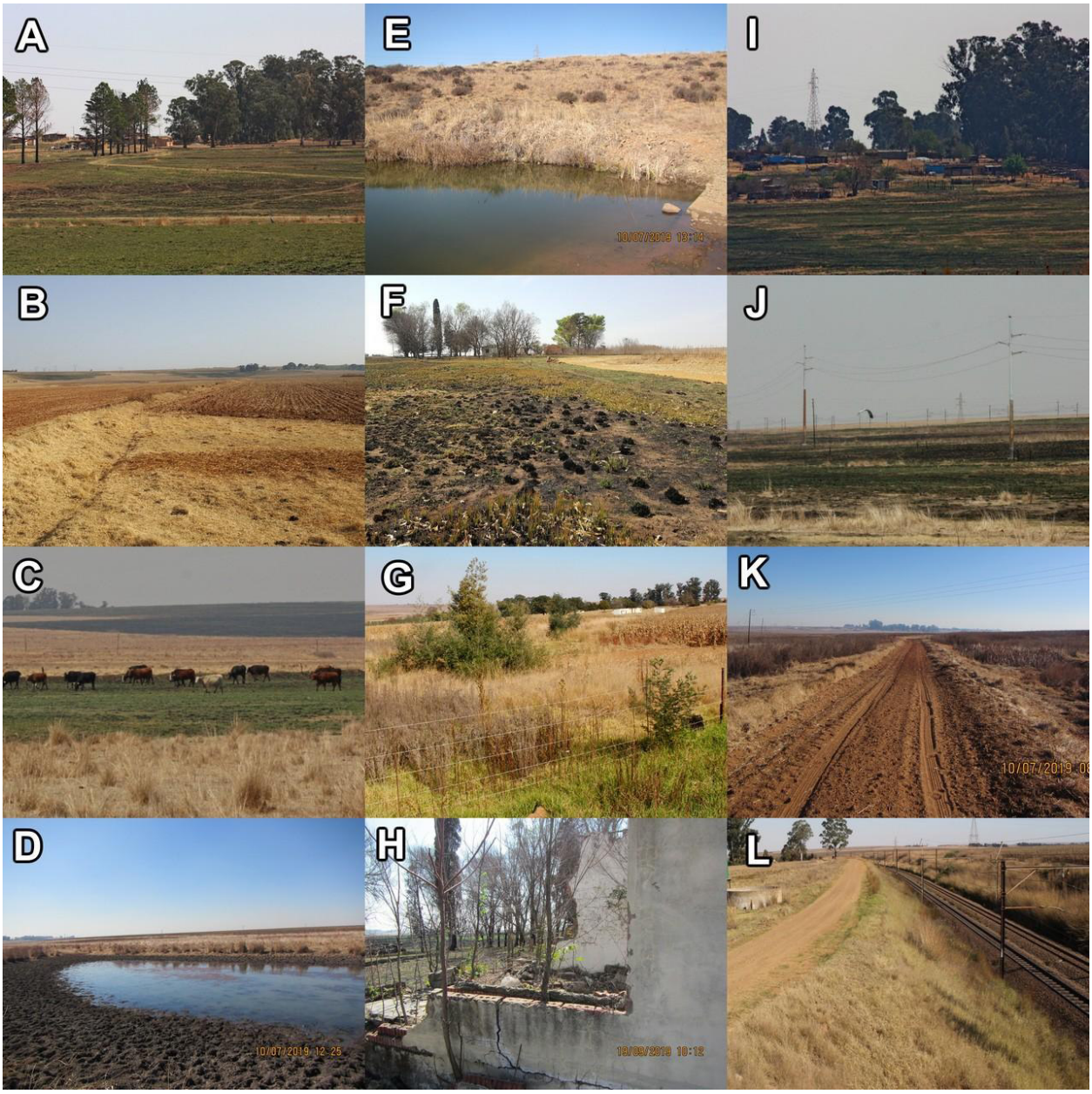


Figure 4-1: Photographic evidence of current impacts observed within the PAOI[14].

[14] A: Alien Trees; B: Agriculture; C: Cattle grazing; D: Trampled water-body by cattle; E: Damming of watercourse; F: Fire; G: Fencing; H: Infrastructure; I: Local settlement; J: Powerlines; K: Road; L: Railway

The current impacts prevailing within the PAOI are ongoing in the absence of activities related to the proposed development and should therefore be described appropriately to make sure that impacts from the proposed development can be quantified separately as well as combined for a cumulative impact analysis. The following major obvious current impacts directly affect the faunal and floral assemblages and do not necessarily include all possible current impacts found within the PAOI:

Agriculture (commercial crops)

Large-scale production of monoculture maize and soya beans is the dominant landuse type in the area. Very few natural faunal species were present in these areas, especially given that the dry survey took place post-harvest, while the ground was bare and recently furrowed. These fields isolate sections of persisting natural grassland, which require natural corridors to ensure proper ecology functioning.

Cattle grazing and trampling of wetlands

Cattle were observed grazing in the PAOI, in addition to their effects on riparian communities. The edges of water-bodies are trampled by cattle, removing the riparian vegetation that provides refuge for many water-dependent species. In addition, defecation by cattle pollute water (leading to eutrophication) and overgrazing can cause erosion, compaction and successional changes in the grassland community.

Fires

Although fire is a natural disturbance which the Highveld grassland community has evolved with, the unnatural regularity of this disturbance due to deliberate yearly burning (by farmers) and uncontrolled accidental burnings, leads to exclusion of many species from the community and ultimately a depauperate ecosystem consisting of low species diversity and abundance while favouring the proliferation of rapid colonizers such as weeds and alien invasive species.

5 HABITAT SENSITIVITY

Based on the fauna and flora observations during the fieldwork as well as the current impacts described above, ecological sensitivity of each habitat type was identified (Table 5-1; Figure 5-1). This sensitivity is rated as either very low, low, medium, high or very high where low sensitivity is considered ideal for development and high sensitivity areas are to be avoided by the development. Based on the above, mostly agricultural fields, Intact Grassland and Disturbed Grassland would be affected by the proposed mining development, due to the proposed open cast mining blocks and mine infrastructure.

Table 5-1: Taxon specific and combined habitat sensitivity for the western portion of the MR area and PAOI.

Habitat	Taxon Group	Sensitivity	Justification	Overall Sensitivity
Agriculture	Avifauna	Very Low	Unsuitable for most species	Very Low
	Flora	Very Low	None	

	Herpetofauna	Very Low	Unsuitable for most species	
	Mammals	Very Low	Unsuitable for most species	
Alien Trees & Infrastructure	Avifauna	Low	Suitable for some LC species	Low
	Flora	Very Low	Unsuitable for most species	
	Herpetofauna	Low	Suitable for some LC species	
	Mammals	Low	Suitable for some LC species	
Coal Mine	Avifauna	Very Low	Unsuitable for most species	Very Low
	Flora	Very Low	Unsuitable for most species	
	Herpetofauna	Very Low	Unsuitable for most species	
	Mammals	Very Low	Unsuitable for most species	
Disturbed Grassland	Avifauna	Moderate	Foraging SCC	Moderate
	Flora	Low	Unsuitable for some species	
	Herpetofauna	Moderate	No exclusive SCC	
	Mammals	Moderate	No exclusive SCC	
Intact Grassland	Avifauna	High	Foraging and breeding SCC	High
	Flora	Moderate	Expected SCC; Protection from soil erosion	
	Herpetofauna	Moderate	Suitable for many LC species	
	Mammals	Moderate	No exclusive SCC	
Water-bodies	Avifauna	Very High	Exclusive SCC	Very High
	Flora	Moderate	No exclusive SCC	
	Herpetofauna	Very High	Exclusive SCC	
	Mammals	Very High	Exclusive SCC	
Watercourse	Avifauna	Very High	Exclusive SCC	Very High
	Flora	Moderate	No exclusive SCC	
	Herpetofauna	High	Exclusive for many LC species	
	Mammals	Very High	Exclusive SCC	

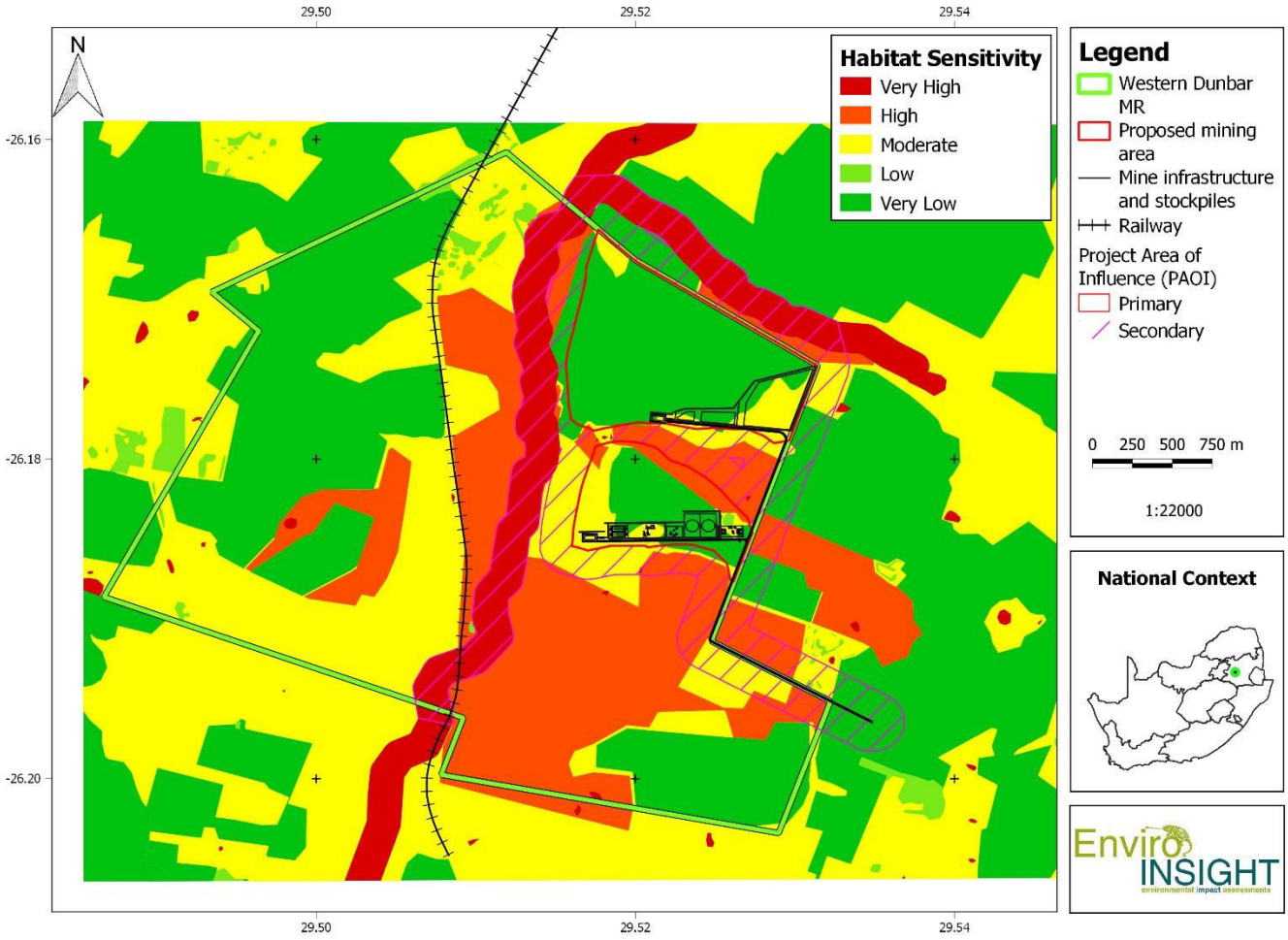


Figure 5-1: Combined habitat sensitivity for the western portion of the MR area and PAOI in relation to mine infrastructure.

6 IMPACT ASSESSMENT

6.1 LOSS OF EXISTING HABITAT DUE TO CLEARING OF VEGETATION

a. Physical removal of vegetation
   i. Digging and laying foundations for the mine processing plant, infrastructure (roads) and pits [Construction & Operation] – *direct habitat loss of grassland as vegetation and soil is removed, although the majority of the area is currently used for agriculture;*
   ii. Construction camps & laydown areas [Construction] - *these areas need to be cleared of vegetation for safe operation and therefore the available habitat for terrestrial fauna species will be reduced;* and
   iii. Stochastic events such as fire (e.g. cooking fires or cigarettes of workers) [Construction & Operation] - *careless discarding of lit cigarette butts and/or glowing embers from cooking fires being blown into surrounding vegetation may cause runaway fires to temporarily remove or alter habitat for terrestrial*

fauna.

b. Secondary impacts associated with the loss of habitat and removal of vegetation
    i. Displacement/loss of flora & fauna (including rare or endangered species and important habitats) - *the removal of habitat, in particular vegetation, will directly result in the loss of flora species, and indirectly affect fauna reliant on this vegetation for foraging and/or refugia;*
    ii. Soil erosion due to vegetation clearing and earthworks [Construction] – soil *erosion caused by wind and rain will occur on bare earth. Such erosion undermines the stability of the habitat and reduces overall habitat quality for flora and fauna, including in aquatic habitats (due to siltation);* and
    iii. Establishment of alien and invasive vegetation – *alien and invasive flora may establish in areas cleared of natural vegetation and spread from these sites, reducing available natural habitat and habitat quality for flora and fauna.*
c. Impact Assessment (Pre-mitigation) – Refer to Table 6-1.
d. Mitigation and Enhancement Measures
    i. Clearings associated with construction and development area to occur in as small a footprint as possible;
    ii. Vegetation clearing close to the watercourse should be prevented from occurring within the 100 m buffer and where necessary, appropriate storm water management should be put in place to limit erosion potential of exposed soil. Sedimentation trapping should be in place to prevent exposed soils from spilling into the watercourse;
    iii. The watercourse and its buffer areas should be demarcated and fenced off prior to construction to exclude the watercourse from development activities;
    iv. Buffer zones are allocated to sensitive or important habitat features to alleviate the effect of habitat loss, habitat fragmentation, disturbances, increased isolation and edge effects. It is suggested that at least a 100 m buffer zone from the watercourse must be implemented as a wildlife support area;
    v. A further verification for SCC should take place after significant rains have fallen and prior to any construction activities followed by an updated evaluation of habitat sensitivities;
    vi. Earthworks and vegetation clearing should be left open for as short a time as possible. Temporary erosion control measures during the construction phase should be implemented to limit erosion;
    vii. Re-vegetation (with naturally occurring flora) where required after clearance should commence immediately after the construction phase;
    viii. Re-vegetation (with naturally occurring flora) as part of the rehabilitation phase post-mining is critical to re-establish the baseline environment pre-mining conditions;
    ix. Alien vegetation control should take place during all phases of the proposed operation, including the pre-construction phase (to limit the likelihood of seed dispersal) and rehabilitation phase (post-construction); and
    x. An environmental induction for all staff members must be mandatory in which specific issues related to the potential of fire are addressed e.g. only smoking in designated areas, no open cooking fires etc.
e. Impact Assessment (Post-mitigation) – Refer to Table 6-2.
f. Residual impacts –
    i. A degree of erosion will take place during the construction phase but proper mitigation will reduce the residual impacts to acceptable levels and should not have an effect on sensitive habitats; and
    ii. The spread of alien species is likely to occur and should be continuously controlled.
    iii. Despite minimizing habitat loss an amount of habitat must be removed for the mining infrastructure during the of life of the mine; and
    iv. Disturbance of topsoil in the overburden will hamper restoration attempts after mine closure.

g. Uncertainty – The degree to which this development could impact on SCC and their habitat outside of the proposed mining infrastructure areas.

6.2 DIRECT MORTALITY OF FAUNA

- Project components that can cause direct mortality of fauna:
  i. Staff or construction workers poaching [Construction & Operational phase] - *Several fauna species could be hunted and consumed by staff to supplement their protein requirements*;
  ii. Direct mortality due to collisions with vehicles (roadkill) [Construction & Operational phase] - *Vehicles are defined as support vehicles (e.g. bakkies / pickups), staff vehicles (light passenger vehicles), large and slow moving construction vehicles (such as earth moving equipment/trucks) that will be either self-propelled or towed (construction phase). There will be increased traffic volumes during each phase of the project, and this will extend over multiple years. Reptiles, amphibians, small mammals and avifauna are prone to collisions with fast moving vehicles as they do not move out of the way upon approach by a vehicle. Furthermore, vehicle drivers rarely see small fauna on the road surface or avifauna flying across, and cannot avoid collisions with these animals while travelling at high speed;*
  iii. Intentional killing of fauna [Construction & Operation] - *In general people are either superstitious or extremely fearful of snakes which usually results in the death of the snake when it is encountered. Despite the beneficial ecological functions of snakes such as rodent control, snakes are usually considered to be dangerous (despite the many non-venomous species) and are therefore killed;*
  iv. Loss of SCC [Construction & Operation] – *If residing at the location of the mine pits or infrastructure, all individuals will either be killed or have to move away and face competition with conspecifics*; and
  v. Direct mortality due to vegetation clearing and ground preparation for construction [Construction] - *The clearing of vegetation with machinery followed by the preparation of ground surfaces for construction is expected to result in the direct mortality of fauna by mechanical action (cutting, grinding and crushing), especially for burrowing fauna.*
- Secondary impacts associated with direct mortality of fauna
  i. Changes in fauna population dynamics (e.g. rodent population explosion) – *for* example, *prolonged mortality or exclusion of predacious species such as snakes could significantly reduce the population density of these predators and allow prey species to undergo localised population explosions. This in turn can have major negative impacts on the surrounding ecology, including agricultural yields.*
- Impact Assessment (Pre-mitigation) – Refer to Table 6-1.
- Mitigation and Enhancement Measures
  i. All vehicle speeds associated with the project should be monitored and should be limited to 40 km/h (maximum) while within the site during the construction and operation phases, or as prescribed by the Traffic Impact Assessment;
  ii. Speed restriction bumps should be erected in the main road to reduce the speed of all vehicles making use of this road;
  iii. The ECO should monitor live animal observations in order to monitor trends in animal populations and thus implement proactive adaptable mitigation of vehicle movements, especially in close proximity to any wetlands;
  iv. Road mortalities should be monitored by both vehicle operators (for personal incidents only) and the ECO (all road kill on a periodic monitoring basis as well as specific incidents) with trends being monitored and subject to review as part of the monthly reporting. Monitoring should occur via a

logbook system where staff takes note of the date, time and location of the sighting/incident. This will allow determination of the locations where the greatest likelihood exists of causing road mortality and allow mitigation against it (e.g. fauna underpasses, and speed reductions mentioned above). Finally, mitigation should be adaptable to the onsite situation which may vary over time;

v. Reduce direct mortalities by allowing for fauna to cross the roads. This can be achieved by constructing fauna underpasses under the roads (large culverts or large open-ended concrete pipes laid into the raised roads). These underpasses should be used in conjunction with "fauna barriers" which prevent the most susceptible small fauna from crossing the roads on the surface by directing them towards the underpasses where they can cross under the roads safely. It is important to note that utilization of underpasses is strongly dependent on animal body size (larger culverts are more successful) and the surrounding habitat;

vi. All staff operating motor vehicles must undergo an environmental induction training course that includes instruction on the need to comply with speed limits, to respect all forms of wildlife and, wherever possible, prevent accidental road kills of fauna. Snakes should only be handled after inductions have taken place due to the risks of envenomation. Drivers not complying with speed limits should be subject to penalties;

vii. A pre-construction survey must be conducted in order to verify the presence of Secretary Bird nesting locations;

viii. All potential African Grass Owl habitat will be subjected to rope flushing and intensive nest inspections in order to determine the presence/ absence of individuals within the mine footprint and the presence of breeding activity, leading to appropriate relocation procedures for chicks only if and where appropriate; and

ix. A wet season supplementary survey is required in order to determine the presence SCC and update the species inventory for monitoring purposes. This should include a Giant bullfrog assessment, updated flora species list, camera trapping and a follow-up avifaunal census.

- Impact Assessment (Post-mitigation) – Refer to Table 6-2.
- Residual impacts
  - It is not possible to avoid all faunal deaths but proper mitigation will reduce the residual impacts to acceptable levels.
- Uncertainty – The degree to which this development could impact on avifauna SCC breeding habitat.

6.3 DISRUPTION / ALTERATION OF ECOLOGICAL LIFE CYCLES (BREEDING, MIGRATION, FEEDING) DUE TO THE RESTRICTION OF SPECIES MOVEMENT (MIGRATION/DISPERSAL)

a. Project components that can cause disruption/alteration of ecological lifecycles due to restricted movement:
   i. Open trenches and other linear barriers [Construction & Operation] – *Deep trenches dug during the construction phase for the laying of foundations/pipelines will represent dispersal barriers for certain fauna and may also trap certain species;* and
   ii. Infrastructure [Construction & Operation] – *The large development footprint will hinder fauna movement and may even trap some species in the pit (e.g. amphibians). As the infrastructure area is located close to a watercourse, aquatic species including reptiles, amphibians, mammals and birds could be affected. The open pit mine will also remove breeding and feeding habitat for numerous species, including Tyto capensis.*
b. Secondary impacts associated with disruption/alteration of ecological lifecycles
   i. Reduced population viability [Construction] – *Restriction of movement and trapping of certain animals*

prevents genetic exchange and the ability to escape to more favourable habitats, ultimately leading to a reduction in population viability.

c. Impact Assessment (Pre-mitigation) – Refer to Table 6-1.
d. Mitigation and Enhancement Measures
    i. Excavated trenches must be left open for as short a time as possible to avoid acting as dispersal barriers or traps;
    ii. All open excavated trenches for the infrastructure phase must have at least one of the slopes with an angle of less than 45° to allow for trapped fauna to crawl out;
    iii. Barriers that restrict fauna from falling into the mining pit should be erected; and
    iv. Pathways such as the Leeufonteinspruit watercourse serve as a migration corridor that ensures safe movement of species across the landscape and all activities within a 100 m buffer of this shall be prohibited;
e. Impact Assessment (Post-mitigation) – Refer to Table 6-2.
f. Residual impacts – None
g. Uncertainty – None

6.4 DISRUPTION / ALTERATION OF ECOLOGICAL LIFE CYCLES SURROUNDING MINING INFRASTRUCTURE (BREEDING, MIGRATION, FEEDING) DUE TO NOISE, DUST AND LIGHTING [CONSTRUCTION & OPERATION]

a. Project components that can result in increased noise, dust and lighting:
    i. Access roads and construction works [Construction & Operation] – *Noise, dust and lighting generated from moving vehicles operating on access roads and from machinery on site can disrupt fauna populations by interfering with their movements and/or breeding activities. In particular, lighting at night is expected to attract insects which will attract geckos and amphibians which in turn can attract snakes (which might be venomous). Lighting at night may also disrupt flight paths of migrating birds and bats foraging at night which could cause collisions;* and
    ii. Mining operations [Operation] - *Lighting at night may disrupt flight paths of migrating birds and bats foraging at night which could cause collisions. Also noise generated at night (especially from blasting) could disrupt nocturnal faunal activities, especially close to the watercourse. Fly-rock from blasting could also affect faunal species moving too close to the site, and damage the surrounding habitat where species forage or breed. In particular, dust from the actual mining operation will settle on the adjacent vegetation can reduce photosynthesis which may have indirect effects on fauna.*

b. Secondary impacts associated with disruption/alteration of ecological lifecycles
    i. Increased probability of interaction with reptiles – *As described above, snakes may be attracted to potential prey due to lights and represent a potential health and safety threat. In addition, reptiles attracted to site such as snakes could be killed by staff on site.*

c. Impact Assessment (Pre-mitigation) – Refer to Table 6-1.

d. Mitigation and Enhancement Measures
    i. Equipment with low noise emissions must be used;
    ii. A dust monitoring system should be implemented during the construction phase;
    iii. Water or dust control agents should be used in working areas and roads will be sprayed for dust suppression on a regular basis in designated susceptible areas during heavy usage;

iv. Reduce exterior lighting to that necessary for safe operation, and implement operational strategies to reduce spill light. Use down-lighting from non-UV lights where possible, as light emitted at one wavelength has a low level of attraction to insects. This will reduce the likelihood of attracting insects and their predators;
v. Keep noise levels suppressed as per the local municipality or national standards. Do not unnecessarily disturb faunal species, especially during the breeding season and those with juveniles;
vi. Where possible restrict blasting to daylight hours;
vii. Erect standard diamond mesh fences (2 -3 m high) as barriers to keep fauna species away from the mining operations to reduce impacts from blasting and habitat destruction, the fence must encompass the entire mine pit footprint as well as the Intact Grassland between the two pits, separating the watercourse from the mine activities. Where possible the fence should be separated from mining activities by up to 200 m;
viii. All staff should be subjected to an induction training program where appropriate conservation principles, safety procedures, snake bite avoidance and first aid treatment are taught. Several staff members should complete a snake handling course in order to safely remove snakes from construction areas; and
ix. Ongoing periodic avifaunal monitoring will take place at pre-determined monitoring points associated within highly sensitive habitats within the area of influence of the mine (e.g. *Imperata cylindrica* stands within 100 m of the mining operations).

e. Impact Assessment (Post-mitigation) – Refer to Table 6-2

f. Residual impacts –

- Despite mitigation reducing the severity of the impact, the long duration and high frequency of the impact will result in unavoidable residual impacts.

g. Uncertainty – The radius of the fly-rock, noise and vibration from blasting, i.e. the affected area.

6.5 INTRODUCTION AND PROLIFERATION OF ALIEN AND/OR INVASIVE FLORA AFFECTING NATIVE FLORA AND FAUNAL ASSEMBLAGES

a. Project components that can result in increased densities of alien flora:
   i. Vehicles and machinery [Construction & Operation] – *Vehicles and machinery can spread alien plant seeds throughout the PAOI which could potentially spread into the adjacent (natural) areas. Alien plants can cause alterations to the environment which could affect local flora and fauna, especially since the PAOI is located within a threatened ecosystem;*
   ii. Soil Disturbance [Construction & Operation] – *Seeds lying dormant for years could germinate when the soil is disturbed, especially since Category 1 and 2 alien invasive species occur on site; and*
   iii. Stockpiles [Construction & Operation] – *the various stockpiles could accumulate alien and/or invasive flora species over the life of mine, which could spread into the surrounding natural areas.*
b. Secondary impacts associated with increased alien flora and fauna species
   i. Displacement of native species due to competition and/or unfavourable habitats due to alien establishment.
c. Impact Assessment (Pre-mitigation) – Refer to Table 6-1.

d. Mitigation and Enhancement Measures
    i. Alien flora on site should be eradicated prior to construction including all Category 1 and 2 alien invasive species. Any remaining alien flora post-construction should be monitored and removed as part of the management plan;
    ii. Disturbance of natural areas should be avoided and the spread of alien flora into natural areas should be controlled;
    iii. Continuous monitoring of the growth and spread of alien flora coupled with an adaptive management approach to identify suitable control mechanisms, preferably mechanical for such a small area. No chemical control should take place within a 50 m buffer of the watercourse;
    iv. No planting of alien invasive species as part of landscaping. Only trees indigenous to the vegetation unit and endemic to the area may be planted, even if only for visual purposes. This should be indicated prior to development and approved by the competent authority;
    v. Stockpiles to be vegetated with suitable indigenous species to prevent erosion and establishment of alien and invasive flora; and
    vi. Rehabilitation post-mining operations should include an Alien and Invasive species monitoring and eradication action plan, in order to ensure that the spread and establishment of Alien and Invasive species are controlled and monitored (starting from the operational phase of the mine) and that disturbances post-mining are minimal and mitigated where necessary. The site needs to be restored to its previous condition/ land-use.
e. Impact Assessment (Post-mitigation) – Refer to Table 6-2.
f. Residual impacts
    - Despite mitigation the establishment of aliena and invasive species will occur continuously and must therefore also be continuously managed to attempt to limit the degree and spread of infestation.
g. Uncertainty – The types of alien species that might be dormant within the soil seed bank. The management of alien flora remains a global issue with the success of control measures highly dependent on the management strategy as well as resources available (e.g. financial and intellectual).

6.6 INCREASE IN EROSION REDUCES HABITAT QUALITY & QUANTITY

a. Project components that can cause an increase in erosion:
    i. Vegetation clearing and earthworks [Construction and Operation] –*Vegetation clearing and earthworks will lead to erosion caused by wind and rain. Such erosion undermines the stability of the habitat and reduces overall habitat quality for fauna and flora.*
    ii. Water runoff [Construction and Operation] – *Increased erosion could occur from increased water runoff due to artificial surfaces, which could cause increased sedimentation build-up within the watercourses.*
b. Secondary impacts associated with increased erosion
    i. Establishment of alien and invasive vegetation – *as alien and invasive flora establish and spread across the site (due to disturbed soils) it reduces available natural habitat and habitat quality for fauna*.
c. Impact Assessment (Pre-mitigation) – Refer to Table 6-1
d. Mitigation and Enhancement Measures
    i. Earthworks and vegetation clearing should be left open for as short a time as possible during the

construction phase. Erosion control methods during the construction phase should be implemented to limit erosion;

ii. Re-vegetation after clearance should commence directly after the construction phase; and

iii. An effective stormwater management plan with sedimentation traps implemented during the construction and operational phases of the project.

e. Impact Assessment (Post-mitigation) – Refer to Table 6-2

f. Residual impacts – A minor degree of erosion is unavoidable during the construction phase but proper mitigation will reduce the residual impacts to acceptable levels.

g. Uncertainty – The effective implementation of a stormwater management plan.

6.7 WATERCOURSE CONTAMINATION DUE TO DUST POLLUTION

a. Project components that can cause increase dust pollution of watercourses:

i. Mining operations [Operation] – *Dust spillage from trucks or cumulative siltation caused by prevailing winds, especially close to the watercourse, can cause dust to settle in watercourses, and their surrounding vegetation. This dust can cause siltation and eutrophication of the aquatic habitats and also alter the chemical composition thereof, particularly if coal dust blows into the surrounding landscape. Dust siltation could dramatically affect site suitability for avifauna and herpetofauna species utilising the watercourse as breeding and foraging habitat of this area is likely to have high species diversity and abundance.*

b. Secondary impacts associated with increased dust pollution:

ii. Mining operations [Operation] – *Dust spillage from trucks or cumulative siltation caused by prevailing winds, especially close to the watercourse, can cause habitat loss and remove the effectiveness of it as a migratory corridor.*

c. Impact Assessment (Pre-mitigation) – Refer to Table 6-1

d. Mitigation and Enhancement Measures

i. Windbreak (dust suppression) panels must be installed in order to line the entire western boundary of the mining pits to protect the Leeufonteinspruit watercourse adjacent to the project from excessive dust;

ii. Dust impacts on the watercourse must be monitored and reduced to zero; and

iii. A comprehensive monitoring program for both avifauna and amphibians must be implemented on a seasonal basis for life of mine.

e. Impact Assessment (Post-mitigation) – Refer to Table 6-2

f. Residual impacts –. It is unlikely that dust impacts can be completely negated by the mitigation measures proposed and therefore, some residual impacts can be expected from this impact. The severity of these residual impacts will require monitoring and adaptive mitigation.

g. Uncertainty – Watercourse fauna species affected (to be completed during wet season supplementary survey) and degree to which this impact can be effectively mitigated.

6.8 WATERCOURSE CONTAMINATION DUE TO HYDROCARBON POLLUTION

a. Project components that can cause hydrocarbon contamination of watercourse:
    i. *Hydrocarbon spillage from trucks and vehicles close to the watercourse can severely contaminate the associated watercourses. Serious spills (e.g. from tankers) can dramatically affect mortality rates of avifauna, mammals and herpetofauna species utilising the watercourse as breeding and foraging habitat. Standing vehicles and machinery may leak hydrocarbons which can be washed into the surrounding watercourses during rainfall events. Similarly, the spillage of hydrocarbons during the servicing of construction vehicles on site can lead to the pollution of watercourse and surrounding habitats.*

b. Secondary impacts associated with contamination of watercourse
    ii. Mining operations [Operation] – *Hydrocarbon spillage from trucks can cause habitat loss and remove the effectiveness of it as a migratory corridor; and*
    iii. *Pollution of water downstream.*

c. Impact Assessment (Pre-mitigation) – Refer to Table 6-1

d. Mitigation and Enhancement Measures
    i. Zero tolerance for hydrocarbon spillage next to the watercourse – all mining activities within 100 m of the watercourse to be prohibited;
    ii. No vehicles or machinery are allowed within the buffer areas of the watercourse. Predetermined areas should be indicated where vehicles and machinery are to be stored, repaired and refueled within a bunded area;
    iii. Use of drip trays positioned under stationary vehicles to collect hydrocarbons is mandatory at all times;
    iv. Implementation of rapid response emergency spill procedures to deal with spills immediately, including training of staff to deal with such instances; and
    v. Ongoing monitoring of presence of hydrocarbons in the watercourse should be done by an aquatic specialist as well as monitoring of the avifauna and herpetofauna assemblages within potentially affected watercourses.

e. Impact Assessment (Post-mitigation) – Refer to Table 6-2

f. Residual impacts – None

g. Uncertainty – fauna species affected (to be completed during wet season supplementary survey).

Table 6-1: The pre-mitigation impacts from the proposed development on fauna and flora.

Impact	Impacts Status	Spatial scale	Duration	Frequency	Probability	Severity	Significance value	Significance rating
Loss of existing habitat due to loss of vegetation								
Physical removal of vegetation	Negative	2	5	3	5	4	88	Medium – High
Construction camps & lay down areas	Negative	2	2	3	5	4	64	Low – Medium
Stochastic events such as fire	Negative	3	3	3	4	4	70	Low – Medium
Direct mortality of fauna								
Staff or construction workers poaching and hunting	Negative	3	4	2	3	3	50	Low
Collisions with vehicles	Negative	4	4	4	5	4	108	High
Intentional killing of fauna	Negative	3	4	3	4	3	70	Low – Medium
Vegetation and ground clearing	Negative	3	3	3	5	3	64	Low – Medium
Disruption/alteration of ecological life cycles due to the restriction of species movement (migration/dispersal)								
Open trenches and other linear barriers	Negative	1	4	4	4	4	72	Low – Medium
Infrastructure	Negative	3	4	5	3	2	72	Low – Medium
Open pit mine	Negative	3	4	5	4	4	99	Medium – High
Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and lighting								
Access roads and construction works	Negative	3	4	5	4	4	99	Medium – High
Mining operations	Negative	3	4	5	5	4	110	High
Introduction of alien flora affecting native faunal assemblages								
Vehicles and machinery	Negative	4	5	5	2	4	91	Medium – High
Soil Disturbance	Negative	2	5	3	4	4	77	Medium – High
Stockpiles	Negative	2	5	5	2	4	77	Medium – High
Increase in erosion reduces habitat quality								
Vegetation clearing and earthworks	Negative	4	3	2	4	4	66	Low – Medium
Water runoff	Negative	4	5	2	4	4	78	Medium – High
Watercourse contamination due to dust pollution								
Mining operations	Negative	4	4	5	5	5	130	Very High
Watercourse contamination due to hydrocarbon spillage								

Spillage from trucks and vehicles	Negative	4	4	5	4	4	108	High

Table 6-2: The post-mitigation impacts from the proposed development on fauna and flora.

Impact	Impacts Status	Spatial scale	Duration	Frequency	Probability	Severity	Significance value	Significance rating
Loss of existing habitat due to loss of vegetation								
Physical removal of vegetation	Negative	1	4	3	5	4	72	Low – Medium
Construction camps & lay down areas	Negative	2	2	3	5	2	48	Low
Stochastic events such as fire	Negative	2	3	2	2	2	28	Low
Direct mortality of fauna								
Staff or construction workers poaching and hunting	Negative	3	4	1	2	3	21	Very Low
Collisions with vehicles	Negative	4	4	3	2	4	60	Low – Medium
Intentional killing of fauna	Negative	3	4	2	2	3	40	Low
Vegetation and ground clearing	Negative	3	4	3	5	4	56	Low – Medium
Disruption/alteration of ecological life cycles due to the restriction of species movement (migration/dispersal)								
Open trenches and other linear barriers	Negative	1	4	2	1	1	18	Very Low
Infrastructure	Negative	2	4	5	3	2	64	Low – Medium
Open pit mine	Negative	2	4	3	2	4	50	Low
Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and lighting								
Access roads and construction works	Negative	2	4	5	4	1	63	Low – Medium
Mining operations	Negative	2	4	4	4	2	64	Low – Medium
Introduction of alien flora affecting native faunal assemblages								
Vehicles and machinery	Negative	1	4	5	2	2	49	Low
Soil Disturbance	Negative	1	4	3	2	2	35	Low
Stockpiles	Negative	1	4	5	2	2	49	Low
Increase in erosion reduces habitat quality								

Vegetation clearing and earthworks	Negative	2	3	2	2	2	28	Low
Water runoff	Negative	2	4	2	2	2	32	Low
Watercourse contamination due to dust pollution								
Mining operations	Negative	4	4	4	4	4	96	Medium – High
Watercourse contamination due to hydrocarbon spillage								
Spillage from trucks and vehicles	Negative	4	4	5	1	2	60	Low – Medium

7 CUMULATIVE IMPACTS

Cumulative impacts were assessed by combining the effects of past activities and present ongoing activities with the potential future effects of the anticipated coal mining activities. Other future activities such as the development of new mines/roads/pastures on adjacent properties were also considered where possible, although it is not possible to acquire detailed information on all planned developments within the surrounding area. Furthermore, it is not possible to simply add or subtract an impact in order to achieve a cumulative effect because of the highly complex interactions between different actions and their impacts.

Cumulative impacts from the proposed coal mining activities and existing mining, agriculture and infrastructure impacts on the local ecology are likely to result in the following exacerbation of impacts:

- Habitat loss – continued removal of natural vegetation and poor rehabilitation of mined areas leading to large-scale destruction of habitat. Many existing and planned mines occur in the region which is heavily used for agricultural practises. Habitat loss is therefore inevitable but not necessarily restricted to natural habitats as most of the proposed mining activities fall within agricultural areas. Nevertheless, the loss of these agricultural lands must be recouped elsewhere, usually undeveloped areas and therefore a knock-on effect of habitat loss is predicted;
- Water pollution – continued pollution of wetlands/streams due to runoff from mining activities (e.g. coal washing effects) and agricultural practices;
- Road mortalities – constant traffic on existing roads and the development of new roads and increased traffic load are likely to lead to greater road-related mortalities which will predominantly occur outside the actual project footprint. However, arrival and departure of mining staff on a daily basis will add to the traffic volume; and
- Dust – constant deposition of gravel and coal dust in surrounding areas leading to siltation and pollution of watercourses.

Cumulative impacts are assessed over the entire lifespan of the mining operation and are therefore not broken down into the construction, operation and decommissioning phases.

8 CONCLUSION AND PROFESSIONAL OPINION

The mine is encompassed within the Eastern Highveld Grassland which has been listed as a threatened ecosystem with a status of Vulnerable. According to the MBSP, a Critical Biodiversity Area (CBA) falls within the western portion of the mining right area, but not within the proposed mining infrastructure which is predominantly made up of 'Heavily or moderately modified' and 'Other Natural Areas'. No Protected Areas or Important Bird Areas (IBA) occur within close proximity to the mining right, with the closest IBA (The Amersfoort-Bethal-Carolina) approximately 11 km from the proposed mining infrastructure. According to the Mining and Biodiversity Guideline, although the proposed mining infrastructure falls mostly within areas of no biodiversity importance, a section of the PAOI is located in areas of Highest Biodiversity Importance and Moderate Biodiversity Importance which indicates that there is a high to moderate risk to biodiversity from mining activities.

No flora SCC have been observed within the PAOI which is predominately represented by large-scale agricultural fields (maize), Intact and Disturbed Grassland although this is subject to final assessment after sufficient rainfall, especially in relation to grassland patches and watercourses. A number of avifaunal SCC are predicted to occur with some of which will forage and possibly breed within the PAOI. However, the final assessment of the significance of the avifaunal assemblage is subject to a further assessment during the wet season supplementary survey (November). No mammal SCC (predicted or confirmed) are considered to represent a fatal flaw, although mitigations concerning road infrastructure (roadkill impacts) will have to be applied. Lastly, a single herpetofauna SCC is predicted to occur in the PAOI namely the Giant Bullfrog (*Pyxicephalus adspersus*). The Giant Bullfrog is unlikely to breed within the proposed mine layout due to the lack of temporary pans and the highly transformed nature of this area. However, it may utilise the area to forage/migrate and measures need to be taken to prevent individuals being trapped in excavations, excessive roadkill and unnecessary mortality during excavation.

Most anticipated flora and fauna impacts are low/medium to high/medium prior to implementation of mitigation measures. Following the application of mitigation measures, most impacts are reduced to low/medium or low, except for the effects of dust on watercourses. The proposed mining layout will remove agricultural land (the majority), some Intact and Disturbed Grassland (in the Northeast and Southeast) with unknown influences on adjacent grassland areas. Despite the predominantly disturbed nature of the grassland and the lack of CBA status, the area may provide foraging and nesting sites for avifaunal SCC, such as the Grass Owl and Secretary bird, which would need to be confirmed in the supplementary wet season survey. However, this is a relatively small patch of grassland and the mitigation measures provided should be sufficient to reduce impacts to acceptable levels. Nonetheless, the area should be rehabilitated to as close to its natural state as possible during the post-mining operations.

Incomplete baseline data for monitoring purposes was established, and a pre-construction survey during optimal seasonal and climatic conditions will be required as indicated above. Following such a survey, additional mitigation measures will be provided to reduce the anticipated impacts, where necessary. If additional SCC are recorded, the necessary mapping of suitable habitat

and the appropriate buffer areas will be updated. As with camera trapping, it must be stated that due to logistical limitations and security concerns, as well as adequate results stemming from the utilisation of other methods (i.e. scat analysis and Mackinnon sampling), no Sherman Traps were deployed for the study. However, ongoing Sherman trap monitoring during both the construction and monitoring phases of the project is recommended when sufficient security has been established to ensure the low likelihood of trap theft.

Conclusion: It is unlikely that any severe and lasting impacts could occur from the mine activities if proper mitigation and monitoring takes place (as outlined in this report). The biggest concern is the effect of pollution/siltation on the Leeufonteinspruit watercourse and the importance of this habitat for the regional flora and fauna. It is therefore recommended that frequent monitoring must take place within this system to prevent and mitigate potential impacts, as well as to link impacts to specific events for adaptive management.

9 REFERENCES

BATES, M.F., BRANCH, W.R., BAUER, A.M., BURGER, M., MARAIS, J., ALEXANDER, G.J. & DE VILLIERS, M.S. (Eds.). 2014. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. Suricata 1. South African National Biodiversity Institute, Pretoria, South Africa.

BROMILOW, C. 2010. Problem plants and alien weeds of South Africa. Briza Publications. Pretoria, South Africa.

CHILD, M.F., ROXBURGH, L., DO LINH SAN, E., RAIMONDO, D., DAVIES-MOSTERT, H.T. (Eds.). 2017. Red List of Mammals of South Africa, Lesotho and Swaziland. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

DEL HOYO, J., ELLIOTT, A. AND SARGATAL, J. 1992. *Handbook of the birds of the world*. Barcelona: Lynx edicions, 1992 - 2011.

Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, and South African National Biodiversity Institute. 2013. *Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector*. Pretoria. 100 pg.

DU PREEZ, L.H. & CARRUTHERS, V. 2017. *Frogs of Southern Africa: A Complete Guide*. 2nd Revised edition, Struik Nature.

FERRAR, A.A. & LÖTTER, M.C., 2007. Mpumalanga biodiversity conservation plan handbook. *Mpumalanga Tourism & Parks Agency, Nelspruit*.

FrogMAP. 2019. The Southern African Frog Atlas Project (SAFAP, now FrogMAP). http://vmus.adu.org.za/

GILL, F. & DONSKER, D. 2012. IOC world bird names (version 3.1). Website: www. worldbirdnames. org.

HOCKEY, P.A.R., DEAN, W.R.J. & RYAN, P.G. (Eds.) 2005. *Roberts – Birds of Southern Africa*, VIIth ed. The Trustees of the John Voelker Bird Book Fund, Cape Town.

IUCN. 2019. The IUCN red data list website. Available at www.iucnredlist.org (Visited July 2019).

JOHNSON, S.D. & BYTEBIER, B. 2015. *Orchids of South Africa: A Field Guide*. Struik Nature.

LIEBENBERG, L., LOUW, A. & ELBROCH, M. 2010. *Practical tracking: a guide to following footprints and finding animals*. Stackpole Books.

MACKINNON, J. & PHILLIPS, K., 1993. *A Field Guide to the Birds of Borneo, Sumatra, Java and Bali, the Greater Sunda Islands*. Oxford University Press, Oxford.

MammalMAP. 2019. Virtual Museum MammalMAP Project. University of Cape Town. http://vmus.adu.org.za.

MARNEWICK, M., RETIEF, E., THERON, N., WRIGHT, D., & ANDERSON, T. 2015. *Important Bird and Biodiversity Areas of South Africa.* Johannesburg: BirdLife South Africa.

MINTER, L.R., BURGER, M., HARRISON, J.A., BRAACK, H.H., BISHOP, P.J. & KLOEPFER, D. 2004. *Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland.* SI/MAB Series #9. Smithsonian Institution, Washington DC.

Mpumalanga Tourism and Parks Agency. MBSP Terrestrial Assessment 2014 [Vector] 2014. Available from the Biodiversity GIS website.

MUCINA, L. & RUTHERFORD, M.C. (Eds.) 2010. The vegetation of South Africa, Lesotho and Swaziland. Strelizia 19. South African National Biodiversity Institute, Pretoria

National Environmental Management: Biodiversity Act. 2004 (act 10 of 2004): Publication of lists of critically endangered, endangered, vulnerable and protected species.

QGIS Development Team, 2016. QGIS Geographic Information System. Open Source Geospatial Foundation. URL http://qgis.osgeo.org.

RAIMONDO, D., VON STADEN, L., FODEN, W., VICTOR, J.E., HELME, N.A., TURNER, R.C., KAMUNDI, D.A. & MAYAMA, P.A. (Eds). 2009. Red List of South African plants. Strelitzia 25. South African National Biodiversity Institute, Pretoria.

ReptileMAP. 2019. The Southern African Reptile Conservation Assessment (SARCA, now ReptileMAP). http://vmus.adu.org.za/

SABAP2 (South African Bird Atlas Project). Visited July 2019. http://vmus.adu.org.za/

SANBI. 2019. Botanical Database of Southern Africa (BODATSA) [dataset]. Retrieved from http://newposa.sanbi.org/

SANBI. 2018. Vegetation Map of South Africa, Lesotho and Swaziland (Shapefile) [vector geospatial dataset] 2018. Available from the Biodiversity GIS website, downloaded on 26 September 2019

SANBI. 2017. *Red List of South African Plants version 2017.1.* Retrieved from http://redlist.sanbi.org/index.php

SINCLAIR, I. & RYAN, P. 2010. *Birds of Africa South of the Sahara: a comprehensive illustrative guide.* 2nd Ed. Cape Town: Struik Publishers

SKINNER J.D. & CHIMIMBA, C.T. 2007. *The Mammals of the Southern African Subregion* (New Edition). Cambridge University Press. South Africa.

STUART, C. & STUART, T. (1998). *A Field Guide to the Tracks and Signs of Southern and East Africa.* South Africa: Southern Book Publishers.

TAYLOR, M.R., PEACOCK, F. & WANLESS, R.M., 2015. *The Eskom red data book of birds of South Africa, Lesotho and Swaziland*. BirdLife South Africa, Johannesburg.

VAN OUDTSHOORN, F. 2004. *Gids tot die grasse van Suider-Afrika*. Second Edition. Pretoria. Briza Publikasies

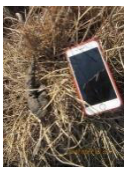
VAN WYK, B & MALAN, S. 1998. *Field guide to the wildflowers of the Highveld*. Struik Publishers, Cape Town.

VAN WYK, B & VAN WYK, P. 2013. *Field guide to trees of Southern Africa*. Cape Town. Struik Publishers

10 APPENDIX

10.1 APPENDIX 1: GEOREFERENCED PHOTOGRAPHS TAKEN DURING THE FIELDWORK SURVEY.

				
8752	8753	8754	8755	8756
				
8757	8758	8759	8760	8761
				
8762	8763	8764	8765	8766
				
8767	8768	8770	8771	8772
				
8773	8774	8775	8776	8777
				

8778	8779	8780	8781	8782
				
8783	8784	8785	8786	8788
				
8789	8790	8791	8792	8793
				
8794	8795	8796	8797	8798
				
8799	8800	8801	8802	8803
				
8804	8805	8806	8807	8808
				
8809	8810	8811	8812	8813

				
8814	8815	8816	8817	8818
				
8819	8820	8821	8822	8823
				
8824	8825	8826	8827	8828
				
8829	8830	8831	8832	8833
				
8835	8836	8837	8838	8839
				
8840	8841	8842	8843	8844

				
8845	8846	8847	8848	8849
				
8850	8851	8852	8853	8854
				
8855	8856	8857	8858	8859
				
8860	8861	8862	8863	8864
				
8865	8866	8867	8868	8869
				
8870	8871	8872	8873	8874

				
8875	8876	8877	8878	8879
				
8880	8881	8882	8883	8884
				
8885	8886	8887	8888	8889
				
8890	8891	8893	8894	8895
				
8896	8897	8898	8899	8900
				
8901	8902	8903	8904	8905

				
8906	8907	8908	8909	8911
				
8912	8913	8914	8915	8916
				
8918	8919	8920	8921	8922
				
8923	8924	8925	8926	8927
				
8928	8929	8930	8931	8932
				
8933	8934	8935	8936	8937

* Spatial location of images (identified by number) can be viewed in Figure 3-1.

10.2 APPENDIX 2: EXPECTED FLORA SPECIES LIST

Plant species recorded on the BODATSA database for the xMin, yMin 29.20°, -26.00° : xMax, yMax 30.00°,-26.40° (WGS84 datum) extent. Species of Conservation Concern are highlighted in Red.

Scientific name	IUCN Category[15]
Satyrium trinerve	LC
Dicoma sp.	
Hesperantha coccinea	LC
Haemanthus humilis	LC
Verbena rigida	
Melasma scabrum	LC
Limeum sulcatum	LC
Helichrysum caespititium	LC
Drimia elata	DD
Habenaria clavata	LC
Senecio sp.	
Pearsonia sessilifolia	LC
Haplocarpha scaposa	LC
Solanum campylacanthum	
Lasiosiphon burchellii	LC
Eriospermum cooperi	LC
Pellaea calomelanos	LC
Hibiscus aethiopicus	LC
Pelargonium luridum	LC
Raphionacme hirsuta	LC
Hyparrhenia hirta	LC
Asclepias cultriformis	LC
Thesium costatum	LC
Convolvulus sagittatus	LC
Alloteropsis semialata	LC
Aristida junciformis	LC
Salvia repens	LC
Bulbostylis densa	LC
Thesium costatum	LC
Pycreus nitidus	LC
Polygala hottentotta	LC
Satyrium longicauda	NE

[15] LC = Least Consern; NE = Not evaluated; DD = Data deficient; NT = Near Threatened

Selago densiflora	LC
Asclepias stellifera	LC
Dianthus transvaalensis	LC
Xysmalobium parviflorum	LC
Vigna unguiculata	NE
Pentanisia prunelloides	LC
Blechnum australe	LC
Crotalaria sphaerocarpa	LC
Brachiaria serrata	LC
Lasiosiphon caffer	LC
Conyza bonariensis	
Nemesia fruticans	LC
Urochloa panicoides	LC
Gerbera natalensis	LC
Schizachyrium sanguineum	LC
Eragrostis mexicana	NE
Nymphoides thunbergiana	LC
Eragrostis remotiflora	LC
Bryum dichotomum	
Cyperus schlechteri	LC
Lasiosiphon microcephalus	
Crotalaria eremicola	LC
Zornia milneana	LC
Hilliardiella hirsuta	LC
Babiana flabellifolia	LC
Orthochilus vinosus	
Pelargonium pseudofumarioides	LC
Ipomoea simplex	LC
Pseudognaphalium luteoalbum	LC
Afrosciadium magalismontanum	LC
Convolvulus arvensis	
Searsia magalismontana	LC
Cerastium capense	LC
Ziziphus zeyheriana	LC
Leobordea foliosa	LC
Brachycorythis pubescens	LC
Indigofera hilaris	LC
Eulophia sp.	
Hypoxis hemerocallidea	LC

Zornia capensis	LC
Cyperus squarrosus	LC
Indigofera hedyantha	LC
Rumex crispus	
Elionurus muticus	LC
Linum thunbergii	LC
Acalypha caperonioides	DD
Monsonia brevirostrata	LC
Searsia discolor	LC
Albuca virens	LC
Kyllinga erecta	LC
Hilliardiella aristata	LC
Limosella maior	LC
Moraea pallida	LC
Andropogon eucomus	LC
Diclis rotundifolia	LC
Gomphocarpus rivularis	LC
Oenothera tetraptera	
Striga elegans	LC
Aspidoglossum glanduliferum	LC
Aspidoglossum biflorum	LC
Ursinia cakilefolia	LC
Dipcadi viride	LC
Dolichos angustifolius	LC
Eulophia cooperi	LC
Eulophia hians	LC
Anthospermum rigidum	LC
Euphorbia striata	LC
Ursinia tenuiloba	LC
Agrostis lachnantha	LC
Cyperus marginatus	LC
Berkheya speciosa	LC
Euphorbia inaequilatera	LC
Athrixia elata	LC
Albuca baurii	LC
Moraea filicaulis	LC
Ursinia nana	LC
Melolobium wilmsii	LC
Argyrolobium harveyanum	LC

Eragrostis racemosa	LC
Aristida congesta	LC
Habenaria falcicornis	LC
Lipocarpha rehmannii	LC
Oxygonum dregeanum	NE
Pogonarthria squarrosa	LC
Polygala uncinata	LC
Blepharis innocua	LC
Polygala albida	LC
Ipomoea ommanneyi	LC
Satyrium neglectum	LC
Gladiolus sericeovillosus	LC
Riccia okahandjana	
Eriospermum porphyrovalve	LC
Cosmos bipinnatus	
Wahlenbergia undulata	LC
Solanum lichtensteinii	LC
Drimia multisetosa	LC
Gladiolus paludosus	VU
Cucumis myriocarpus	LC
Xyris capensis	LC
Mossia intervallaris	LC
Polygala krumanina	LC
Isolepis setacea	LC
Euphorbia gueinzii	LC
Harpochloa falx	LC
Juncus dregeanus	LC
Cyperus margaritaceus	LC
Ascolepis capensis	LC
Alysicarpus zeyheri	LC
Asparagus laricinus	LC
Lobelia flaccida	LC
Dryopteris athamantica	LC
Nerine rehmannii	LC
Pontederia cordata	
Gerbera ambigua	LC
Listia heterophylla	LC
Eriosema cordatum	LC
Aspidoglossum ovalifolium	LC

Eragrostis obtusa	LC
Juncus exsertus	LC
Disa woodii	LC
Merremia verecunda	LC
Leersia hexandra	LC
Senecio pentactinus	LC
Acalypha sp.	
Schizoglossum nitidum	LC
Hibiscus microcarpus	LC
Persicaria lapathifolia	
Lagarosiphon muscoides	LC
Pentanisia angustifolia	LC
Andropogon schirensis	LC
Eriosema sp.	
Rubus ludwigii	LC
Khadia carolinensis	VU
Isolepis sepulcralis	LC
Riccia atropurpurea	
Geigeria burkei	NE
Scirpoides burkei	LC
Eriosema simulans	LC
Falkia oblonga	LC
Orthochilus sp.	
Triraphis andropogonoides	LC
Agrostis continuata	LC
Melanospermum rupestre	LC
Oxalis obliquifolia	LC
Crinum bulbispermum	LC
Osteospermum scariosum	NE
Rumex lanceolatus	LC
Nidorella resedifolia	LC
Chironia purpurascens	LC
Eriosema salignum	LC
Pentanisia prunelloides	LC
Digitaria tricholaenoides	LC
Spergularia media	
Pycreus rehmannianus	LC
Gazania sp.	
Eriospermum porphyrium	LC

Pycreus macranthus	LC
Cyperus laevigatus	LC
Exormotheca holstii	
Riccia crystallina	
Helichrysum nudifolium	LC
Leobordea adpressa	LC
Kyllinga alba	LC
Miraglossum pulchellum	LC
Berkheya pinnatifida	LC
Geranium multisectum	LC
Elephantorrhiza elephantina	LC
Aponogeton junceus	LC
Berkheya zeyheri	LC
Schizocarphus nervosus	LC
Cordylogyne globosa	LC
Ajuga ophrydis	LC
Hilliardiella elaeagnoides	
Hypoxis rigidula	LC
Bulbostylis humilis	LC
Hypericum lalandii	LC
Chaenostoma neglectum	LC
Rhynchosia adenodes	LC
Helichrysum oreophilum	LC
Pityrogramma argentea	LC
Conyza podocephala	
Cyperus longus	NE
Andropogon appendiculatus	LC
Setaria nigrirostris	LC
Calamagrostis epigejos	LC
Koeleria capensis	LC
Eragrostis patentissima	LC
Lepidium transvaalense	LC
Leobordea eriantha	LC
Nidorella anomala	LC
Tolpis capensis	LC
Aspidoglossum xanthosphaerum	VU
Buchnera sp.	
Lasiosiphon kraussianus	
Alepidea peduncularis	DD

Justicia anagalloides	LC
Trachypogon spicatus	LC
Hypoxis multiceps	LC
Vigna oblongifolia	LC
Setaria pumila	LC
Sopubia cana	LC
Helichrysum aureonitens	LC
Salvia runcinata	LC
Limosella sp.	
Dipcadi marlothii	LC
Datura stramonium	
Polygala gracilenta	LC
Cyperus rupestris	LC
Polygala transvaalensis	LC
Senecio laevigatus	LC
Valeriana capensis	LC
Argyrolobium speciosum	LC
Kniphofia porphyrantha	LC
Syncolostemon pretoriae	LC
Schistostephium crataegifolium	LC
Acalypha wilmsii	LC
Riccia cavernosa	
Digitaria eriantha	LC
Myosotis graminifolia	LC
Drosera burkeana	LC
Asparagus virgatus	LC
Cyanotis speciosa	LC
Blepharis stainbankiae	LC
Tragus racemosus	LC
Pycreus chrysanthus	LC
Gladiolus dalenii	LC
Schoenoplectus corymbosus	LC
Senecio harveianus	LC
Sebaea leiostyla	LC
Anomobryum julaceum	
Wahlenbergia virgata	LC
Senecio affinis	LC
Chascanum sp.	
Exochaenium grande	LC

Limosella longiflora	LC
Erucastrum austroafricanum	LC
Gnaphalium filagopsis	LC
Rorippa fluviatilis	LC
Helichrysum rugulosum	LC
Eulophia ovalis	LC
Gladiolus robertsoniae	NT
Riccia rosea	
Agrostis eriantha	LC
Lotus discolor	LC
Senecio othonniflorus	LC
Cymbopogon caesius	LC
Commelina africana	LC
Selago sp.	
Satyrium hallackii	LC
Utricularia prehensilis	LC
Fimbristylis complanata	LC
Cyperus rigidifolius	LC
Eleocharis limosa	LC
Eragrostis chloromelas	LC
Gomphrena celosioides	
Senecio bupleuroides	LC
Bryum cellulare	
Empodium elongatum	LC
Pavonia columella	LC
Heliophila carnosa	LC
Aristida canescens	LC
Alchemilla capensis	LC
Trifolium africanum	NE
Delosperma sp.	
Fingerhuthia sesleriiformis	LC
Searsia dentata	LC
Nerine angustifolia	LC
Kiggelaria africana	LC
Vigna luteola	LC
Crassula natans	LC
Indigofera frondosa	LC
Orthotrichum diaphanum	
Kyllinga pulchella	LC

Cynodon dactylon	LC
Searsia rigida	LC
Felicia filifolia	LC
Asclepias eminens	LC
Kniphofia typhoides	NT
Laurembergia repens	LC
Euryops laxus	LC
Disa aconitoides	LC
Afroaster hispidus	LC
Asclepias sp.	
Moraea elliotii	LC
Sisyranthus imberbis	LC
Pennisetum thunbergii	LC
Felicia muricata	LC
Cycnium tubulosum	LC
Cyperus congestus	LC
Nerine gracilis	VU
Pycreus pumilus	LC
Gladiolus vinosomaculatus	LC
Helichrysum cephaloideum	LC
Bryum argenteum	
Kohautia caespitosa	LC
Crotalaria sp.	
Chlorophytum fasciculatum	LC
Sporobolus albicans	LC
Dyschoriste burchellii	LC
Linderniella nana	
Tulbaghia acutiloba	LC
Lobelia sonderiana	LC
Crassula setulosa	NE
Cyperus obtusiflorus	LC
Hibiscus trionum	
Clutia sp.	
Brachystelma foetidum	LC
Paspalum urvillei	NE
Sanguisorba minor	
Melinis nerviglumis	LC
Gladiolus sericeovillosus	LC
Othonna natalensis	LC

Agrostis gigantea	
Berkheya insignis	LC
Asclepias gibba	LC
Eragrostis tef	NE
Senecio laevigatus	LC
Senecio erubescens	NE
Asclepias multicaulis	LC
Nesaea sagittifolia	LC
Harveya speciosa	LC
Eragrostis lappula	LC
Argyrolobium tuberosum	LC
Tribulus terrestris	LC
Mimulus gracilis	LC
Cynoglossum austroafricanum	LC
Eriocaulon abyssinicum	LC
Persicaria amphibia	LC
Heteropogon contortus	LC
Scabiosa columbaria	LC
Medicago laciniata	NE
Rendlia altera	LC
Zaluzianskya spathacea	LC
Carex rhodesiaca	LC
Juncus oxycarpus	LC
Hyparrhenia dregeana	LC
Commelina africana	LC
Linaria vulgaris	NE
Striga gesnerioides	LC
Cynoglossum hispidum	LC
Dolichos falciformis	LC
Eucomis autumnalis	NE
Schoenoplectus tabernaemontani	
Herniaria erckertii	LC
Gladiolus sp.	
Chlorophytum cooperi	LC
Catalepis gracilis	LC
Berkheya setifera	LC
Lipocarpha nana	LC
Ornithogalum flexuosum	LC
Paspalum dilatatum	NE

Conyza sumatrensis	
Tristachya rehmannii	LC
Hermannia cristata	LC
Schoenoplectus decipiens	LC
Aspidoglossum lamellatum	LC
Anisotoma pedunculata	LC
Ledebouria marginata	LC
Silene burchellii	
Fuirena coerulescens	LC
Schkuhria pinnata	
Guilleminea densa	
Euphorbia sp.	
Persicaria decipiens	LC
Panicum schinzii	LC
Ledebouria leptophylla	LC
Commelina africana	LC
Jamesbrittenia sp.	
Geigeria burkei	LC
Digitaria ternata	LC
Crassula capitella	LC
Melolobium alpinum	LC
Indigofera dimidiata	LC
Aristida scabrivalvis	LC
Gazania krebsiana	LC
Dierama mossii	LC
Dierama insigne	LC
Eulophia hians	LC
Silene undulata	
Ipomoea crassipes	LC
Argyrolobium transvaalense	LC
Ceratiosicyos laevis	LC
Rumex acetosella	
Cleome monophylla	LC
Polygala africana	LC
Riccia natalensis	
Monopsis decipiens	LC
Eragrostis planiculmis	LC
Aloe ecklonis	LC
Schizochilus zeyheri	LC

Chamaecrista capensis	LC
Eragrostis sclerantha	LC
Cladophascum gymnomitrioides	
Eriospermum flagelliforme	LC
Galium capense	LC
Cynodon hirsutus	LC
Isolepis costata	LC
Ledebouria cooperi	LC
Holcus lanatus	NE
Helichrysum adenocarpum	LC
Hermannia cordata	LC
Ozoroa engleri	LC
Schoenoplectus muriculatus	LC
Argyrolobium rupestre	LC
Striga bilabiata	LC
Lactuca inermis	LC
Cyperus difformis	LC
Cyperus fastigiatus	LC
Eragrostis capensis	LC
Indigofera sanguinea	LC
Rhynchosia nervosa	LC
Gladiolus elliotii	LC
Dimorphotheca caulescens	LC
Oenothera stricta	
Habenaria epipactidea	LC
Cotula anthemoides	LC
Juncus punctorius	LC
Trachyandra asperata	LC
Thesium scirpioides	LC
Portulaca oleracea	
Hypoxis argentea	LC
Sonchus asper	
Berkheya radula	LC
Cyperus esculentus	LC
Rhynchosia totta	LC
Polygala transvaalensis	
Asclepias aurea	LC
Asclepias gibba	LC
Hermannia sp.	

Sida chrysantha	LC
Sporobolus fimbriatus	LC
Eragrostis curvula	LC
Acalypha angustata	LC
Thesium asterias	LC
Helictotrichon turgidulum	LC
Delosperma sutherlandii	LC
Senecio latifolius	LC
Pseudopegolettia tenella	
Amaranthus hybridus	
Eulophia hians	LC
Euphorbia natalensis	LC
Kniphofia albescens	LC
Rhynchosia reptabunda	LC
Erythrina zeyheri	LC
Orthochilus foliosus	LC
Helichrysum nudifolium	LC
Geigeria aspera	LC
Cyperus sphaerospermus	LC
Aeschynomene rehmannii	LC
Gomphostigma virgatum	LC
Lessertia frutescens	LC
Gladiolus longicollis	LC
Gnidia fastigiata	LC
Mucuna coriacea	
Gnidia gymnostachya	LC
Hebenstretia rehmannii	LC
Trachyandra saltii	LC
Kohautia amatymbica	LC
Thunbergia atriplicifolia	LC
Bulbine capitata	LC
Lespedeza cuneata	NE
Loudetia simplex	LC
Hypoxis filiformis	LC
Ledebouria ovatifolia	
Ranunculus multifidus	LC
Riccia elongata	
Senecio subcoriaceus	LC
Riccia albovestita	

Satyrium parviflorum	LC
Denekia capensis	LC
Riccia stricta	
Euclea sp.	

10.3 APPENDIX 3: EXPECTED AVIFAUNA SPECIES LIST

Avifauna predicted to potentially occur within the PAOI based on SABAP2 records. Species of conservation concern have been highlighted in red.

Scientific Name	Common Name	Conservation status Taylor et al. (2015)
Acridotheres tristis	Myna, Common	Least Concern
Acrocephalus baeticatus	Reed-warbler, African	Least Concern
Acrocephalus gracilirostris	Swamp-warbler, Lesser	Least Concern
Acrocephalus palustris	Warbler, Marsh	Least Concern
Actitis hypoleucos	Sandpiper, Common	Least Concern
Actophilornis africanus	Jacana, African	Least Concern
Afrotis afraoides	Korhaan, Northern Black	Least Concern
Alcedo cristata	Kingfisher, Malachite	Least Concern
Alopochen aegyptiacus	Goose, Egyptian	Least Concern
Amadina erythrocephala	Finch, Red-headed	Least Concern
Amandava subflava	Waxbill, Orange-breasted	Least Concern
Amaurornis flavirostris	Crake, Black	Least Concern
Anas capensis	Teal, Cape	Least Concern
Anas erythrorhyncha	Teal, Red-billed	Least Concern
Anas smithii	Shoveler, Cape	Least Concern
Anas sparsa	Duck, African Black	Least Concern
Anas undulata	Duck, Yellow-billed	Least Concern
Anhinga rufa	Darter, African	Least Concern
Anthus cinnamomeus	Pipit, African	Least Concern
Apus affinis	Swift, Little	Least Concern
Apus caffer	Swift, White-rumped	Least Concern
Ardea cinerea	Heron, Grey	Least Concern
Ardea goliath	Heron, Goliath	Least Concern
Ardea melanocephala	Heron, Black-headed	Least Concern
Ardea purpurea	Heron, Purple	Least Concern
Ardeola ralloides	Heron, Squacco	Least Concern
Asio capensis	Owl, Marsh	Least Concern

Bostrychia hagedash	Ibis, Hadeda	Least Concern
Bradypterus baboecala	Rush-warbler, Little	Least Concern
Bubo africanus	Eagle-owl, Spotted	Least Concern
Bubulcus ibis	Egret, Cattle	Least Concern
Burhinus capensis	Thick-knee, Spotted	Least Concern
Buteo vulpinus	Buzzard, Steppe	Least Concern
Calandrella cinerea	Lark, Red-capped	Least Concern
Calidris minuta	Stint, Little	Least Concern
Ceryle rudis	Kingfisher, Pied	Least Concern
Charadrius hiaticula	Plover, Common Ringed	Least Concern
Charadrius pecuarius	Plover, Kittlitz's	Least Concern
Charadrius tricollaris	Plover, Three-banded	Least Concern
Chersomanes albofasciata	Lark, Spike-heeled	Least Concern
Chlidonias hybrida	Tern, Whiskered	Least Concern
Chrysococcyx caprius	Cuckoo, Diderick	Least Concern
Cisticola aridulus	Cisticola, Desert	Least Concern
Cisticola ayresii	Cisticola, Wing-snapping	Least Concern
Cisticola cinnamomeus	Cisticola, Pale-crowned	Least Concern
Cisticola fulvicapilla	Neddicky, Neddicky	Least Concern
Cisticola juncidis	Cisticola, Zitting	Least Concern
Cisticola lais	Cisticola, Wailing	Least Concern
Cisticola textrix	Cisticola, Cloud	Least Concern
Cisticola tinniens	Cisticola, Levaillant's	Least Concern
Colius striatus	Mousebird, Speckled	Least Concern
Columba guinea	Pigeon, Speckled	Least Concern
Columba livia	Dove, Rock	Least Concern
Corvus albus	Crow, Pied	Least Concern
Cossypha caffra	Robin-chat, Cape	Least Concern
Coturnix coturnix	Quail, Common	Least Concern
Crithagra atrogularis	Canary, Black-throated	Least Concern
Crithagra flaviventris	Canary, Yellow	Least Concern
Crithagra mozambicus	Canary, Yellow-fronted	Least Concern
Dendrocygna viduata	Duck, White-faced	Least Concern
Egretta garzetta	Egret, Little	Least Concern
Egretta intermedia	Egret, Yellow-billed	Least Concern
Elanus caeruleus	Kite, Black-shouldered	Least Concern
Ephippiorhynchus senegalensis	Stork, Saddle-billed	Least Concern
Estrilda astrild	Waxbill, Common	Least Concern
Euplectes afer	Bishop, Yellow-crowned	Least Concern

Euplectes albonotatus	Widowbird, White-winged	Least Concern
Euplectes ardens	Widowbird, Red-collared	Least Concern
Euplectes axillaris	Widowbird, Fan-tailed	Least Concern
Euplectes orix	Bishop, Southern Red	Least Concern
Euplectes progne	Widowbird, Long-tailed	Least Concern
Eupodotis caerulescens	Korhaan (Bustard), Blue	Near Threatened
Falco amurensis	Falcon, Amur	Least Concern
Falco rupicolus	Kestrel, Rock	Least Concern
Fulica cristata	Coot, Red-knobbed	Least Concern
Gallinago nigripennis	Snipe, African	Least Concern
Gallinula chloropus	Moorhen, Common	Least Concern
Geocolaptes olivaceus	Woodpecker, Ground	Near Threatened
Glareola nordmanni	Pratincole, Black-winged	Near Threatened
Haliaeetus vocifer	Fish-eagle, African	Least Concern
Himantopus himantopus	Stilt, Black-winged	Least Concern
Hirundo albigularis	Swallow, White-throated	Least Concern
Hirundo cucullata	Swallow, Greater Striped	Least Concern
Hirundo fuligula	Martin, Rock	Least Concern
Hirundo rustica	Swallow, Barn	Least Concern
Hirundo spilodera	Cliff-swallow, South African	Least Concern
Ixobrychus minutus	Bittern, Little	Least Concern
Jynx ruficollis	Wryneck, Red-throated	Least Concern
Lamprotornis nitens	Starling, Cape Glossy	Least Concern
Lanius collaris	Fiscal, Common (Southern)	Least Concern
Larus cirrocephalus	Gull, Grey-headed	Least Concern
Lybius torquatus	Barbet, Black-collared	Least Concern
Macronyx capensis	Longclaw, Cape	Least Concern
Merops apiaster	Bee-eater, European	Least Concern
Mirafra africana	Lark, Rufous-naped	Least Concern
Mirafra cheniana	Lark, Melodious	Least Concern
Motacilla capensis	Wagtail, Cape	Least Concern
Myrmecocichla formicivora	Chat, Anteating	Least Concern
Netta erythrophthalma	Pochard, Southern	Least Concern
Numida meleagris	Guineafowl, Helmeted	Least Concern
Oena capensis	Dove, Namaqua	Least Concern
Oenanthe pileata	Wheatear, Capped	Least Concern
Onychognathus morio	Starling, Red-winged	Least Concern
Ortygospiza atricollis	Quailfinch, African	Least Concern
Oxyura maccoa	Duck, Maccoa	Near Threatened

Passer diffusus	Sparrow, Southern Grey-headed	Least Concern
Passer domesticus	Sparrow, House	Least Concern
Passer melanurus	Sparrow, Cape	Least Concern
Phalacrocorax africanus	Cormorant, Reed	Least Concern
Phalacrocorax carbo	Cormorant, White-breasted	Least Concern
Philomachus pugnax	Ruff, Ruff	Least Concern
Phoenicopterus minor	Flamingo, Lesser	Near Threatened
Phoenicopterus ruber	Flamingo, Greater	Near Threatened
Phoeniculus purpureus	Wood-hoopoe, Green	Least Concern
Platalea alba	Spoonbill, African	Least Concern
Plectropterus gambensis	Goose, Spur-winged	Least Concern
Plegadis falcinellus	Ibis, Glossy	Least Concern
Ploceus capensis	Weaver, Cape	Least Concern
Ploceus cucullatus	Weaver, Village	Least Concern
Ploceus velatus	Masked-weaver, Southern	Least Concern
Podiceps cristatus	Grebe, Great Crested	Least Concern
Porphyrio madagascariensis	Swamphen, African Purple	Least Concern
Prinia flavicans	Prinia, Black-chested	Least Concern
Prinia subflava	Prinia, Tawny-flanked	Least Concern
Pternistis swainsonii	Spurfowl, Swainson's	Least Concern
Pycnonotus tricolor	Bulbul, Dark-capped	Least Concern
Quelea quelea	Quelea, Red-billed	Least Concern
Recurvirostra avosetta	Avocet, Pied	Least Concern
Riparia cincta	Martin, Banded	Least Concern
Riparia paludicola	Martin, Brown-throated	Least Concern
Riparia riparia	Martin, Sand	Least Concern
Sagittarius serpentarius	Secretarybird, Secretarybird	Vulnerable
Saxicola torquatus	Stonechat, African	Least Concern
Scleroptila levaillantii	Francolin, Red-winged	Least Concern
Scopus umbretta	Hamerkop, Hamerkop	Least Concern
Serinus canicollis	Canary, Cape	Least Concern
Sphenoeacus afer	Grassbird, Cape	Least Concern
Spizocorys conirostris	Lark, Pink-billed	Least Concern
Spreo bicolor	Starling, Pied	Least Concern
Streptopelia capicola	Turtle-dove, Cape	Least Concern
Streptopelia semitorquata	Dove, Red-eyed	Least Concern
Streptopelia senegalensis	Dove, Laughing	Least Concern
Tachybaptus ruficollis	Grebe, Little	Least Concern
Tadorna cana	Shelduck, South African	Least Concern

Thalassornis leuconotus	Duck, White-backed	Least Concern
Threskiornis aethiopicus	Ibis, African Sacred	Least Concern
Trachyphonus vaillantii	Barbet, Crested	Least Concern
Tringa glareola	Sandpiper, Wood	Least Concern
Tringa nebularia	Greenshank, Common	Least Concern
Tringa stagnatilis	Sandpiper, Marsh	Least Concern
Turdus smithi	Thrush, Karoo	Least Concern
Upupa africana	Hoopoe, African	Least Concern
Vanellus armatus	Lapwing, Blacksmith	Least Concern
Vanellus coronatus	Lapwing, Crowned	Least Concern
Vanellus senegallus	Lapwing, African Wattled	Least Concern
Vidua macroura	Whydah, Pin-tailed	Least Concern
Zosterops virens	White-eye, Cape	Least Concern

10.4 APPENDIX 4: EXPECTED MAMMAL SPECIES LIST

Mammals predicted to potentially occur within the PAOI with confirmed species in **bold**. Species of conservation concern are highlighted in red.

Family	Species	Common name	Status
BATHYERGIDAE	*Cryptomys hottentotus*	Southern African Mole-rat	Least Concern
BOVIDAE	*Alcelaphus buselaphus caama*	Red Hartebeest	Least Concern
BOVIDAE	*Antidorcas marsupialis*	Springbok	Least Concern
BOVIDAE	*Connochaetes gnou*	Black Wildebeest	Least Concern
BOVIDAE	*Damaliscus pygargus phillipsi*	Blesbok	Least Concern
BOVIDAE	*Kobus ellipsiprymnus*	Waterbuck	Least Concern
BOVIDAE	*Oryx gazella*	Gemsbok	Least Concern
BOVIDAE	*Ourebia ourebi*	Oribi	Endangered
BOVIDAE	*Raphicerus campestris*	Steenbok	Least Concern
BOVIDAE	*Sylvicapra grimmia*	Bush Duiker	Least Concern
BOVIDAE	*Syncerus caffer*	African Buffalo	Least Concern
BOVIDAE	*Taurotragus oryx*	Common Eland	Least Concern
BOVIDAE	*Tragelaphus strepsiceros*	Greater Kudu	Least Concern
CANIDAE	*Canis mesomelas*	Black-backed Jackal	Least Concern
CANIDAE	*Vulpes chama*	Cape Fox	Least Concern
CERCOPITHECIDAE	*Chlorocebus pygerythrus pygerythrus*	Vervet Monkey	Least Concern
EQUIDAE	*Equus quagga*	Plains Zebra	Least Concern
ERINACEIDAE	*Atelerix frontalis*	Southern African Hedgehog	Near Threatened

FELIDAE	*Felis nigripes*	Black-footed Cat	Vulnerable
FELIDAE	*Felis silvestris*	Wildcat	Least Concern
FELIDAE	*Leptailurus serval*	Serval	Near Threatened
FELIDAE	*Panthera leo*	Lion	Least Concern
FELIDAE	*Panthera pardus*	Leopard	Vulnerable
HERPESTIDAE	*Cynictis penicillata*	Yellow Mongoose	Least Concern
HERPESTIDAE	*Herpestes sanguineus*	Slender Mongoose	Least Concern
HERPESTIDAE	*Suricata suricatta*	Meerkat	Least Concern
HYAENIDAE	***Hyaena brunnea***	**Brown Hyena**	**Near Threatened**
HYSTRICIDAE	*Hystrix africaeaustralis*	Cape Porcupine	Least Concern
LEPORIDAE	*Lepus saxatilis*	Scrub Hare	Least Concern
LEPORIDAE	*Pronolagus randensis*	Jameson's Red Rock Hare	Least Concern
MURIDAE	*Dasymys incomtus*	Water Rat	**Near Threatened**
MURIDAE	*Gerbilliscus brantsii*	Highveld Gerbil	Least Concern
MURIDAE	*Mastomys coucha*	Southern African Mastomys	Least Concern
MURIDAE	*Mastomys natalensis*	Natal Mastomys	Least Concern
MURIDAE	*Mus (Nannomys) minutoides*	Southern African Pygmy Mouse	Least Concern
MURIDAE	*Otomys auratus*	Southern African Vlei Rat	Near Threatened
MURIDAE	*Rhabdomys pumilio*	Xeric Four-striped Grass Rat	Least Concern
MUSTELIDAE	*Aonyx capensis*	African Clawless Otter	Near Threatened
MUSTELIDAE	*Hydrictis maculicollis*	Spotted-necked Otter	Near Threatened
MUSTELIDAE	*Ictonyx striatus*	Striped Polecat	Least Concern
MUSTELIDAE	*Mellivora capensis*	Honey Badger	Least Concern
MUSTELIDAE	*Poecilogale albinucha*	African Striped Weasel	Near Threatened
NESOMYIDAE	*Dendromus mystacalis*	Chestnut African Climbing Mouse	Least Concern
NESOMYIDAE	*Steatomys pratensis*	Common African Fat Mouse	Least Concern
ORYCTEROPODIDAE	*Orycteropus afer*	Aardvark	Least Concern
PROCAVIIDAE	*Procavia capensis*	Cape Rock Hyrax	Least Concern
SORICIDAE	*Crocidura flavescens*	Greater Red Musk Shrew	Least Concern
SORICIDAE	*Crocidura mariquensis*	Swamp Musk Shrew	Near Threatened
SORICIDAE	*Myosorex cafer*	Dark-footed Mouse Shrew	Vulnerable
SORICIDAE	*Myosorex varius*	Forest Shrew	Least Concern
SUIDAE	*Phacochoerus africanus*	Common Warthog	Least Concern
VIVERRIDAE	*Genetta maculata*	Rusty-spotted Genet	Least Concern

10.5 APPENDIX 5: EXPECTED HERPETOFAUNA SPECIES LIST

Herpetofauna predicted to potentially occur within the PAOI. Species of conservation concern have been highlighted in red and those highly unlikely to occur in the PAOI have been struck through.

Family	Common name	Scientific name	National Conservation Status	IUCN Conservation Status	Habitat preference	Focal QDGC's (2629AB,2629BA)	Probability of Occurrence	Justification
				Amphibians				
~~Bufonidae~~	~~Northern Pygmy Toad~~	~~*Poyntonophrynus fenoulheti*~~	~~LC~~	~~LC~~	~~Aquatic/riparian generalist across wide array of biomes~~	~~0~~	~~Low~~	~~marginal range~~
Bufonidae	Red Toad	*Schismaderma carens*	LC	LC	Habitat generalist in savanna and woodland	x	High	
Bufonidae	Raucous Toad	*Sclerophrys capensis*	LC	LC	Habitat generalist across wide array of biomes	x	High	
Bufonidae	Guttural Toad	*Sclerophrys gutturalis*	LC	LC	Habitat generalist across wide array of biomes	x	High	
Bufonidae	Flatbacked Toad	*Sclerophrys pusilla*	LC	LC	Habitat generalist in lowveld grassland and savanna	0	High	
Hyperoliidae	Bubbling Kassina	*Kassina senegalensis*	LC	LC	Habitat generalist across wide array of biomes	x	High	
Hyperoliidae	Rattling Frog	*Semnodactylus wealii*	LC	LC	Endorheic and palustrine systems in a wide variety of biomes	x	High	
Phrynobatrachidae	Snoring Puddle Frog	*Phrynobatrachus natalensis*	LC	LC	Habitat generalist across wide array of biomes	x	High	
Pipidae	Common Platanna	*Xenopus laevis*	LC	LC	Habitat generalist but requires aquatic habitats that are at least semi-permanently inundated	x	High	

Ptychadenidae	Striped Grass Frog	*Ptychadena porosissima*	LC	LC	Habitat generalist in savanna, prefers areas with permanent water	0	High	
Pyxicephalidae	Delalande's River Frog	*Amietia delalandii*	LC	LC	Habitat generalist across wide array of biomes	x	High	
Pyxicephalidae	Poynton's River Frog	*Amietia poyntoni*	LC	LC	Habitat generalist across wide array of biomes	0	High	
Pyxicephalidae	Common Caco	*Cacosternum boettgeri*	LC	LC	Endorheic and palustrine systems in a wide variety of biomes	x	High	
~~Pyxicephalidae~~	~~Bronze Caco~~	~~*Cacosternum nanum*~~	~~LC~~	~~LC~~	~~Habitat generalist in mesic enviroments with high rainfall~~	~~0~~	~~Low~~	~~marginal, not known from highveld~~
Pyxicephalidae	Giant Bull Frog	*Pyxicephalus adspersus*	NT	LC	Seasonal endorheic and palustrine systems in a wide variety of biomes. Will not breed in permanent water.	0	High	
Pyxicephalidae	Striped Stream Frog	*Strongylopus fasciatus*	LC	LC	Moist grassy areas across wide array of biomes	x	High	
~~Pyxicephalidae~~	~~Clicking Stream Frog~~	~~*Strongylopus grayii*~~	~~LC~~	~~LC~~	~~Habitat generalist mesic enviroments with temporary water bodies~~	~~0~~	~~Low~~	~~marginal range~~
Pyxicephalidae	Tremelo Sand Frog	*Tomopterna cryptotis*	LC	LC	Endorheic and palustrine systems in a wide variety of biomes	x	High	
Pyxicephalidae	Natal Sand Frog	*Tomopterna natalensis*	LC	LC	Habitat generalist in grassland and savanna	x	High	
Pyxicephalidae	Tandy's Sand Frog	*Tomopterna tandyi*	LC	LC	Endorheic and palustrine systems in a wide variety of biomes	x	High	
				Reptiles				
Agamidae	Distant's Ground Agama	Agama aculeata distanti	LC	LC	Habitat generalist in grassland and savanna	x	High	

Agamidae	Southern Rock Agama	Agama atra	LC	LC	Habitat generalist across wide array of biomes, prefers rocky areas	0	Zero	no rocky areas on the site
Chamaeleonidae	Common Flap-neck Chameleon	Chamaeleo dilepis	LC	LC	Coastal forest, savanna, woodland and bushy grasslands	0	Zero	lack of native trees and bushes
Colubridae	Red-lipped Snake	Crotaphopeltis hotamboeia	LC	LC	Habitat generalist across wide array of biomes, preferring moist areas	x	High	
Colubridae	Rhombic Egg-eater	Dasypeltis scabra	LC	LC	Habitat generalist across wide array of biomes	x	High	
Colubridae	Boomslang	Dispholidus typus typus	LC	LC	Arboreal generalist in fynbos, savanna, grassland, karoo scrub and forest	0	Zero	lack of native trees and bushes
Colubridae	Western Natal Green Snake	Philothamnus occidentalis	LC	LC	Habitat generalist in forests and wooded grasslands, prefers areas close to water	0	Low	marginal and lack of trees and bushes
Colubridae	Spotted Bush Snake	Philothamnus semivariegatus	LC	LC	Moist savanna, grassland, karoo scrub and forest, prefers areas with trees and rock outcrops	0	Zero	absent from highveld grassland
Colubridae	Eastern Tiger Snake	Telescopus semiannulatus semiannulatus	LC	LC	Savanna and lowland forest, lives in trees and rocky outcrops	0	Zero	absent from highveld grassland
Cordylidae	Coppery Grass Lizard	Chamaesaura aenea	LC	LC	High elevation grassland	0	High	
Cordylidae	Common Girdled Lizard	Cordylus vittifer	LC	LC	Rupicolous, living in rocky outcrops	0	Low	lack of rocks
Cordylidae	Common Crag Lizard	Pseudocordylus melanotus melanotus	LC	LC	Rupicolous, crag specialist	0	Zero	No large rock formations
Elapidae	Speckled Shield Cobra	Aspidelaps scutatus scutatus	LC	LC	Partly fossorial, bushveld and some grasslands, prefers sandy areas	0	Low	marginal range, but present in highveld grassland

Elapidae	Highveld Garter Snake	Elapsoidea sundevallii media	LC	LC	Habitat generalist in grasslands and savanna, prefers loose soils	0	Moderate	marginal range, but suitable habitat
Elapidae	Rinkhals	Hemachatus haemachatus	LC	LC	Grassland, rocky outcrops and wetlands	x	Confirmed	
~~Elapidae~~	~~Snouted Cobra~~	~~Naja annulifera~~	~~LC~~	~~LC~~	~~Savanna and marginally in forest and coastal scrubland~~	~~0~~	~~Zero~~	~~absent from highveld grassland~~
~~Elapidae~~	~~Mozambique Spitting Cobra~~	~~Naja mossambica~~	~~LC~~	~~LC~~	~~Habitat generalist across moist savanna and lowland forest~~	~~1~~	~~Zero~~	~~absent from highveld grassland~~
~~Gekkonidae~~	~~Common Tropical House Gecko~~	~~Hemidactylus mabouia~~	~~LC~~	~~LC~~	~~Commensal species~~	~~0~~	~~Low~~	~~out of range but possibly introduced~~
~~Gekkonidae~~	~~Common Dwarf Gecko~~	~~Lygodactylus capensis capensis~~	~~LC~~	~~LC~~	~~Commensal, prefers habitats with rocks, trees or buildings~~	~~0~~	~~Low~~	~~out of range but possibly introduced~~
~~Gekkonidae~~	~~Spotted Dwarf Gecko~~	~~Lygodactylus ocellatus~~	~~LC~~	~~LC~~	~~Rupicolous, rocky outcrops in grassland and savanna~~	~~1~~	~~Zero~~	~~no rocky outcrops on site~~
Gekkonidae	Transvaal Gecko	Pachydactylus affinis	LC	LC	Generalist in grassland and savanna	x	Moderate	lack of rocks
Gekkonidae	Cape Gecko	Pachydactylus capensis	LC	LC	Generalist in grassland and savanna	x	Moderate	lack of rocks
Gekkonidae	Van Son's Gecko	Pachydactylus vansoni	LC	LC	Generalist in grassland with rocky outcrops (highveld)	x	Moderate	lack of rocks
~~Lamprophiidae~~	~~Many-spotted Snake~~	~~Amplorhinus multimaculatus~~	~~LC~~	~~LC~~	~~Reed beds, vleis and riverside vegetation in fynbos, montane grassland and montane forests~~	~~0~~	~~Zero~~	~~unsuitable habitat~~
Lamprophiidae	Black-headed Centipede-eater	Aparallactus capensis	LC	LC	Partly fossorial, generalist across wide array of biomes	x	High	
Lamprophiidae	Bibron's Stiletto Snake	Atractaspis bibronii	LC	LC	Partly fossorial, generalist across wide array of biomes	0	High	

Lamprophiidae	Brown House Snake	Boaedon capensis	LC	LC	Habitat generalist across wide array of biomes	x	High	
~~Lamprophiidae~~	~~South African Slug-eater~~	~~Duberria lutrix lutrix~~	~~LC~~	~~LC~~	~~Moist habitats across wide array of biomes~~	~~0~~	~~Low~~	
Lamprophiidae	Striped Harlequin Snake	Homoroselaps dorsalis	LC	NT	Partly fossorial, grassland specialist often utilising termitaria	0	Moderate	sparse records, but in range
Lamprophiidae	Spotted Harlequin Snake	Homoroselaps lacteus	LC	LC	Partly fossorial, generalist across wide array of biomes	x	High	
Lamprophiidae	Aurora House Snake	Lamprophis aurora	LC	LC	Habitat generalist across wide array of biomes	0	Moderate	sparse records, but suitable habitat
Lamprophiidae	Olive House Snake	Lycodonomorphus inornatus	LC	LC	Habitat generalist across wide array of biomes	x	High	
Lamprophiidae	Brown Water Snake	Lycodonomorphus rufulus	LC	LC	Wetland generalist across wide array of biomes, prefers habitats associated with water	x	High	
Lamprophiidae	Cape Wolf Snake	Lycophidion capense capense	LC	LC	Habitat generalist across wide array of biomes	x	High	
Lamprophiidae	Short-snouted Grass Snake	Psammophis brevirostris	LC	LC	Habitat generalist in savanna and grassland	0	High	
Lamprophiidae	Cross-marked Grass Snake	Psammophis crucifer	LC	LC	Habitat generalist in fynbos and grassland	x	High	
Lamprophiidae	Spotted Grass Snake	Psammophylax rhombeatus	LC	LC	Habitat generalist across wide array of biomes	x	Confirmed	
Lamprophiidae	Striped Grass Snake	Psammophylax tritaeniatus	LC	LC	Habitat generalist across grassland and savanna	0	Moderate	sparse records, but suitable habitat
Lamprophiidae	Mole Snake	Pseudaspis cana	LC	LC	Partly fossorial, generalist across wide array of biomes	x	High	
~~Leptotyphlopidae~~	~~Distant's Thread Snake~~	~~Leptotyphlops distanti~~	~~LC~~	~~LC~~	~~Partly fossorial, generalist across bushveld and savanna~~	~~0~~	~~Low~~	~~marginal habitat (highveld)~~
Leptotyphlopidae	Eastern Thread Snake	Leptotyphlops scutifrons conjunctus	LC	LC	Partly fossorial, generalist across wide array of biomes	x	Confirmed	

~~Pythonidae~~	~~Southern African Python~~	~~Python natalensis~~	~~LC~~	~~LC~~	~~Habitat generalist in savanna, prefers rocky or riverine low-lying areas~~	~~0~~	~~Zero~~	~~not present in highveld grassland~~
~~Pyxicephalidae~~	~~Cape River Frog~~	~~Amietia fuscigula~~	~~LC~~	~~LC~~	~~Habitat generalist across wide array of biomes~~	~~1~~	~~Zero~~	
~~Scincidae~~	~~Short-headed Legless Skink~~	~~Acontias breviceps~~	~~LC~~	~~LC~~	~~Fossorial, mesic montane grasslands~~	~~0~~	~~Zero~~	~~out of range~~
Scincidae	Thin-tailed Legless Skink	Acontias gracilicauda	LC	LC	Loose soil in open to partly wooded habitats	0	High	
Scincidae	Western Legless Skink	Acontias occidentalis	LC	LC	Fossorial, generalist across savanna and grassland	0	High	
Scincidae	Cape Skink	Trachylepis capensis	LC	LC	Habitat generalist across wide array of biomes	0	Confirmed	
Scincidae	Speckled Rock Skink	Trachylepis punctatissima	LC	LC	Habitat generalist across wide array of biomes	x	Confirmed	
Scincidae	Common Variable Skink Complex	Trachylepis varia sensu lato	LC	LC	Habitat generalist across grassland and savanna	0	Moderate	marginal range but suitable habitat
~~Testudinidae~~	~~Lobatse Hinged Tortoise~~	~~Kinixys lobatsiana~~	~~V~~	~~V~~	~~Rocky hillsides in woodland, Bushveld and Thornveld with dense, short shrubland to open tree savanna~~	~~0~~	~~Zero~~	~~absent from highveld grassland~~
~~Testudinidae~~	~~Leopard Tortoise~~	~~Stigmochelys pardalis~~	~~LC~~	~~LC~~	~~Habitat generalist across wide array of biomes~~	~~0~~	~~Low~~	~~out of range, absent from highveld grassland~~
Typhlopidae	Bibron's Blind Snake	Afrotyphlops bibronii	LC	LC	Partly fossorial, generalist across wide array of biomes	x	Confirmed	
Varanidae	Water Monitor	Varanus niloticus	LC	LC	Aquatic/riparian generalist across wide array of biomes	0	High	
Viperidae	Puff Adder	Bitis arietans arietans	LC	LC	Habitat generalist across wide array of biomes	0	Moderate	sparse records, but expected to occur on site

Viperidae	Rhombic Night Adder	Causus rhombeatus	LC	LC	Habitat generalist across wide array of biomes, prefers habitats associated with water	x	High

10.6 APPENDIX 6: SPECIALISTS PROOF OF QUALIFICATION

Specialist: Samuel David Laurence

SACNASP
South African Council for Natural Scientific Professions

herewith certifies that

Samuel David Laurence
Registration number: 400450/13

is registered as a

Professional Natural Scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule I of the Act)

Zoological Science	20 November 2013
Ecological Science	20 November 2013

COPY

20 November 2013
Pretoria

President

Executive Director

Disclaimer

I Samuel Laurence Pr. Sci. Nat. (Ecology and Zoology) declare that the work presented above is my own and has not been influenced in any way by the client. At no point has the client asked me as a specialist to manipulate my results and the above methods has been carried out to the highest ecological standards.

Samuel Laurence (*Pr. Sci. Nat.*)