ESKOM HOLDINGS (PTY) LTD,

PROPOSED ESTABLISHMENT OF LEHATING SUBSTATION AND ASSOCIATED KLIPKOP-LEHATING OVERHEAD POWER LINE, NORTHERN CAPE.

TERRESTRIAL BIODIVERSITY ECOLOGICAL & IMPACT SURVEY

OCTOBER 2015

Prepared for:

Jeffares & Green (Pty) Ltd

Report authors: Dr Mathew Ross (*Pr Sci Nat*), Dr Tahla Ross
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EnviRoss *CC*
CK 2007/051532/23
VAT: 4810234999
PO Box 369, Wendywood, 2144.
Tel/fax: 011 706 9753
Email: admin@enviross.co.za

DECLARATION

This report has been prepared according to the requirements of the Environmental Impact Assessments Regulations (GNR 543) in Government Gazette 33306 of 18 June 2010, as well as the Northern Cape Nature Conservation Act (Act 9 of 2009). We (the undersigned) declare the findings of this report free from influence or prejudice.

Report Authors:

Dr Mathew Ross *Pr Sci Nat* (Ecological Sciences) 400061/09

MSc (Aquatic Health) (RAU)
PhD (Aquatic Health), (University of Johannesburg).

Field of expertise:

Fish ecology, fishway evaluations, biomonitoring and wetland evaluations, aquatic ecology, aquatic & terrestrial fauna and flora.

_____ Date: 11 April 2016

Dr Mathew Ross

Dr Tahla Ross

MSc (Zoology) (RAU)
PhD (Zoology) (RAU)

Field of expertise:

Biomonitoring and wetland evaluations, aquatic ecology, aquatic & terrestrial fauna and flora.

_____ Date: 11 April 2016

Dr Tahla Ross

EXECUTIVE SUMMARY

EnviRoss CC was requested to undertake the faunal and floral ecological and impact evaluations for the proposed ESKOM Klipkop-Lehating overhead power line as well as the establishment of the Lehating Substation, together with loop in and loop out lines to the existing Wessels Substation.

The survey area falls within an area utilised for cattle farming in the northern parts, and remains largely undeveloped within this area. Current land use within the southern areas include urban and mining establishments and therefore disturbance factors are more prevalent.

An impact significance rating was undertaken and all impacts were found to be significantly reduced through implementation of mitigation measures. Impacts were noted to be rated from medium through to low prior to mitigation and low after mitigation.

Following completion of the desktop review, field survey and impact evaluations, the following general conclusions can be offered:

- The survey area generally does not suffer a high degree of transformation at present and has retained a high present ecological state (PES) and incorporates habitat units that are regarded as inherently ecologically sensitive that support a wide diversity of fauna and flora;
- The proposed development activities will result in limited transformation of the habitat;
- No RDL faunal or floral features were noted during the field survey, but individuals of protected tree species will be impacted by the proposed development;
- Impact evaluations showed that the impacts range from medium through to low significance ratings due to the various aspects pertaining to the project. Some impacts cannot be realistically mitigated for and aspects such as destruction of vegetation and habitat within areas directly related to the substation site as well as services associated with this site are an inevitable consequence of a development of this nature. Other impacts have been shown to be abated by implementation of mitigation measures to reduce their overall significance;
- The analysis of the preferred alternatives showed that the overall Alternative 3 was proposed and, after presentation of the two further deviations of Alt 3, it was found that Alt 3B is preferred;
- The overall cumulative impact of the development is considered *low*.

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1. INTRODUCTION & TERMS OF REFERENCE

1.1. Background

Eskom Holdings Ltd has proposed the construction of the new Lehating 132 kV distribution substation and the proposed construction of a new 14km Single Circuit Chickadee powerline between the new Lehating Substation and the existing Klipkop Substation. The Klipkop Substation is situated at the Blackrock Mine, situated 12km North West of Hotazel in the Northern Cape Province. The proposed new Lehating Substation will be situated approximately 14km north of the existing Klipkop Substation. A new mine, the Lehating mine, is proposed on the site where the new Lehating Substation will be constructed. The Lehating mine approached Eskom to construct a substation to supply power to the new mine. No alternative sites have been proposed for the proposed Lehating Substation, so a 1 km x 1 km study area will be investigated in order to make provision for the proposed Lehating Substation, and three (3) alternative line study corridors will be investigated. The line study corridors are 1km in width. The locality of the survey area is presented in Figure 1.

The aim of the survey was to ascertain the present ecological state of the terrestrial habitat units that would be inundated by the proposed development activities that could potentially be impacted by the proposed development. The significance of the potential impacts emanating from a development of this nature within the areas proposed could be determined and quantified upon completion of the survey. A field survey was undertaken to the site during July 2015.

1.2. Scope of Work

The Scope of Work included a baseline ecological survey for the areas that would be impacted by the proposed development activities. These baseline data would then allow for predicted impact evaluations in order to evaluate the potential impacts to the area.

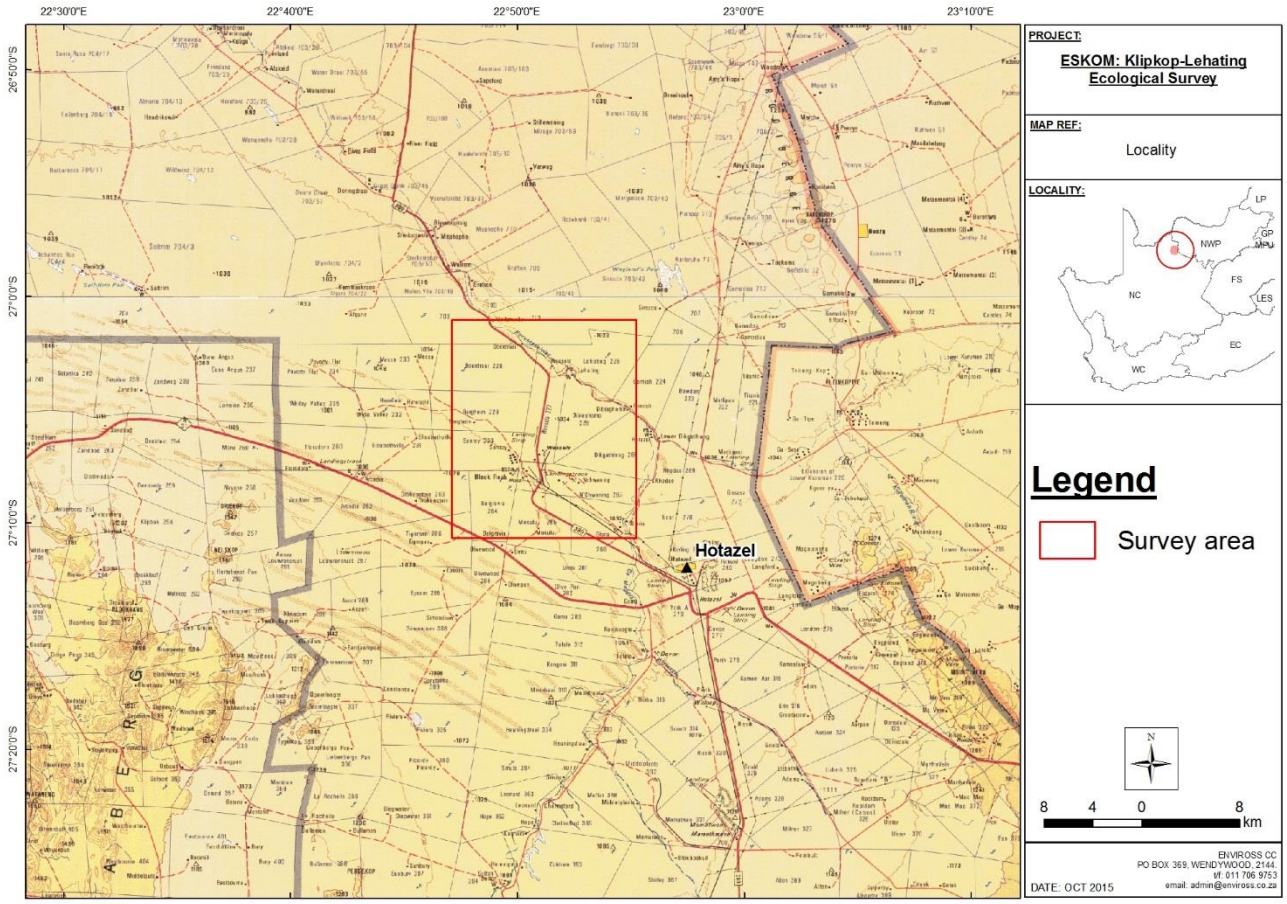

Figure 1: Locality of the study area.

1.3. Assumptions & Limitations

The conclusions to overall perceived impacts have been based on a desktop survey that was reiterated by ground-truthing through field surveys of the survey area. Even though every effort was undertaken to identify ecologically sensitive habitats, the presence of RDL and protected species and other pertinent ecological issues relating to the project, the large extent of the project necessitated certain assumptions regarding the potential presence or absence of species. These assumptions were largely based on the professional judgement that is supported by similar field experience within similar areas of the specialist.

2. AIMS & OBJECTIVES

The objective of this report is to provide the relevant biological information pertaining to the terrestrial habitat units and the implications of the potential to the planning, management and construction teams of

the proposed development activities. This will enable mitigation measures to be implemented to minimise the potential ecological impacts.

3. GENERAL STUDY AREA CHARACTERISTICS

The study area is located to the nearby northwest of Hotazel in the Northern Cape Province (Figure 1). The survey area is regarded as having an arid climate. Dominant land use within the region is cattle and sheep farming, but mining forms the prominent land use in isolated areas and urban centres (Hotazel and Black Rock) have been established as support areas for prominent mining enterprises. Vast expanses of open habitat remain within the region. Limited accessibility to water is largely the limiting factor to development within the area, which has also limited the agricultural potential. This means that natural habitat has been retained over large areas.

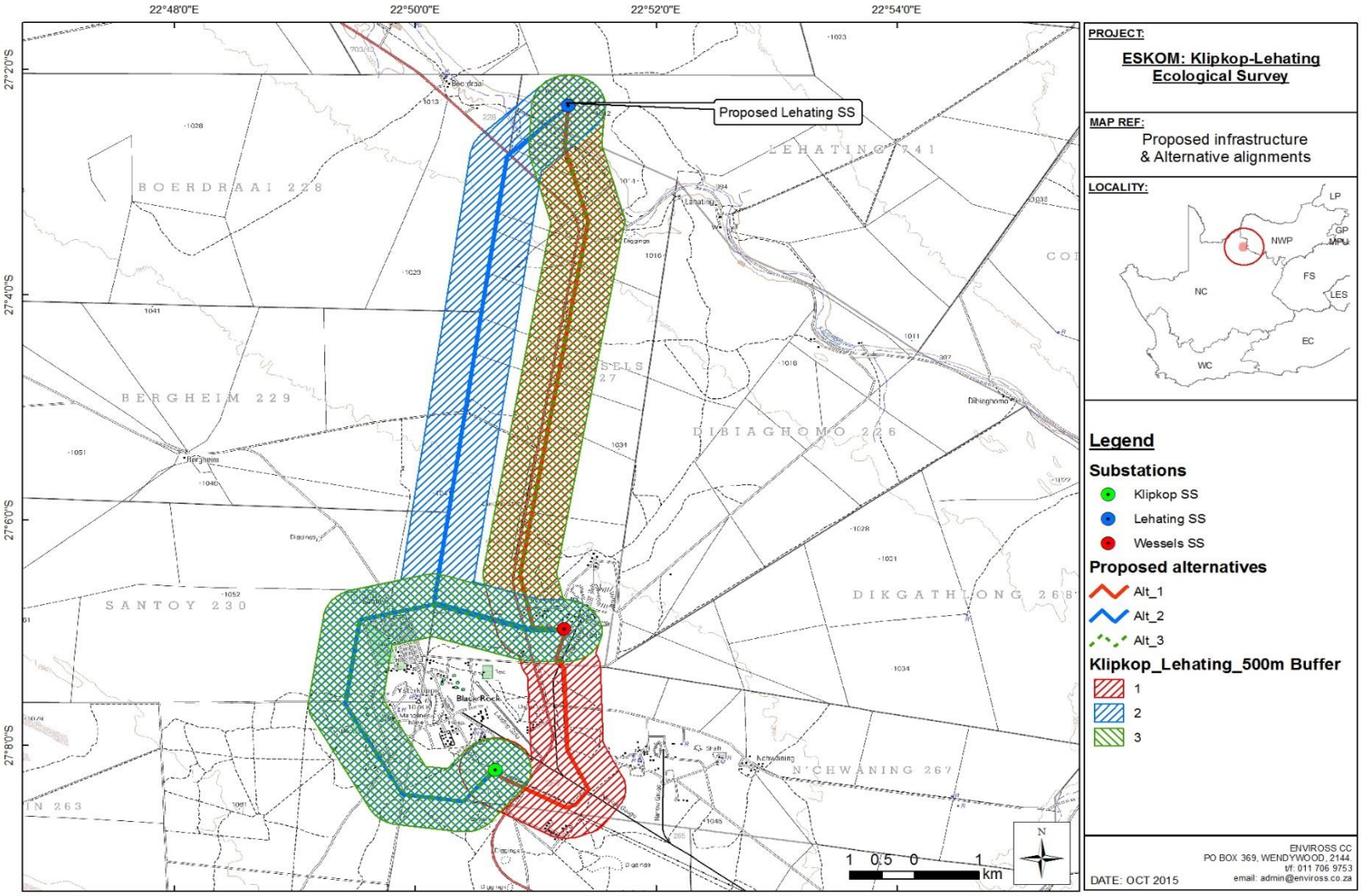

Figure 2: Proposed development infrastructure, showing the various alternatives.

4. MATERIALS & METHODS

4.1. Desktop survey

Scrutiny of topographical maps, aerial photography and available GIS mapping databases (provincial and national) as well as the latest available literature were used to set the baseline data for the survey area. A further source of data was from the SANBI Biodiversity GIS website (www.bgis.sanbi.org.za) with specific reference to the status of ecosystems and biodiversity within the area. Impacts of developments similar in nature were also ascertained during the desktop survey.

A field survey was also undertaken for ground-truthing, which then enabled the confirmation from on-site visual observations, allowing for habitat unit characterisation and assessment of ecological status. This aspect then further allowed for the establishment of the general ecological integrity of the vegetation and habitat units in order to establish the potential overall impacts of the proposed development on the associated habitat units and ecological processes for both fauna and flora.

4.2. Field survey

A field survey was undertaken during July 2015, during which the proposed survey area was assessed. This field survey allowed for the identification of ecologically sensitive habitat, the overall ecological integrity of the vegetation structures and the areas where RDL and protected faunal and floral species could potentially occur. The general degree of transformation of the habitat types and units were also assessed during the field survey that allowed for overall general impressions as well as to allow for generalisations regarding habitat sensitivity. Site photographs were taken at all points of interest in order to characterise these habitat types. This allowed for cross-referencing to those data that were gathered during the desktop survey.

5. RESULTS & DISCUSSIONS

5.1. Ecological processes & landscape features associated with the survey area

The survey area incorporates the watercourse of the Kuruman River (regarded as a non-perennial watercourse with associated floodplain wetlands and riparian zones) within its northern section. This represents the only major watercourse within the area. The proposed overhead power line runs in a north-south direction, crossing through terrestrial habitat within an area utilised for cattle farming toward the town of Black Rock, where loop in and loop out lines associate the proposed line to the existing Wessels Substation. The overhead line circumnavigates the residential area of Black Rock to terminate at the Klipkop Substation within the Black Rock mining area. Impacting and transformation features of the natural habitat increase toward the southern sections of the proposed survey area.

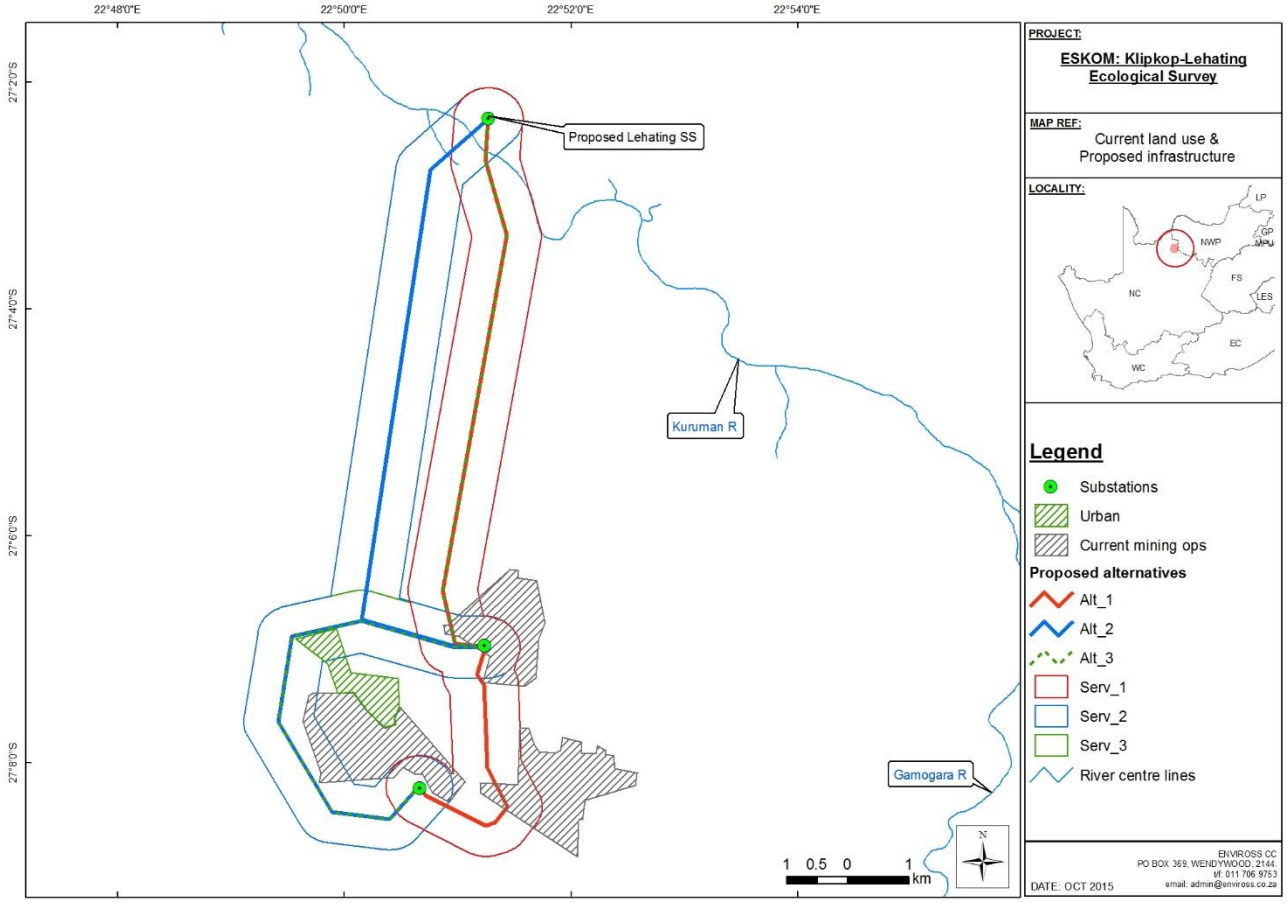

Figure 3: Ecological processes and present land use features associated with the proposed development site.

5.2. Floral features

5.2.1. Floral endemism

The survey area falls within the Griqualand West Centre of Plant Endemism (CoPE), which has a core area that coincides with surface outcrops of the Ghaap Group and Olifantshoek Supergroup of rocks. The outer boundaries of the floristic components are rather diffuse and spill over onto related substrates, especially alkaline ones rich in calcium. It is bordered in the east by the Harts River and in the west by the Asbestos and Kuruman Hills, and extends from the confluence of the Orange and Vaal Rivers, northwards to Vryburg. Topographically the eastern portion if dominated by a plateau and the western portion is hilly and mountainous and characterised by north-south trending ridges of the Korannaberg and Langberg. The altitude varies from 450 to 1250 m AMSL. Rainfall is erratic and varies from 250 to 450 mm per year and occurs in summer. The mean annual temperature is about 18°C, but can vary between below freezing in winter to 42°C in summer (van Wyk & Smith, 2001). It is a CoPE that is regarded as being particularly rich in plant diversity. Figure 4 shows the survey area and how it associates with the Griqualand West CoPE.

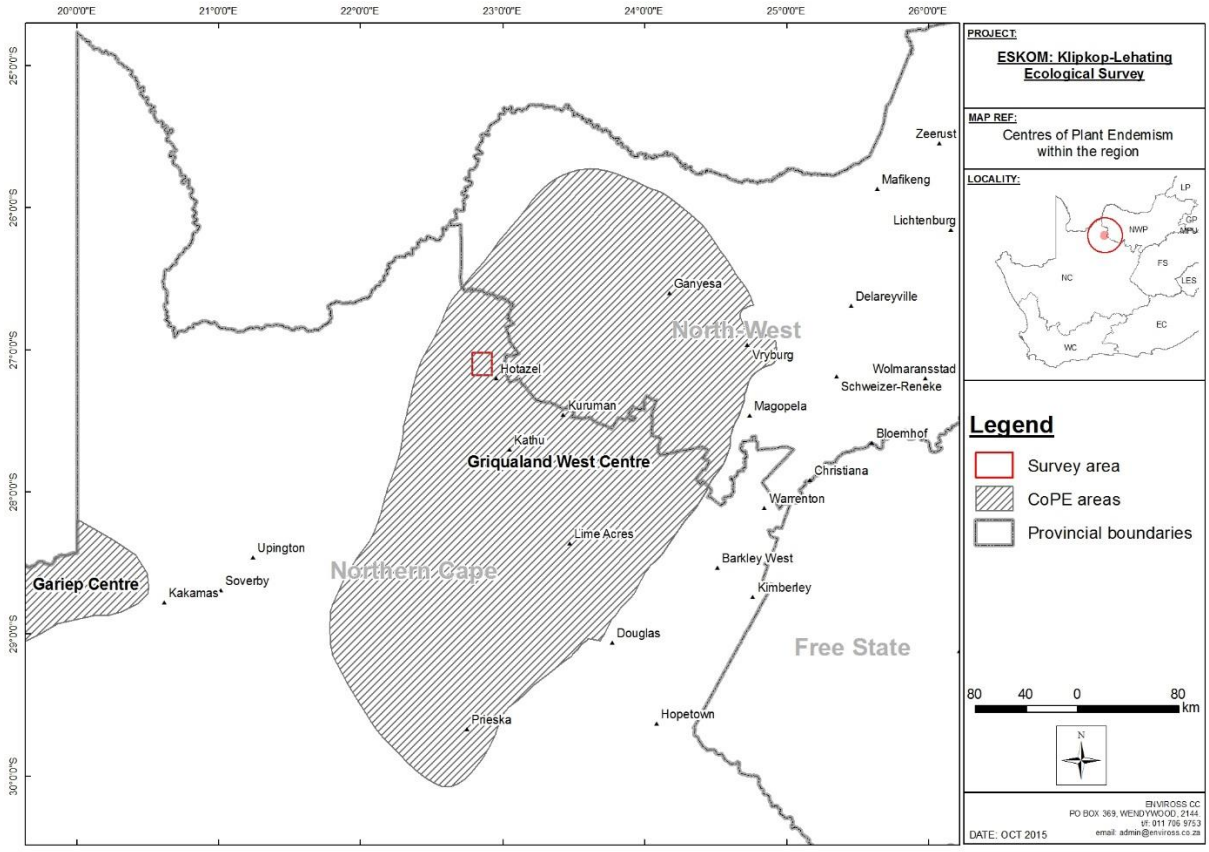

Figure 4: The proposed development area and its association with the Griqualand West Centre of Plant Endemism.

The floristic unit is regarded as being under studied, and of particular interest are studies pertaining to the influence of calcareous soils and certain heavy metals (manganese and iron especially) on plant distribution and speciation. The unit contains vast iron deposits as well as 81% of all know manganese deposits worldwide. Mining is particularly prevalent within the region. Outcroppings that are not yet impacted by mining activities should be conserved (van Wyk & Smith, 2001). *Tarchonanthus camphoratus* is a particularly common woody species, together with *Searsia* (=*Rhus*) *tridactyla*, *Croton gratissimus* and *Buddleja saligna*. Karoo-type vegetation encroachment is common within overgrazed areas. A number of succulent and non-succulent floral species occur within the unit.

5.2.2. Vegetation types and floral community structures

The footprint of the proposed development activities is associated with two main vegetation types that, namely *Kathu Bushveld* (Least threatened) of the Eastern Kalahari Bushveld bioregion and *Savanna* biome (Mucina & Rutherford, 2006). The proposed Lehating Substation site falls on the outskirts of *Southern Kalahari Mekgacha* vegetation type, of the Inland Saline vegetation bioregion, which falls within the azonal Inland saline vegetation bioregion (the floodplain areas of the Kuruman River). The northern region of the proposed development site seems to fall within a transitional zone between various vegetation types, and shares features with the adjacent-located Gordonia Duneveld as well. Some transformation of the vegetation structures has taken place due to farming infrastructure and cattle activities within the northern and central areas. The wetland areas of the Kuruman River are largely dominated by the invasive exotic tree species, namely *Prosopis glandulosa*. This is largely due to these areas being subject to greater grazing pressure and therefore suffer the effects of trampling more than the surrounding area. This factor is considered the main driver to ecological change within the area. The southern areas have been transformed through urbanisation, mining and road construction. Much natural habitat remains, however, both locally and regionally.

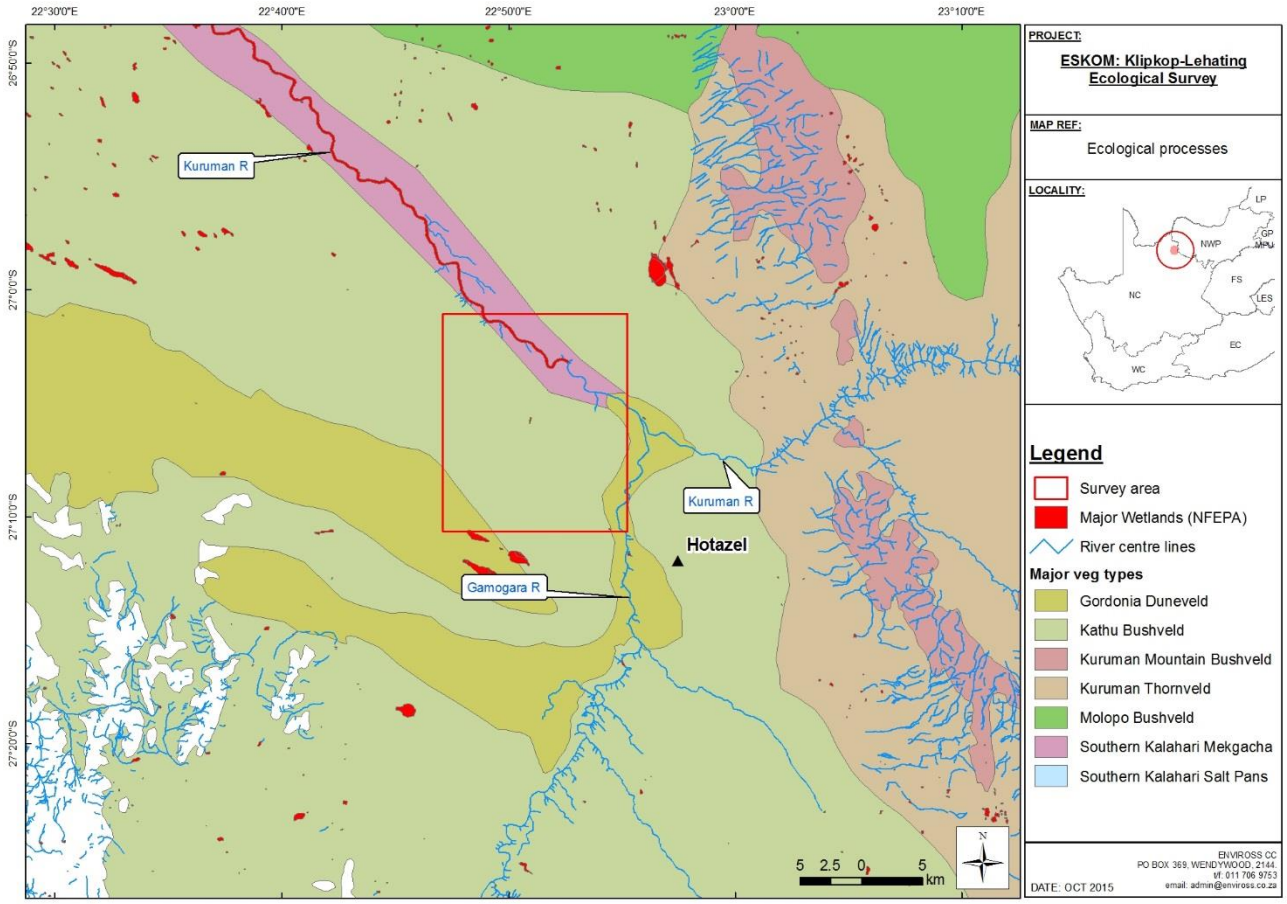

Figure 5: Vegetation map of the surrounding region.

Floral species commonly encountered within the northern area, north of the Kuruman River where the proposed Lehating Substation is proposed include *Vachellia haematoxylon* (protected species), *Senegalia mellifera* subsp *detinens, Lycium bosciifolium, Ziziphus mucronata, Searsia lancea, Grewia flava, Stipagrostis amabilis, Cynodon dactylon, Aristida adscensionis, Aristida congesta, Eragrostis echinochloidea* and various annual grass species.

Figure 6: Various views of the typical habitat features associated with the northern sections of the proposed development site.

The mid areas were largely dominated by *Senegalia mellifera*, as a response to grazing pressure from cattle, with a high inclusion of *Grewia flava* and occasional inclusion of *Vachellia erioloba* (protected species). A full species account is provided in Appendix A, Table 16.

Figure 7: Various views of the typical habitat features associated with the mid sections of the proposed development site.

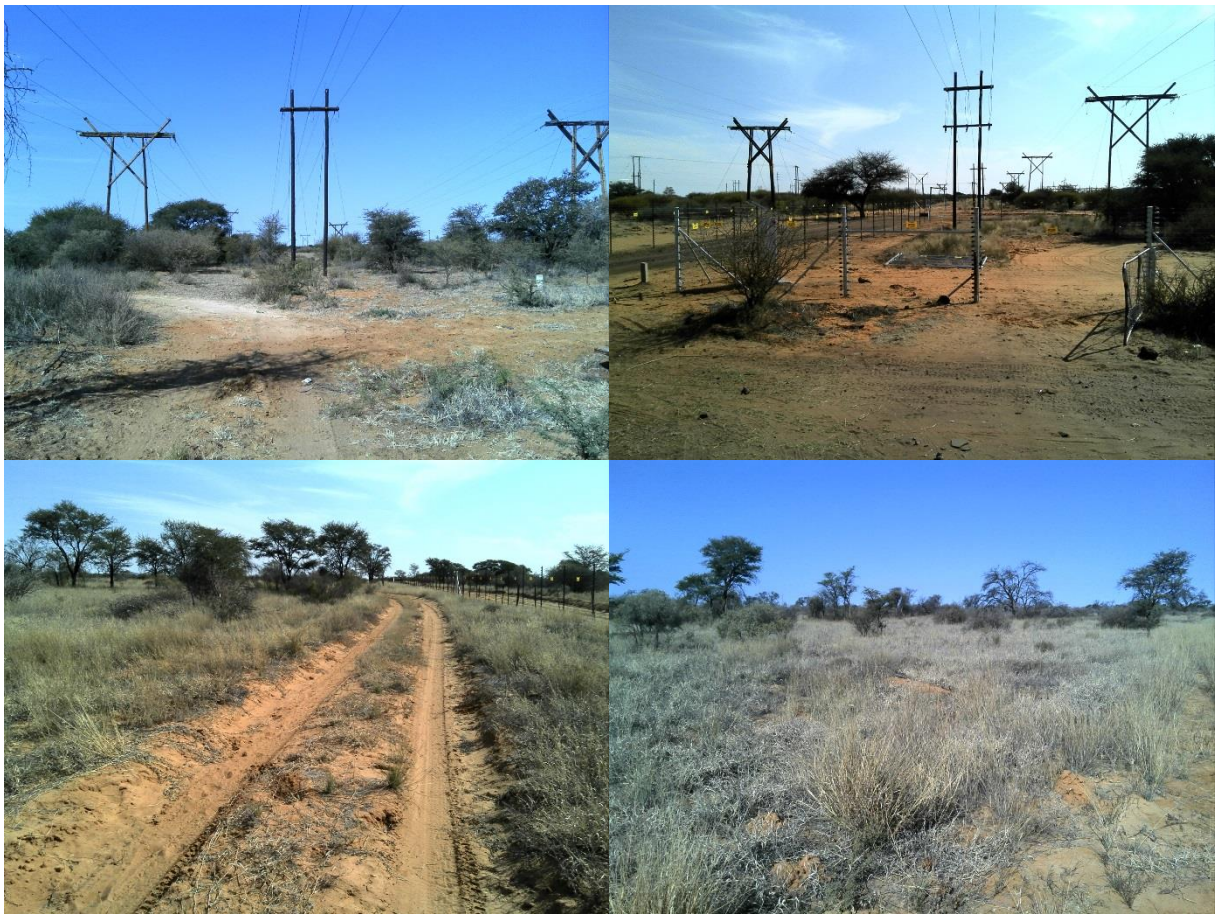

Figure 8: Various views of the typical habitat features associated with the southern sections of the proposed development site.

It should be noted that a high dominance of *Senegalia (=Acacia) mellifera* subsp *detinens* was noted within some areas, which is as a response to grazing and trampling pressures emanating from livestock. This was not thought, however, to be problematic within the area.

The natural vegetation units were well represented within the survey area and diagnostic floral species representative of the various vegetation types were present in both diversity and good numbers. Various impacting features have, however, transformed the floral species community structures to a degree.

5.2.3. Exotic and invasive floral species

Alien invader species are plants that are of exotic origin and are invading previously pristine areas or ecological niches (Bromilow, 2001). Not all weeds are exotic in origin, but, as these exotic plant species have very limited natural "check" mechanisms within the natural environment, they are often the most opportunistic and aggressively-growing species within the ecosystem. They are therefore often the most

dominant and noticeable within an area. Disturbances of the ground through trampling, excavations or landscaping often leads to the dominance of exotic pioneer species that rapidly dominate the area. Under natural conditions, these pioneer species are overtaken by sub-climax and climax species through natural veld succession. This process, however, takes many years to occur, with the natural vegetation never reaching the balanced, pristine species composition prior to the disturbance. There are many species of indigenous pioneer plants, but very few indigenous species can out-compete their more aggressively-growing exotic counterparts, which are then able to dominate an area, effectively displacing the natural floral components. The dominance of exotic vegetation also very often inhibits the establishment of undergrowth (small shrubs and grasses) by outcompeting them for resources. This then leads to subsequential exposure to soil erosion. Exotic vegetation also, being fast-growing, has relatively shallow root systems and therefore do not have any significant soil binding functionality. This is especially pertinent along watercourses where flowing water scours riverbanks. The soils are therefore easily eroded when the riverbanks are dominated by exotic vegetation.

Alien vegetation invasion causes degradation of the ecological integrity of an area, causing (Bromilow, 2001):

- A decline in species diversity;
- Local extinction of indigenous species;
- Ecological imbalance;
- Decreased productivity of grazing pastures; and
- Increased agricultural input costs.

Grasslands are particularly prone to bush encroachment and alien vegetation invasion as this vegetation type is the most utilised for agricultural purposes. This is mainly for livestock grazing, or complete transformation for agronomy (crops). These areas therefore suffer the highest degree of degrading factors that include overgrazing, trampling, incorrect fire management, and removal as grassland areas are traditionally sought after for agronomy as they often occur on rich, fertile soils. These factors lead to an imbalance in the species composition and make the grasslands prone to alien vegetation invasion. Bush encroachment can also occur within the savanna, where indigenous woody species dominate as a response mechanism to habitat disturbances (e.g. road development, overgrazing and trampling by livestock). This is not only true for pure grasslands, but to the grass component within savanna biomes as well. Species that readily encroach under these conditions are *Acacia karroo, Acacia mellifera* and *Dichrostachys cinerea*, and an increase in *Senegalia* (=*Acacia*) *mellifera* was noted throughout the survey area.

Succulent species such as *Opuntia ficus-indica* and *Cereus jamacaru* often also invade drier climates. A general loss of floral and faunal species diversity then occurs that was once dependent on the natural habitat. Riparian zones are also prone to exotic invasion due to the rich alluvial soils and moisture-rich habitat type. Species common throughout South Africa that invade riparian zones include *Eucalyptus camaldulensis, Populus x canescens, Melia azedarach, Salix babylonica, Robinnia pseudoacacia, Ligustrum lucidum*, etc. Riparian zones within the more arid north-western regions of South Africa are very often invaded by *Prosopis glandulosa, Eucalyptus sideroxylon* and *Eucalyptus camaldulensis,* and the riparian and wetland zones of the Kuruman River (within the northern section of the proposed development area) was included a significant component of *Prosopis glandulosa*. This was shown to be limited to the river valley area and the extent of invasion warrants intervention to eradicate it and to control future recruitment. This species adds a woody floral component in an otherwise grass-dominated habitat unit, which has an impact on the potential grazing value of the unit. It also displaces indigenous biodiversity, competes with indigenous counterparts for resources and offers limited ecological value nor function to the unit.

Figure 9: Prosopis glandulosa that was dominant within the watercourse of the Kuruman River.

Further than the encroachment of *Prosopis glandulosa* within the watercourse area of the Kuruman River. Invasion of exotic vegetation was not common within the survey area, probably due to the lack of seed banks within the remote areas. Seeds of exotic species are carried by the water and wind and this is regarded as the main mechanism for seed dispersal. Annual weed species such as Tagetes minuta and various *Conyza* species were common throughout, but not to problematic levels. The urban area Black Rock incorporated the typical cultivated garden floral species, although the general aridity of the region means that these species were dominated by indigenous drought-resistant floral species.

5.2.4. Floral species of conservational concern & protected species

Floral species of conservational concern are categorised according to their conservation status. Red Data Listed (RDL) species are those classified as *Critically Endangered* (CE), *Endangered* (EN) or *Vulnerable* (VU). Species are regarded as being Orange Listed if they fall into the categories of *Near Threatened* (NT), *Rare* (Ra), *Declining* or *Data Deficient* (DD). *Data Deficient* species are further categorised into DDD (Data deficient – insufficiently known) or DDT (Data deficient – taxonomically problematic) (*from* SANBI POSA).

The desktop survey for protected, RDL and Orange listed floral species showed that no species of conservational concern occur within the Quarter Degree Square (QDS) grid 2722BB associated with the impact area pertaining to the proposed development [according to the latest available data from SANBI (2015)], but tree species that are nationally protected under the National Forests Act (Act No 84 of 1998) were identified during the field survey, namely *Boscia albitrunca* (SA Tree no 122), *Vachellia* (=*Acacia*) *haematoxylon* (SA Tree no 169) and *Vachellia* (=Acacia) *erioloba (SA Tree no 168)* that were relatively common within the survey area.

The SANBI (POSA - Plants of southern Africa: A checklist) database was utilised in order to see if any protected tree species have been recorded from the survey area. It should be noted that a permit to remove or destroy protected species has to be sought from the national authority (DAFF) prior to the removal or destruction of these species. Protected species are not necessarily species of conservational concern, but have rather been protected from indiscriminate collection and destruction due to them being highly-valued for furniture production, infrastructure construction as well as ornamental use. Furthermore, these trees species generally have a timber quality and further characteristics that makes them sought-after for construction, ornament carvings and traditional medicines. The wood from these species is also a valuable firewood resource. These are all aspects that make these species a valued resource, especially to the rural sector. Therefore, many of these trees have been removed or are heavily-utilized within the rural sectors, regardless of their national protection status.

It is estimated that approximately 5 *Vachellia erioloba* will have to be either removed or trimmed to accommodate the overhead power line and servitude maintenance area. Approximately 50 *Boscia albitrunca* individuals may be impacted by the proposed development, with approximately 20 individuals falling within the proposed Lehating Substation footprint area. The most significant impact will be to *Vachellia haematoxylon*, with approximately 300 being identified within the footprint area of the proposed Lehating Substation that will be required to be removed, and it is estimated that this would be the scenario

for any locality of the substation within the given survey area. This species is notably common though throughout the survey area in suitable habitat. The arid nature of the region means that vegetation is slow-growing and takes time to establish. This means that recruitment following site disturbances is a relatively slow process and that spontaneous self-rehabilitation of vegetation does not readily take place.

Figure 10: Protected tree species noted within the survey area that will be impacted by the proposed development activities (top left: *Vachellia* (=*Acacia*) *haematoxylon*; Top right: *Vachellia erioloba*; Bottom: *Boscia albitrunca*).

Provincial legislature also provides a list of *specially protected* (Schedule 1) and *protected* (Schedule 2) floral species (NCNCA - Northern Cape Nature Conservation Act (Act 9 of 2009). It should be noted that the NCNCA regards all indigenous floral species as protected species (Schedule 2), where environmental authorisation will be required prior to removal or destruction of these species. Species of particular relevance that were observed within the scope of the survey site include those species already mentioned above as being of national importance.

5.2.5. Areas identified as ecologically sensitive for floral species of conservational concern

The region is regarded as being relatively arid, with the Kuruman River providing a greenbelt zone where the opportunity for the occurrence of habitat specialist species is provided. The mid to northern areas surveyed were also shown to have retained a high degree of functionality and little transformation. Therefore, there remains a high likelihood that RDL and protected species recorded from the area, within similar habitat units, would occur along the riparian zones of the river. An ecological sensitivity map has been developed as a guideline to overall ecological sensitivity of the area pertaining to the proposed development activities (see section 6), which also indicates the restriction to development that varies within the different zones.

5.3. Faunal features

It should be noted that the Northern Cape Nature Conservation Act (NCNCA) (Act 9 of 2009) has declared all faunal species that naturally occur within the province as protected. Only species that are considered vermin and exotic species are not included.

The survey area falls within a region that has suffered little transformation, has an expanse of wide open habitat, has a diversity of topographical features, and offers a seasonal source of surface water within an otherwise arid region that has suffered little disturbance. One of the few defining factors within the region is the occurrence of fences (mostly standard 1.2 m cattle and sheep fencing) as well as some informal roads (within the central to northern areas). Urbanisation and mining has largely transformed the lower areas associated with the proposed development activities. The riparian zones of the Kuruman River remain largely open to free migrations of wild animals. Further afield, formal commercial agriculture is a major driver of ecological change. Formal agriculture, however, is unlikely to expand significantly within the near future as this sector is dependent on the provision of an irrigation scheme that would require establishment of canal networks and pumping infrastructure. More and more landowners are realising the benefits of game farming within the region and therefore it is more likely that protected areas would expand, offering greater refuge to species.

5.3.1. Mammals

There are 55 mammalian species that have been historically recorded from the region pertaining to the area that will be impacted by the proposed development activities (Friedmann & Daly, 2004). This is regarded as a relatively low species abundance and can be attributed to the generally arid climate of the area that does not naturally support a wide species diversity. As mentioned, the area offers a large expanse of undeveloped and open habitat, with relatively few drivers of transformation.

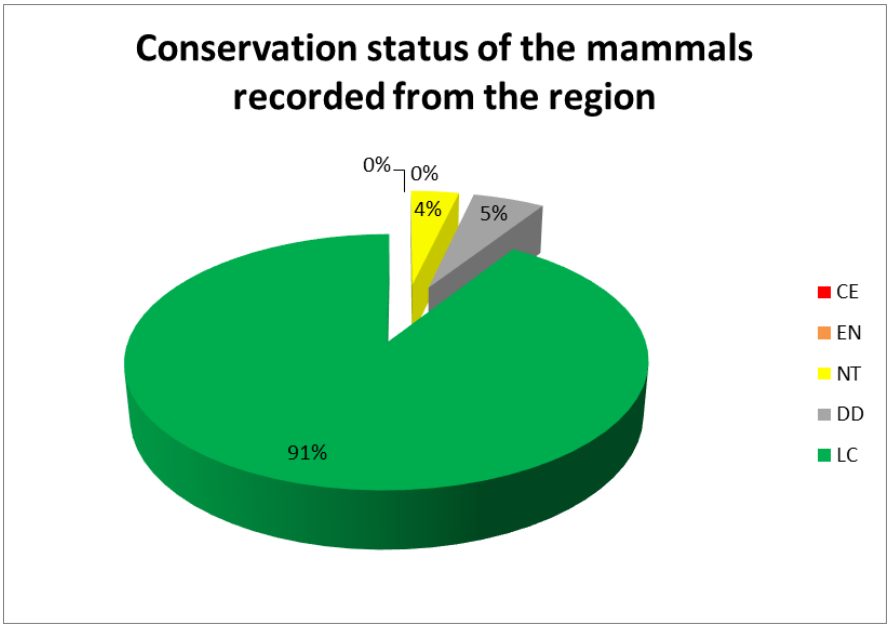

Figure 11: The proportion of mammalian species of conservational concern recorded from the region.

Figure 11 shows the conservation status categories of all the historically recorded species. Of a total of 55 species that have a historical distribution range that coincides with the survey area, none are classified as *Critically Endangered* or *Endangered*. Two (4%) are classified as *Near Threatened,* and three (5%) are classified as *Data Deficient*. The remaining 50 species (91%) are regarded as *Least Concern*.

Table 1: Mammalian species of conservational concern pertaining to the project.

Species	Common name	RDL status	Probability of occurrence
Red Data Listed (Threatened)			
None	None		
Orange Listed (Near threatened)			
Mellivora capensis	Honey badger	NT	Med-High
Miniopterus schreibersii	Schreiber's Long-Fingered Bat	NT	Low
Crocidura hirta	Lesser red Musk Shrew	DD	Med-High
Crocidura cyanea	Reddish-grey Musk Shrew	DD	Med-high

Species	Common name	RDL status	Probability of occurrence
Tatera leucogaster	Bushveld Gerbil	DD	Med-high

*** Probability of occurrence (*for naturally-occurring species*) – Distribution was based on historical records of species. Not all of these species would therefore occur within the area. Larger species would only be confined to fenced-off reserve and conservation areas.**

This analysis shows that there are no RDL mammalian species pertaining to the survey area. There are only Orange listed (*Near Threatened* and *Data deficient*) species applicable to the project and that could be potentially negatively impacted by the proposed development activities. The arid climate means that the region is generally inhabited by habitat specialist species, but the vastness of the open habitat means that habitat destruction does not feature as a major driver of ecological change within the area, both locally as well as cumulatively. It should be noted, however, that the cumulative impact of habitat transformation within the greater region, especially through mining, needs to be considered and that natural open habitat is becoming an increasingly rare feature. The full mammalian species biodiversity list is presented in Appendix A, Table 11

The main driver for the classification of the mammalian species as being of conservational concern that occur within the area is regarded as being habitat destruction and transformation. The region does, however, offer vastness and openness of habitat of similar type and therefore it can be assumed that these species would occur in positive numbers within the region. Mammalian species observed during the field survey are indicated in Table 2. These species were either observed directly (i.e. visually confirmed sightings) or indirectly (i.e. observations of scats, spoor, quills, etc). The species observed are all regarded as being widely distributed and relatively common throughout their geographical range.

Table 2: Observed mammalian species noted during the field survey.

Species	Common Name
Antidorcas marsupialis	Springbok
Raphicerus campestris	Steenbok
Redunca fulvorufula	Mountain Reedbuck
Sylvicapra grimmia	Common Duiker
Procavia capensis	Rock Hyrax
Aonyx capensis	Cape Clawless Otter
Atilax paludinosus	Water Mongoose
Canis mesomelas	Black-backed Jackal
Cynictis penicillata	Yellow Mongoose
Galerella sanguinea	Slender Mongoose
Genetta genetta	Small-spotted Genet
Ictonyx striatus	Striped Polecat
Vulpes chama	Cape Fox
Tadarida aegyptiaca	Egyptian Free-tailed Bat
Lepus capensis	Cape Hare / Desert Hare
Lepus saxatilis	Scrub / Savannah Hare
Cercopithecus aethiops pygerythrus	Vervet Monkey

Species	Common Name
Papio ursinus	Chacma Baboon
Cryptomys hottentotus	Common Mole-rat
Hystrix africaeaustralis	Porcupine
Mastomys coucha	Multimammate Mouse
Pedetes capensis	Springhare
Rhabdomys pumilio	Striped Mouse
Xerus inauris	Cape Ground Squirrel

Considering the mammalian species diversity recorded from the area, as well as the habitat type, quality, availability and connectivity, it is assumed that the proposed development is not going to have any significant long term impacts to mammalian species conservation within the region.

5.3.2. Avifauna

5.3.2.1. Habitat units

Within southern Africa, the diversity of bird species in different habitats is strongly dependent on habitat structure and rainfall. In general, the least structured and driest habitats have the fewest species, resulting in strong west-east gradient of increasing species richness (Hockey, *et al*, 2006). The relationship between rainfall and species diversity is, however, not as simple as that. Forests, for example, in high rainfall regions of southern Africa support less species diversity than mesic savannas. Endemism in avifaunal distribution is comparably simpler. Arid areas incorporate a higher degree of specialist species and therefore endemic species as well. There is therefore a simpler correlation between a rainfall gradient, habitat types and avifaunal species endemism than these climatic features and species diversity (Hockey, *et al*, 2006). The proposed development area occurs exclusively within the arid savanna (Karoo) biome, which is typified by low bushes, limited grass cover and taller trees only really occurring along riparian areas and sheltered kloofs. The survey area incorporates a river gorge and therefore rock faces also occur.

The survey area was designated habitat types according to those categories identified by Gibbon (2002) and those species recorded from the region that are known to favour those available habitat types were then focused on for the survey. RDL and other important migratory species that would potentially suffer undue impacts were emphasised during the survey. It is important to note that many of the avifaunal species are known as habitat generalists and therefore do not show complete habitat type specificity. Other species, however, are confined to only one habitat type. These habitat specialists are the species that are generally thought to suffer the greatest impacts as they are unable to adapt to habitat transformations within an area and are very often displaced from a specific area entirely once habitat

transformations have taken place. The relatively small spatial context of the proposed development activities limits the relevance of this aspect, however.

The habitat types identified for the survey region include the following:

- Bushveld and woodlands (BW) – this habitat unit is dominant throughout the survey area and is represented by the Nama Karoo. This is a vast area of low shrubs, perennial and annual grasses, and trees along ephemeral drainage lines;
- Freshwater habitats (Wa) – the riverine and riparian areas form the main focal points of the survey. The riparian zones and a reliable source of fresh water within an otherwise arid area forms a greenbelt that would be depended upon by many avifaunal species;
- Farmlands (Fa) – Farmlands are common throughout the survey area, but do not occur within the scope of the survey area itself. Farmlands (agricultural fields) occur along the banks of the Orange River within the survey region. It is included here as a habitat unit as avifaunal species would utilise the river as a migratory route between agricultural areas. Farmlands form a habitat type that is usually transformed seasonally and therefore does not form a stable habitat type. They are, however, seasonally attractive to various species such as storks and cranes (ACEE, 2006). Refugium is also very often limited within farmlands due to constant weed control and removal of basal vegetation layers. Many of the habitat generalist species utilise this habitat type predominantly for foraging and hunting purposes. The disturbances of the topsoil layers also very often allow for greater foraging for insectivorous species. The planting of grains increases rodent populations within the fields, which, in turn, increases the hunting potential for raptors and other opportunistic rodent eating species. The farmland habitat type, however, is not a habitat type that is relied upon by any avifaunal species for survival, but rather utilised by opportunistic species that migrate between agricultural fields could be adversely affected by collisions with overhead lines that they intercept (ACEE, 2006). Pesticides and fertilisers (agrochemicals) are well-known hazardous substances to wildlife, which impacts sensitive species within the region.

Those species that are regarded as *Near Threatened* are largely associated with waterbodies and habitat destruction has been cited as the major driver that impacts on the numbers of these species. The expansion of the shoreline as a result of the inundation may lead to increased habitat availability to these species over the long term. A negative impact is that many larger trees that inhabit the ravines and terraces within the riparian area, which are utilised for breeding and roosting habitat, will be drowned, which may impact some of the larger avifaunal species.

5.3.2.2. Avifaunal species diversity

There are 233 avifaunal species historically recorded from the QDS of 2722BB that includes the survey area (Gibbon, 2002). The full species list is presented in Appendix A, Table 12. Of these, nine (3.9%) are regarded as RDL (threatened), being classified as *Vulnerable* and a further 9 (3.9%) are regarded as *Near Threatened*. Those species classified as *Vulnerable* are generally the larger raptors that are threatened through habitat destruction, poisoning (persecution from stock farmers) and collisions with overhead lines. It is therefore imperative that the main migratory routes be identified and this impact mitigated for. Birds would utilise the watercourses and associated greenbelt zones for migration and navigation purposes. By placing Bird Flappers along the overhead lines that cross any drainage lines or the river, as well as along any prominent rocky ridge areas, this impact can be abated.

The diversity of habitat types incorporated into QDS grids from where the complete list is sourced makes for an exaggerated species diversity count and therefore not all of these species would be expected to occur within regions pertaining to the survey area. Examples would be those species specific to the forests, marine shoreline, etc habitat types. The RDL species list recorded from the region is presented in Table 3. Those species that are known to have a preference to the habitat units presented within the region are thought to suffer potential negative impacts from the proposed development activities.

Table 3: The RDL and Orange listed avifaunal species recorded from the region pertaining to the entire QDS of 2722BB. RDL species recorded from the region that have habitat preferences that do not correlate with habitat availability within the survey area have been omitted. Habitat abbreviations are given in Appendix A, Table 12.

Rob	English Name	*Scientific*	RDL Status	General Status	Habitats
RED LISTED SPECIES (THREATENED)					
122	Cape Vulture	*Gyps coprotheres*	VU	E-LC	BW, Ki, Gr, Ko, Ds, Fy, Mo, Fa
123	Whitebacked Vulture	*Gyps africanus*	VU	R-C	BW, Ki, Ko, Ds
124	Lappetfaced Vulture	*Torgos tracheliotus*	VU	R-U	BW, Ki, Ko, Ds
132	Tawny Eagle	*Aquila rapax*	VU	R-LC	BW, Ki
140	Martial Eagle	*Polemaetus bellicosus*	VU	R-U	BW, Ki, Gr, Ko, Ds
146	Bateleur	*Terathopius ecaudatus*	VU	R-LC	BW, Ki
183	Lesser Kestrel	*Falco naumanni*	VU	NBM-VC	Gr, Ko, To, Fa
230	Kori Bustard	*Ardeotis kori*	VU	R-R	BW, Ki, Gr, Ko, Ds
232	Ludwig's Bustard	*Neotis ludwigii*	VU	Er-U	Gr, Ko, Ds
ORANGE LISTED SPECIES (NEAR THREATENED)					
84	Black Stork	*Ciconia nigra*	NT	R-U/R	RC, Fa, Wa
89	Marabou Stork	*Leptoptilos crumeniferus*	NT	R-R/LC	BW, Wa
96	Greater Flamingo	*Phoenicopterus ruber*	NT	R(n)-LA	Wa, Ms
97	Lesser Flamingo	*Phoenicopterus minor*	NT	R(n)-LA	Wa, Ms
118	Secretarybird	*Sagittarius serpentarius*	NT	R-U	BW, Ki, Gr, Ko, Ds, Fy, Mo, Fa
168	Black Harrier	*Circus maurus*	NT	E-U	Ki, Gr, Ko, Ds, Fy, Mo, Fa
171	Peregrine Falcon	*Falco peregrinus*	NT	R/NBM-R	Fo, Gr, Ko, Ds, Mo, RC, To
172	Lanner Falcon	*Falco biarmicus*	NT	R-C	BW, Ki, Ko, Ds, Fy, Mo, RC, To, Fa
247	Chestnutbanded Plover	*Charadrius pallidus*	NT	R-U	Wa, Ms
305	Blackwinged Pratincole	*Glareola nordmanni*	NT	NBM-LA	Gr

Further to this, the White Stork (*Ciconia ciconia*) is protected under the BONN Convention. This species is an annual migrator to the region and it is threatened due to it being significantly impacted by collisions with overhead infrastructure and habitat destruction on a global scale.

Those species with a preference for water habitat (Wa) would only be able to utilise this habitat unit within the summer months of rainfall, when the Kuruman River carries persistence surface water. This is a strongly seasonal watercourse that dries every winter and therefore these species would seek this habitat unit elsewhere.

Further to this, there are a variety of non-RDL species that would also suffer undue negative impacts. The species that have a preference for the habitat units presented within the survey area and are thought to potentially be impacted by collisions within overhead lines are presented in Table 4.

Table 4: Further non-RDL species that could be impacted by collisions with overhead lines associated within the prject within the survey area.

Rob	English Name	*Scientific*	General Status	Observed
62	Grey Heron	*Ardea cinerea*	R-C	
63	Blackheaded Heron	*Ardea melanocephala*	R-C	
83	White Stork	*Ciconia ciconia*	NBM-C	
95	African Spoonbill	*Platalea alba*	R(n)-C	
102	Egyptian Goose	*Alopochen aegyptiacus*	R-A	
103	South African Shelduck	*Tadorna cana*	E-C	
104	Yellowbilled Duck	*Anas undulata*	R-A	
108	Redbilled Teal	*Anas erythrorhyncha*	R-C	
113	Southern Pochard	*Netta erythrophthalma*	R-C	
116	Spurwinged Goose	*Plectropterus gambensis*	R-VC	
131	Black Eagle	*Aquila verreauxii*	R-U	
136	Booted Eagle	*Hieraaetus pennatus*	R/NBM-C	
142	Brown Snake Eagle	*Circaetus cinereus*	R-U	
143	Blackbreasted Snake Eagle	*Circaetus pectoralis*	R-U	
148	African Fish Eagle	*Haliaeetus vocifer*	R-C	
149	Steppe Buzzard	*Buteo vulpinus*	NBM-C	
152	Jackal Buzzard	*Buteo rufofuscus*	E-C	
159	Little Banded Goshawk	*Accipiter badius*	R-C	
161	Gabar Goshawk	*Melierax gabar*	R-C	
162	Pale Chanting Goshawk	*Melierax canorus*	Er-C	
166	Montagu's Harrier	*Circus pygargus*	NBM-R	
169	Gymnogene	*Polyboroides typus*	R-C	
237	Redcrested Korhaan	*Eupodotis ruficrista*	Es-C	
239	Whitewinged Korhaan	*Eupodotis afraoides*	E-VC	
299	Burchell's Courser	*Cursorius rufus*	Er-U	
300	Temminck's Courser	*Cursorius temminckii*	R-U	
301	Doublebanded Courser	*Rhinoptilus africanus*	R-LC	
303	Bronzewinged Courser	*Rhinoptilus chalcopterus*	R/BM-U	
339	Whitewinged Tern	*Chlidonias leucopterus*	NBM-A	

The non-RDL species that could potentially be impacted by collisions with the overhead power lines associated with the proposed development within the survey region are made up of herons, egrets,

waterfowl, larger game birds, owls and a variety of larger raptors. The same mitigation measures recommended for averting the impacts on RDL species would be affective in averting the impacts to these species as well.

5.3.2.3. General avifaunal impacts

The impacts to avifaunal species and species community structures emanating from the proposed development activities can be categorised under the two main impacts of habitat destruction (inundation of habitat, flooding of trees that would otherwise be utilised for nesting, loss of terrestrial foraging areas, etc) and impacts resulting from collisions with the overhead power lines. This feature is generally limited to larger avifaunal species. There may also be positive impacts to avifaunal species emanating from the proposed development.

Interactions of wildlife, especially birds, with overhead power lines can be to both the infrastructure (damage to infrastructure due to shorting (earthing) from nest construction, streamers (faecal matter creating an arc between phase wires, etc.) as well as the biodiversity (ecological impacts). A major cause of unnatural mortality of birds emanates from collisions and electrocutions with overhead lines (van Rooyen, 2004). Species groups most at risk are those with heavier bodies and relatively small wingspan, making them less manoeuvrable and therefore more prone to collisions. Species groups include bustards, storks, cranes, eagles, vultures, ibises, etc. Further groups at risk are fast-flying waterfowl, especially ducks and geese. Another group of birds that are known to migrate at night are flamingos (ACEE, 2001; van Rooyen, 2004). Both the Greater flamingo (*Phoenicopterus ruber*) and Lesser flamingo (*Phoenicopterus minor*) have been recorded from the region, but these species tend to migrate between open wetland areas that offer substantive wadeable areas and therefore the likelihood of occurring within the survey area in significant numbers is low. Open water freshwater habitat with persistent or seasonal surface water is relatively rare within the region and therefore the significance of the impact to these two species is thought to be relatively low.

The impact that would be imposed on avifaunal species particularly that is different from the rest of the biodiversity is that of various species either colliding with, or being electrocuted by, overhead power lines. This impact will therefore be dealt with separately as being particular to the potential impacts on avifaunal conservation.

The avifaunal impacts associated with power line construction have been identified as the following (van Rooyen, 2004):

1. Site disturbances, habitat destruction and displacement of species. This is important to all species, but is most pertinent to RDL species identified within the area. Initial destruction and then the maintenance of vegetation clearing within servitudes have a greater impact within savanna areas in comparison to grassland-dominated areas. Grassland areas and areas incorporating a low canopy or sparse canopy cover (low) are generally not stripped of vegetation to accommodate a safe servitude for the overhead line and will re-establish within the servitudes (due to fire risks) following completion of the construction phases. Larger trees and shrubs within savanna areas are felled and removed and are not allowed to re-establish, which leads to habitat transformation. Individuals of larger trees (especially in cases of nationally/provincially protected species) can be accommodated and impacts avoided;
2. Collision of flying birds with overhead wires and electrocution. This is important not only to RDL species, but to all larger and migratory species. *The impact of electrocutions is mostly limited to lines of less than 132 kV due to the short distance between the earth wires and phase wires that can be spanned by larger birds with wider wingspans. This aspect is therefore of limited relevance to the proposed development.* Collisions with overhead power line and telephone line infrastructure accounts for a considerable proportion of the fatalities of larger avifaunal species. Groups such as korhaans and bustards (both represented within the survey area) seem to be particularly prone to collisions, with mortality rates of up to one individual per year per kilometre of line being reported within Karoo areas (Hockey *et al*., 2006).

The impacts on the power lines themselves emanating from avifauna within the area have also been identified as important aspects to consider. These include (van Rooyen, 2004):

1. Bird collision that create interruptions in power supply;
2. Streamers (long streams of bird excreta) emanating from perched birds on pylons can cause short-circuits by affecting the insulators fitted to the line;
3. Nesting birds on pylons that can potentially lead to short-circuits and fires. Some species utilise pieces of wire during nest building, which can short-circuit when the nest collapses (ACEE, 2003).

Research has indicated that 8.1% of recorded line faults have been directly attributed to bird collisions (Bologna, et al., 2001). This is the fourth largest reason for recorded line faults behind “unknown reason” (38.2%), storms (28.8%) and grass fires (15.6%). Following further research, the “unknown” category was thought to contain a large proportion of faults related to bird streamers (long streams of bird excreta).

Further studies on a 275 kV line have shown that 34% of all line faults were due to bird streamer-related faults (Taylor, *et al*., 1999). This has obvious economic implications, with the estimated cost to the South African economy being in the region of R25 million annually (Bologna *et al*., 2001). Reducing bird collisions and further impacts emanating from bird interactions with the power lines is therefore in the better interests of the service provider as line faults are exceedingly costly to rectify.

There are positive interactions between overhead power lines and avifauna as well (van Rooyen, 2004):

1. Pylons can provide a safe nesting and perching sites away from predators. Some Lesser kestrel colonies have been shown to use overhead lines almost exclusively as perching sites;
2. Pylons can also provide nesting sites within areas devoid of tall trees. This has enabled certain species to expand their range.

5.3.2.4. Impacts on avifauna within the survey area

The proposed development activities include the establishment of impoundments along a river, which will lead to permanent inundation of riparian and adjacent terrestrial habitat. Associated infrastructure will include localised powerhouse infrastructure and associated overhead power lines. Below are some pertinent points that are to be taken into consideration when assessing avifaunal impacts and conservation:

1. The species community structures within the various areas pertaining to the proposed project and what proportions of these communities are at risk to collision impacts and are of conservational significance;
2. The degree of habitat destruction that is considered important to avifaunal conservation (especially RDL species);
3. Areas prone to adverse weather conditions that would increase the risk of collisions (mist, high wind velocities, etc.) (ACEE, 2001);
4. Cultivated grain and pasture crops are often seasonally attractive to many species (e.g. cranes and storks) (ACEE, 2001) and are at risk of collision impacts during routine migrations between roosting and foraging areas;
5. Traversing areas that incorporate topographical features that are known to be used by migratory birds as navigational aids, such as mountains, shorelines and river valleys, that pose a risk of collisions with overhead lines should preferable be avoided (ACEE, 2001; van Rooyen, 2004);
6. Route alternatives would be preferred that are located in close proximity to the existing main transmission system infrastructure. Studies have shown that migratory birds become familiar with

the power line patterns within an area and therefore learn to avoid them (van Rooyen, 2009). Existing infrastructure in the area is, however, limited;

7. Existing habitat that is considered as being highly degraded due to historical and present transformations is preferred;
8. Habitat units known to be highly productive in supporting breeding, foraging and roosting sites, such as wetlands, should be avoided;
9. The degree to which each impact can be realistically mitigated in terms of economic viability and the effectiveness of the mitigation measures needs to be evaluated.

The main migratory routes (if any) needed to be identified as part of the avifaunal impact survey and to determine if the overhead power lines will pose a threat to migrating birds. The migratory routes followed would typically coincide with river valleys or valley-bottom wetlands, rivers or mountain ridges. This would ultimately lead to an increase in mortalities of various avifaunal species due to collisions with the overhead lines if the line crosses over these habitat types and would therefore require mitigation to lessen the impacts. A watercourse is associated with the proposed development and therefore collision impacts emanating from the proposed development activities are of concern.

The impacting features emanating from the proposed development activities would also come from the direct habitat destruction within the footprint of the area that will be inundated as well as infrastructure footprints (servitude roads, power house, etc). This includes the immediate adjacent support areas required for use during the construction phase. Species of conservational concern that could be adversely affected by this impact include the ground-dwelling and nesting species such as the bustards, korhaans as well as the Secretarybird. It is also applicable to larger raptors that would potentially nest in the larger Camel thorn (*Vachellia* (=*Acacia*) *erioloba*) trees that occur within outer limits of the riparian zones of the Kuruman River within the area.

5.3.2.5. Proposed mitigation measures

The destruction of habitat that will be associated with the proposed Lehating Substation footprint is regarded as being the greatest impacting feature to avifaunal conservation within the area. The substation footprint area, as well as a buffer zone surrounding it will be completely stripped of vegetation and maintained as such to avert fire risks. This therefore leads to a complete transformation of the habitat, albeit a localised impact. The significance of this impact can be reduced through the reduction of the overall impacting footprint area that is required for service provision (storage yards, service roads,

construction camps, etc that fall outside of the final footprint area). The actual overhead power line and associated towers are thought to not have a significant long term impact as most of the habitat impacted during the construction phase will be either reinstated as part of a rehabilitation plan, or the vegetation will naturally reinstate. The establishment of overhead power lines, and the subsequent risk of collision impacts, are regarding as a secondary impact as well, which can be mitigated for.

Various mitigation measures have been proposed to reduce the impacts of collisions of birds with power lines. Electrocutions are generally not regarded as an impacting feature for power lines of 132 kV or above due to the distance between the earth and phase conductors being greater than the greatest measured wingspan of South African birds. It is well-known that collisions with the overhead shield (earth) wire far outnumber collisions with the phase (conductor) wires. This is because the earth wire is a single line suspended above the conductor lines, which are often bundled together in groups of four or five lines, or the phase wires are considerably thicker than the associated earth wire. These bundled lines are therefore far more visible in comparison to the earth wire, and collisions occur due to poor visibility. Studies have shown that collisions increase within areas where misty conditions are common (Manville, 2005). Collisions also increase when cloud cover is high, presumably due to the lack of contrast between the lines and the background cloud colour. Mitigation measures should therefore be aimed to making the earth wire more visible.

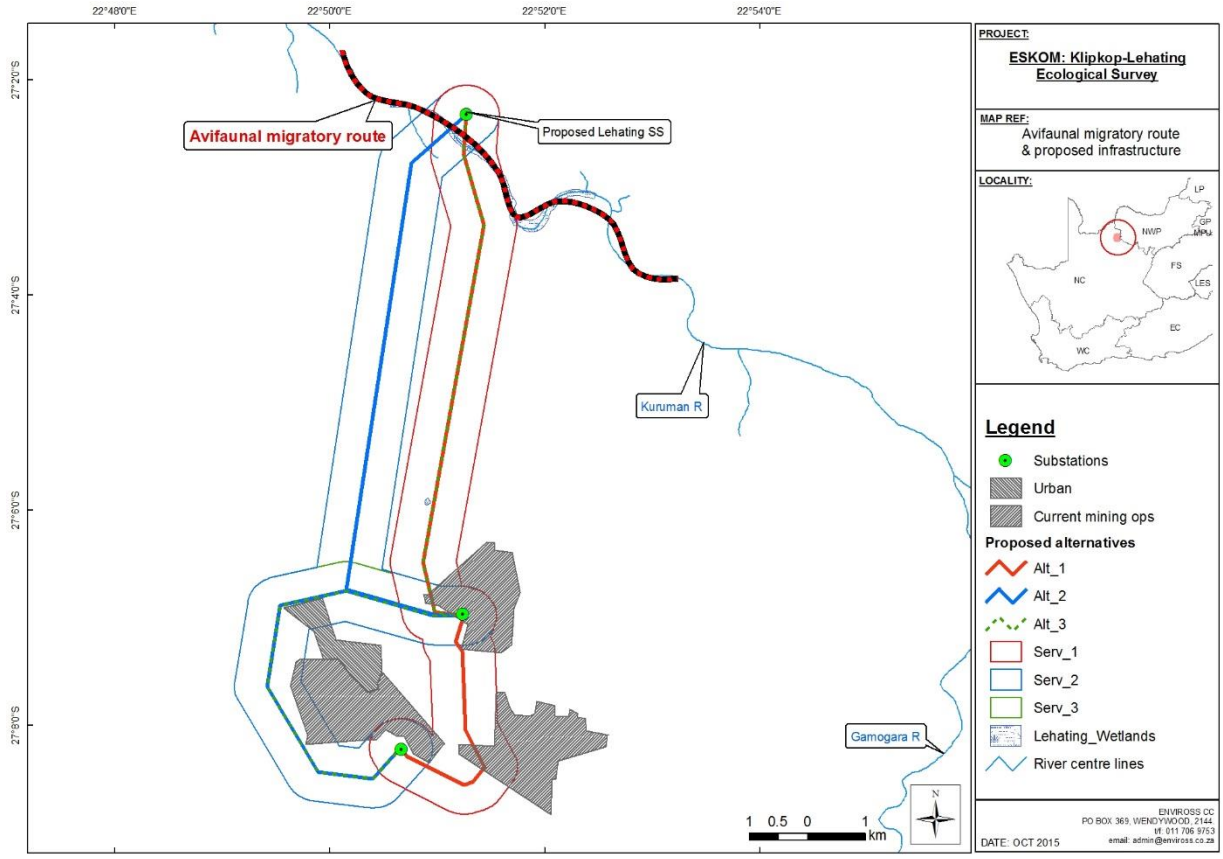

Figure 12: A main migratory route applicable for avifaunal species within the area pertaining to the proposed development activities.

The most favourable mitigation measure to lessen the impacts of bird collisions is to plan the alignment in such a way that migratory routes are avoided and, if this is not possible, to make the lines as visible as possible along these migratory routes. In a linear construction of this magnitude there are numerous factors to consider when choosing a preferred route, and making major alignment shifts are very often not feasible. Bird Flight Diverters (BFD's) were developed in Europe and are attached to the conductor wires. Studies, however, have indicated that their use has had limited success in averting collision impacts in South Africa (ACEE, 2001). Another device, known as a *Bird Flapper*, has been used on a large scale in South Africa since 2001 and has proven to be more effective than the use of BFD's. A *Bird Flapper* is a reflective metallic disc-type device that is loosely attached to the earth wire. The loose-fitting attachment allows the disc to move freely in the wind. The resulting intermittent reflecting of the sun off the disc allows for a device that is highly visible from a greater distance. Fitment frequency of these Bird Flappers has been suggested at 10 m intervals and staggered along parallel lines, resulting in a bird Flapper device being visible along every 5 m of line (ACEE, 2001). These devices should be fitted along all areas were migratory routes have been identified within the survey area. It is also considered to be more practical and more economical to fit these devices at the time of construction rather than to retrofit them. Some RDL species

are known to migrate at night, when line visibility is at its lowest. Flamingos are known to migrate between major water bodies at night or during dusk, where they often fall victim to collisions with overhead infrastructure due to poor visibility. Fluorescent tubes that derive power from the conductor fields of the lines have been shown to avert this impact in high impact areas (ACEE, 2001). It is assumed that there would be few encounters with flamingos as the habitat type is not conducive to supporting large numbers of both species recorded from the region.

Another mitigation measure that has been suggested is the removal of the earth shield wire from areas where migratory routes have been identified, as long as these areas do not fall within areas that are subjected to major electrical storms (ACEE, 2001). This is considered non-feasible due to technical constraints and implications.

5.4.3. Reptiles

Limited reference species lists are available for the quarter degree square area of 2722BB, and therefore the query was expanded to include the degree square regional area of 2722, where it was shown that 46 reptilian species have been recorded within a recent census of the area (Bates *et al.,* 2014; ADU [SARCA] 2015). None the species recorded are regarded as being conservationally significant. The most common species within the region, as indicated by the largest number of observations from SARCA (2015) are *Trachylepis variegata* (Variegated skink), *Trachylepis spilogaster* (Kalahari tree skink), *Pedioplanis lineoocellata lineocellata* (Spotted sand lizard) and *Agama aculeata aculeata* (Common ground agama). Species observed during the field survey were *Trachylepis variegata* (Variegated skink), Puff adder (*Bitis arietans arietans*) and Common dwarf gecko (*Lagodactylus capensis capensis*). These are commonly-occurring and widely distributed species.

Reptilian species are largely dependent on habitat unit structures and prey abundance, which, in turn, also depends on general habitat unit structure and condition. Many reptilian species, together with a large proportion of their prey species, have been shown to be broadly tolerant to a variety of habitat types. The overall good ecological state of the habitat units associated with the survey area means that reptilian species particular to the habitat unit availability would be expected to occur in good abundance. The habitat type, offering a high level of refuge, further reiterates the expectation of good species diversity and abundance. The proposed development will have a limited impact on reptilian conservation within the area due to a limited footprint and the generally short-lived construction phase. One direct impact is

thought to be the killing of snakes encountered by construction crews due to superstition and staff should be educated on the importance of reptilian conservation. Staff should be trained on the safe handling of snakes for relocation purposes should snakes be encountered within workspaces. The full potential reptilian species list is presented in Appendix A, Table 14

5.4.4. Amphibians

Habitat loss, in all its many forms, was cited as the most pervasive threat facing amphibians and was listed for all species during the analysis for the frog atlas project (Minter, *et al.*, 2004) and therefore habitat destruction should be limited to the absolute minimum throughout the survey area. This is especially pertinent to riparian and wetland habitat units. Amphibians have been shown to be steadily declining as a world-wide phenomenon. Care should therefore be practised in conserving all suitable habitats to aid in abating declines in amphibian numbers and diversity.

Again, the search parameter was extended to include the entire 2722 degree square area as opposed to only the QDS of 2722BB as amphibian species diversity was shown to be relatively low. Only eight species have been recorded from the region within the recent census, none of which are of conservation significance (Minter *et al*., 2004; du Preez & Carruthers, 2009 and ADU, 2015). The general lack of persistent surface water within the area limits the occurrence of amphibians as this is a requirement for breeding habitat. The full potential amphibian species diversity list recorded from the region is presented in Appendix A, Table 15.

No significant impacts are thought to be imposed on amphibian conservation within the region. The wetlands associated with the Kuruman River would be utilised seasonally by a variety of species and represents the only significant habitat feature to amphibians. The overhead power lines can span across the watercourse and associated riparian zones with little need to impact the associated habitat.

5.4.5. Invertebrates

The invertebrate taxa that are of conservational concern include the Mygalomorph spiders, scorpions, certain butterfly (Lepidoptera) and dragonfly and damselfly (Odonata) species.

5.4.5.1. Butterflies

There are 18 butterfly species recorded from the QDS region of 2722BB (ADU, 2015), none of which are of conservation concern. Habitat areas that remain important to butterfly conservation within the area are the riparian zones of the watercourses, but the natural grasslands (limited within the survey area), riparian and rocky ridge habitats. These habitat units coincide with the areas identified as being of high ecological sensitivity.

6.4.5.2. Mygalomorph spiders

Mygalomorph spiders as a taxon, includes various families of trapdoor and baboon spiders. This is a poorly-studied taxon nationally, making accurate distribution data difficult to source. The family of Theraphosidae (baboon spiders) are a nationally protected taxa under CITES, prohibiting collection, trade and destruction without the applicable permits (subject also to provincial legislation).

Mygalomorphs are all generally sedentary in habit. The females establish variations of burrows where they generally remain throughout their lifetime. Males, especially during mating seasons, are generally free-roaming. The females are therefore especially vulnerable to habitat destruction and transformations as disturbances that destroy burrows often destroy the inhabitant, or, if displaced from the burrow, the females have difficulty in establishing new burrows or finding adequate refugia. Conservation of this taxon therefore relies on intact habitat functionality.

Mygalomorph spiders inhabit virtually all the habitat types that are represented throughout the survey region, including transformed habitat, although none were observed during the field survey. General habitat conservation is therefore the most viable mitigation measure to abate undue impacts on these species – as is applicable to all biodiversity within the region.

6. SENSITIVITY MAPPING

The survey area incorporates a river valley area that has been subject to minimal transformation and degradation. The area has largely remained open and undeveloped, excepting for limited farming infrastructure with minimal footprint areas. The habitat unit is dominated by riverine and riparian types, with adjacent fringing arid ecotonal low woodland areas. The regional arid climate means that surface water ecosystems are particularly ecologically sensitive, as it supplies a resource that is depended upon by

a great variety of species. This is particular to the northern section of the proposed development. The southern area of the proposed development associates with existing high impact land use and existing infrastructure. These areas have been designated as areas of low ecological sensitivity. The central area of the proposed development has been designated as an area of medium ecological sensitivity. Only small scale transformations have taken place here and much of this section has retained ecological functionality and offers viable habitat to support biodiversity within the area.

Limitations to development according to these zones are proposed below:

- High ecological sensitivity: Ideally these areas should not be disturbed by development and alternative layouts to avoid these areas should be sought. In this case, this impact is unavoidable. A rehabilitation effort for these areas (exotic vegetation management, removal of derelict infrastructure, etc) should be implemented as part of the proposed development. If development within these areas is found to be unavoidable, then site-specific mitigation measures, routine auditing and routine monitoring should take place;
- Medium ecological sensitivity: These areas form support areas as well as buffer zones for other areas regarded as being of high ecological sensitivity. Development within these areas can take place, but care should be taken to not impact any areas designated as being of high ecological sensitivity, as well as creating fringe impacts to those areas designated as being of high ecological sensitivity. If existing infrastructure already exists within this area, then new infrastructure should couple to or be aligned adjacent in order to limit the overall long term footprint. Mitigation measures should be in place to avoid any further overall degradation of these areas;
- Low ecological sensitivity: These areas suffer considerable degradation and transformation to the extent that they offer very limited ecological value. Development within these areas can take place, but again, no impacts should be allowed that will lead to fringing impacts and/or impacts that will lead to degradation and/or transformation of areas regarded as being of high or medium ecological sensitivity (e.g. protection of stockpiled topsoil so that surrounding watercourses will be protected from siltation, etc).

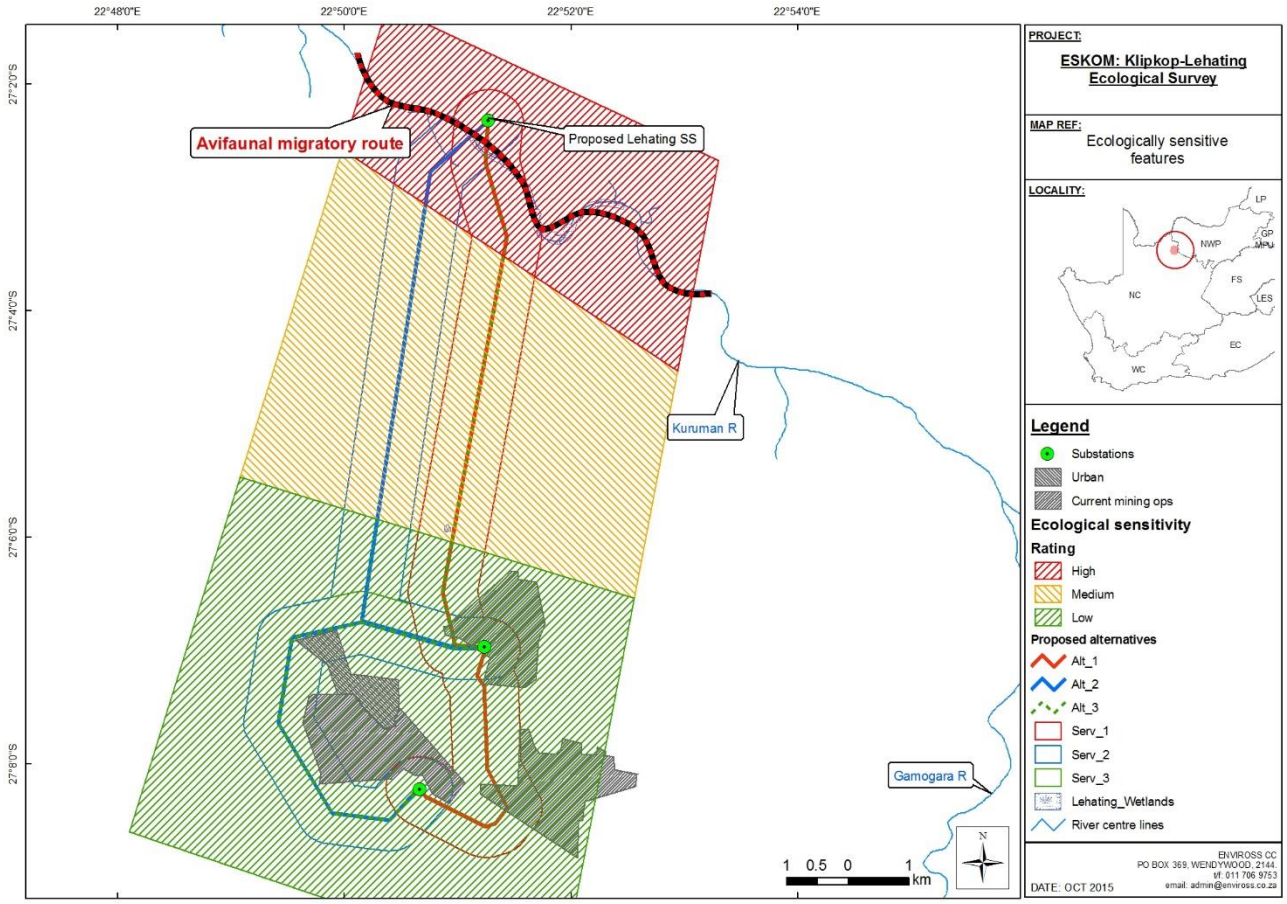

Figure 13: Sensitivity zoning for the area pertaining to the proposed Lehating Substation and associated Klipkop-Lehating overhead power line.

7. PREFERRED ALTERNATIVES

7.1. Substations

Only one site for the Lehating Substation site has been offered and therefore no alternatives have been explored. The survey area for the proposed substation site was expanded to allow for shifting of the footprint to accommodate various features. The proposed footprint area incorporates a relatively high density of a nationally protected tree species, namely *Vachellia haematoxylon*. Figure 14 indicates the density of this species within the footprint area, where 272 individuals were mapped. This is an indication of the general density of this species within the local area and can be used as an indication of how many individuals will be impacted for permit purposes.

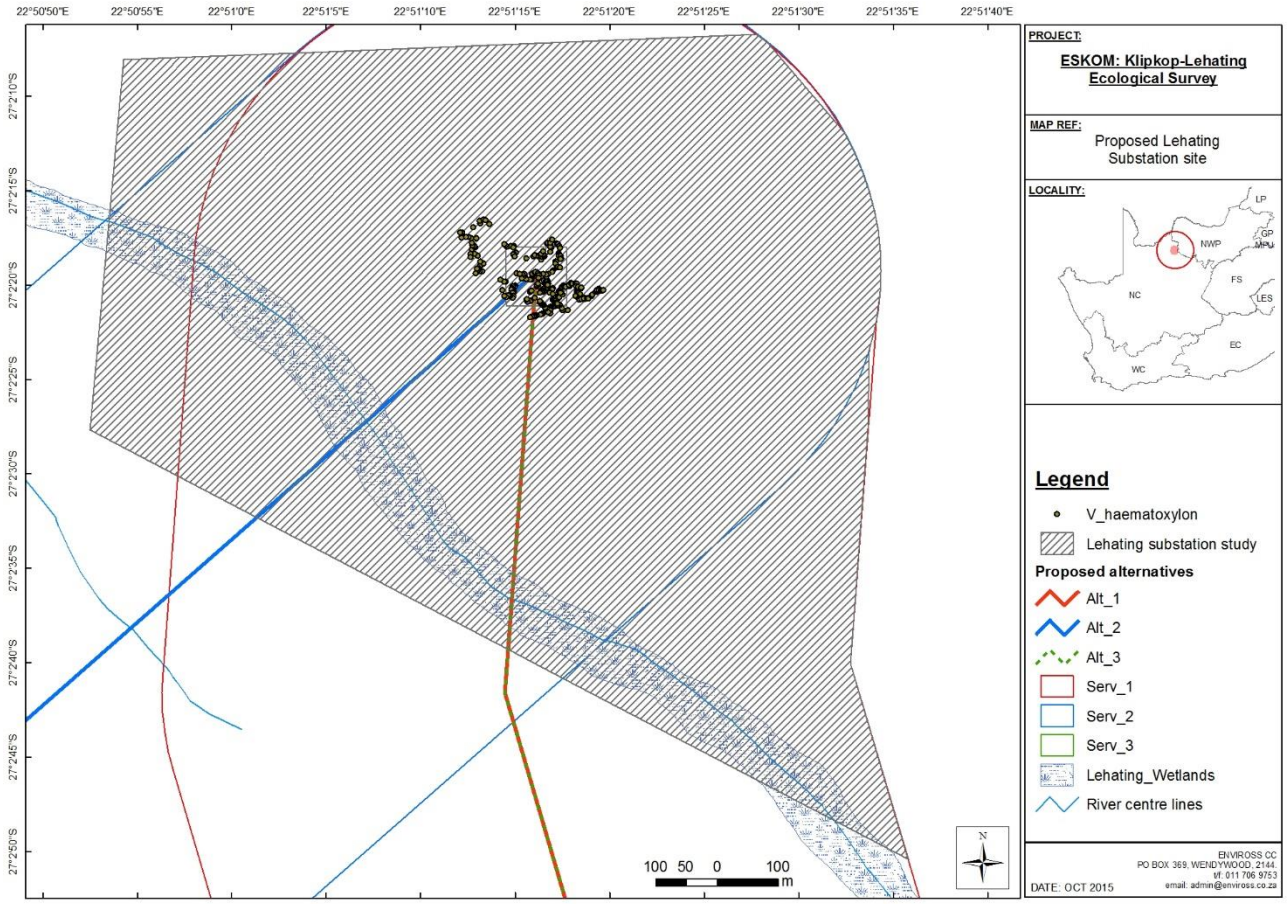

Figure 14: Proposed footprint area for the proposed Lehating Substation site due to sensitive ecological features identified during the field survey.

7.2. Power line alignment alternatives

Three alternatives of the proposed alignment of the overhead power lines have been offered (Alt1, Alt 2 and Alt 3), with a further two alternatives offered that are deviations of Alt 3 (Alt 3A and Alt 3B), which is due to this alternative potentially impacting future development of the current landowner. These two further deviations only affect the northern 2 km of the proposed line and are presented in Figure 15. From this figure it can be seen that these proposed deviations fall in line with the study corridors associated with the other proposed alignment routes.

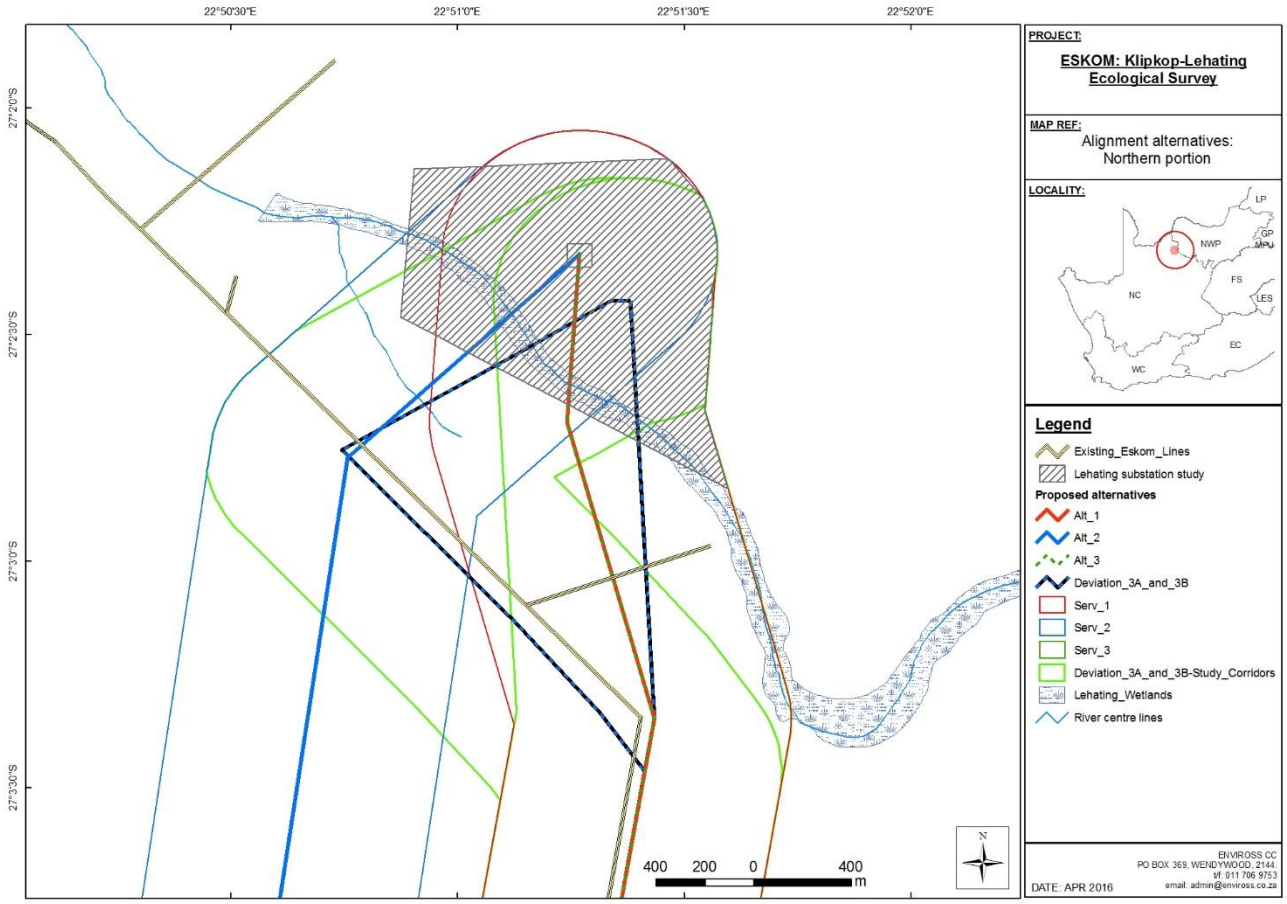

Figure 15: Proposed deviations of Alt 3 for the last 2 km of the northern end of the proposed power line routes.

Table 5 provides a rating of the various alternatives as well as comments on reasoning. The analysis of the impacts of the overhead power lines includes the loop in and loop out lines from the proposed Klipkop-Lehating line to the existing Wessels Substation (located between the proposed Lehating SS and the existing Klipkop SS). No alternatives have been offered for these loop in and loop out lines.

Table 5: Analysis of the various infrastructure alternatives presented for the survey.

Alternative	Advantages	Disadvantages	Preference*
Lehating Substation			
Alternative 1	Refer to mapping (Figure 14)	-	-
Overhead power line route alternatives			
Alternative 1	Shortest route and therefore has the smallest overall footprint	Moves through some areas where no comparable infrastructure exists	3
Alternative 2	Relatively shorter route	Moves through some areas where no comparable infrastructure exists	2
Alternative 3	Remains associated with	Relatively long route	1

Alternative	Advantages	Disadvantages	Preference*
	existing infrastructure of equal or greater stature		
Alt 3 deviation A	-	Relatively longer route and will therefore have the largest footprint of the two deviation alternatives.	2
Alt 3 deviation B	Falls in line with the existing preferred option of Alt 3 and is also the shortest route therefore having the smallest overall footprint area.	-	1

Preference: 1=Preferred; 2=Less preferred; 3=Not preferred.

8. IMPACT SIGNIFICANCE & RATINGS

The potential impacts pertaining to a development of this nature have been identified that could be deleterious to the overall long term ecological functionality and integrity of the proposed development area. The nature of the proposed development means that some impacts cannot be mitigated and that they will impose permanent and total transformation of the present habitat units, whilst others are negated with the implementation of mitigation measures. The significance of these impacts has been rated (quantified) to indicate the severity on various ecological components pertaining to the project. Mitigation measures have been proposed where applicable. It should be noted that the successful implementation of the mitigation measures and the long-term impacts on the overall ecological integrity at the development site can only be possible with the efforts of the management and construction teams associated with the project.

For each potential impact, the **EXTENT** (spatial scale), **MAGNITUDE**, **DURATION** (time scale), **PROBABILITY** of occurrence, **IRREPLACEABLE** loss of resources and the **REVERSIBILITY** of potential impacts are assessed.

Once the evaluation components have been ranked for each potential impact, the significance of each potential impact will be assessed (or calculated) using the following formula:

SP (significance points) = (magnitude + duration + extent + irreplaceable + reversibility) x probability

The full details of the calculations, rankings and scoring protocols are provided in Appendix C.

The significance points (SP) are calculated by the following formula:

$$SP = (M + D + E + I + R) \times P$$

Where:
SP = Significance points
M = Magnitude
D = Duration
E = Extent
I = Irreplaceability
R = Reversibility
P = Probability

The cumulative impacts (C) are rated separately – as per definitions provided in Table 17 (high, medium, low, none).

A summary of the ratings scores for the various aspects is presented in Table 6, with more detailed definitions provided in Table 17 and Table 18. Table 7 presents the outcomes of the perceived ecological impacts imposed by the proposed development activities on the conservation of important habitat units and associated ecological features, functionality and biodiversity conservation. This has been shown for both before and after the implementation of mitigation measures for the duration of the construction and management phases of the proposed development.

Many of the perceived ecological impacts are rated as low to medium. This is largely due to the localised extent of the infrastructure that requires complete habitat modification (the proposed Lehating Substation site) and the limited long term significance of the impacts associated with the overhead power line and associated towers. Limited faunal and floral species of conservation significance also occur within the area. Many of the impacts, especially localised impacts, have been shown to be negated through proposed mitigation measures.

The cumulative ecological impacts from existing similar development were also included. It was shown that the general cumulative impact is a low to medium rating as overhead power lines do exist within the area, and other infrastructure such as mining, urban environments and road development has led to accumulated loss of habitat.

Table 6: Rating scores for the various factors used for calculating the significance rating of a particular impact.

Magnitude (+ or -)		Duration		Extent		Irreplaceable		Reversibility		Probability	
Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
Very high (severe)	10	Permanent	5	International	5	Definite	5	Irreversible	5	Definite (>95% chance)	5
High (considerable)	8	Long term (>20 yrs)	4	National	4	High	4	Low	4	High probability (75-95%)	4
Medium (notable)	6	Medium term (5-20 yrs)	3	Regional (within 5 km) Within provincial)	3	Moderate	3	Moderate	3	Med probability 25-75%)	3
Low (slightly)	4	Short term (<5 yrs)	2	Local (within 5 km)	2	Low	2	High	2	Low probability (5-25%)	2
Very low (negligible)	2	Intermittent (sporadic)	1	Site specific (within 100 m)	1	Very low	1	Will be reversed	1	Improbable (<5%)	1
Zero (unaltered)	0			None	0	None	0	No impact	0		

Table 7: Significance assessment of the perceived major environmental impacts pertaining to a development of this nature and general ecological and habitat conservation both before and after mitigation measures that are applicable to the proposed development activities.

POTENTIAL ENVIRONMENTAL IMPACT / NATURE OF IMPACT	Project activity or issue	ENVIRONMENTAL SIGNIFICANCE																		
		BEFORE MITIGATION									AFTER MITIGATION									
		M	D	E	I	R	P	SP	S	C	M	D	E	I	R	P	SP	S	C
Planning and design (Pre-construction & Construction)																				
Infrastructure development (Stripping of the substation site, construction camps and storage yards, servitude roadways and other supporting infrastructure)																				
General habitat destruction	**Vegetation removal**	6	4	1	2	4	5	80	MH (-)	L	4	4	1	2	3	4	56	L (-)	L
	Comment: Vegetation will be directly impacted through complete removal within the infrastructure footprint area to accommodate the substation site, which will be maintained in perpetuity. Construction camps and storage yards will be rehabilitated upon completion of the construction phase.																		
	Summary of mitigation points: Limit the impact to the footprint and immediate support areas, especially within the areas associated with the proposed substation site; Do not store building materials and excess stockpiled soils within riparian zones or within areas where natural vegetation will remain following completion of the construction phase of the development (ie retain impacts to areas where infrastructure is to be permanently established); Avoid indiscriminate destruction of habitat.																		
	Displacement of faunal species within the local area	4	2	1	2	2	4	44	L (-)	L	4	2	1	2	1	2	20	L (-)	L

POTENTIAL ENVIRONMENTAL IMPACT / NATURE OF IMPACT	Project activity or issue	ENVIRONMENTAL SIGNIFICANCE																	
		BEFORE MITIGATION									AFTER MITIGATION								
		M	D	E	I	R	P	SP	S	C	M	D	E	I	R	P	SP	S	C
	Comment: Vegetation removal and ongoing construction activities will displace faunal species, which will be displaced from the local area; Following completion of the construction phase and subsequent ceasing of disturbance features and rehabilitation of the local site, faunal species will again return to the area.																		
	Summary of mitigation points: Limit the impact to the footprint and immediate support areas, especially within the areas associated with the proposed substation site; Do not store building materials and excess stockpiled soils within riparian zones or within areas where natural vegetation will remain following completion of the construction phase of the development (ie retain impacts to areas where infrastructure is to be permanently established); Avoid indiscriminate destruction of habitat.																		
Direct impacts on RDL & protected species	**Direct impacts due to inclusion of RDL species in vegetation removal**	4	4	1	3	3	3	45	L (-)	L	2	4	1	2	3	3	36	L (-)	L
	Comment: Protected tree species do occur within the scope of the survey area that will be impacted by the proposed development activities. Although not RDL, a permit to remove and/or destroy those individuals affected will have to be applied for through the relevant authorities.																		
	Summary of mitigation points: Limit the impact to the footprint and immediate support areas, especially within the areas associated with the proposed substation site; Do not store building materials and excess stockpiled soils within riparian zones or within areas where natural vegetation will remain following completion of the construction phase of the development (ie retain impacts to areas where infrastructure is to be permanently established); Avoid indiscriminate destruction of habitat; Alignment shifting of the overhead power line is recommended to accommodate taller Vachellia erioloba (camelthorn) individuals. Limit the extent of vegetation clearing within the servitude area.																		
Construction of overhead power lines & towers																			
General habitat destruction	**Vegetation removal and landscaping to accommodate servitude roadway and tower footprints:**	4	3	2	3	3	5	75	MH (-)	L	4	2	1	2	2	3	33	L (-)	L
	Comment: Vegetation will be directly impacted where excavations are needed for foundations at each tower footprint. This feature is not absolute and therefore the overall long term significance is regarded as low.																		
	Summary of mitigation points: Limit the impact to the footprint and immediate support areas; Storage of building materials and excess stockpiled soils to only be allowed in designated areas and not within areas where natural vegetation will remain following completion of the construction phase of the development; Avoid indiscriminate destruction of habitat.																		
	Construction of the towers (and supporting infrastructure – camps, yards, stockpiles, etc):	6	3	2	3	3	5	85	MH (-)	L	4	2	1	2	2	3	33	L (-)	L
	Comment: Indiscriminate vegetation stripping within riparian areas where the greatest potential for the occurrence of RDL (or protected) faunal or floral species to occur leading to loss of those species.																		

POTENTIAL ENVIRONMENTAL IMPACT / NATURE OF IMPACT	Project activity or issue	ENVIRONMENTAL SIGNIFICANCE																	
		BEFORE MITIGATION									AFTER MITIGATION								
		M	D	E	I	R	P	SP	S	C	M	D	E	I	R	P	SP	S	C
	Summary of mitigation points: Limit the impact to the footprint and immediate support areas; Storage of building materials and excess stockpiled soils to only be allowed in designated areas and not within areas where natural vegetation will remain following completion of the construction phase of the development; Avoid indiscriminate destruction of habitat.																		
	Vegetation removal through soil stripping leading displacement of faunal species	6	3	2	3	3	5	85	MH (-)	L	4	2	1	2	2	3	33	L (-)	L
	Comment: Vegetation removal and landscaping will transform habitat, making it unsuitable for inhabitation by faunal species, which will be displaced from the local area.																		
	Summary of mitigation points: Limit the impact to the footprint and immediate support areas; Do not store building materials and excess stockpiled soils within riparian zones or within areas where natural vegetation will remain following completion of the construction phase of the development; Avoid indiscriminate destruction of habitat.																		
Direct impacts on RDL & protected species	**RDL and protected species being destroyed during site infrastructure /services establishment**	4	4	1	3	3	3	45	L (-)	L	2	4	1	2	3	3	36	L (-)	L
	Comment: Protected tree species do occur within the scope of the survey area that will be impacted by the proposed development activities. Although not RDL, a permit to remove and/or destroy those individuals affected will have to be applied for through the relevant authorities.																		
	Summary of mitigation points: Limit the impact to the footprint and immediate support areas, especially within the areas associated with the proposed substation site; Do not store building materials and excess stockpiled soils within riparian zones or within areas where natural vegetation will remain following completion of the construction phase of the development (ie retain impacts to areas where infrastructure is to be permanently established); Avoid indiscriminate destruction of habitat; Alignment shifting of the overhead power line is recommended to accommodate taller Vachellia erioloba (camelthorn) individuals. Limit the extent of vegetation clearing within the servitude area.																		
Operations phase																			
Impacts on vegetation communities & structures	**Change in vegetation structures**	4	4	1	3	3	3	45	L (-)	L	2	4	1	2	3	3	36	L (-)	L
	Comment: Site disturbances will lead to a shift in floral species community structures.																		
	Summary of mitigation points: This is not thought to be a significant impact and is thought to largely self-rehabilitate.																		
	Change in vegetation structures: Exotic vegetation encroachment	6	5	1	2	3	4	68	L (-)	L	4	1	1	2	1	2	18	L (-)	L

POTENTIAL ENVIRONMENTAL IMPACT / NATURE OF IMPACT	Project activity or issue	ENVIRONMENTAL SIGNIFICANCE																	
		BEFORE MITIGATION									AFTER MITIGATION								
		M	D	E	I	R	P	SP	S	C	M	D	E	I	R	P	SP	S	C
	Comment: The potential for encroachment of exotic vegetation into areas that have suffered disturbances exists during the operations phase, especially through *Prosopis glandulosa*.																		
	Summary of mitigation points: Any exotic vegetation must be controlled and monitored for on a routine basis.																		
Impacts on faunal species, communities & structures	**Displacement of sensitive faunal species through increased perpetual disturbance features**	2	5	1	2	4	3	12	L (-)	L	2	5	1	2	4	3	12	L (-)	L
	Comment: Perpetual disturbances within an area that has historically been subject to very limited disturbances will lead to displacement of sensitive faunal species. This is regarded to be relevant at the local level.																		
	Summary of mitigation points: The nature of the proposed development means that perpetual disturbance features are inevitable. Activities should be confined to designated areas only and vehicles to be restricted to designated roadways only.																		
	Collision impacts of avifauna with overhead power lines	4	1	3	3	4	4	60	L (-)	L	2	1	2	3	4	2	20	L (-)	L
	Comment: Avifaunal fatalities as a result of collisions with the earth wire of the overhead power lines within an area of low existing power line density																		
	Summary of mitigation points: Bird flappers are to be fitted to any lines that cross over watercourses and prominent rocky ridges at 10m intervals.																		

9. PROPOSED MITIGATION MEASURES

9.1. Construction phase

9.1.1. Habitat destruction through landscaping and establishing infrastructure

The vegetation within the local area will be completely stripped to accommodate the development footprint of the proposed Lehating site, as well as to provide storage areas for stockpiles, access roadway construction and other supporting infrastructure. As the occurrence of suitable habitat is directly related to the biodiversity that is supported within it, the habitat destruction will have a direct impact on the biodiversity within the area. Faunal species will largely be displaced as they are mobile and have the freedom to escape unfavourable conditions. Floral species will be destroyed unless a rescue plan is implemented. Mitigation measures applicable to this impacting feature are to limit the footprint as far as possible and to avoid indiscriminate habitat destruction outside of the direct footprint and supporting areas. The impacts imposed during the construction phase will run into the operations phase and therefore cognisance of the impact area emanating from the operations and compare it to the areas that will not suffer the long term and permanent impacts. Management of soil erosion will also play an important role in long-term conservation of habitat and soil erosion measures such as gabions, geotextiles, silt traps and silt fences should be utilised within disturbed areas, especially on areas with steeper topography, where applicable. The cumulative impact of this feature within the region is considered low as much habitat of similar characteristics and quality is available within the region.

9.1.2. Direct impacts on RDL and protected species

The stripping of the topsoil layers to accommodate the construction typically includes the vegetation layers as well, which could very well include species of conservation concern or that are protected. This impact is largely limited to the vegetation and the sedentary faunal species (such as burrow-dwelling invertebrates). Mobile faunal species will merely be displaced. It is recommended that a walk-through survey of the construction footprint (of the proposed Lehating Substation site) and supporting areas be undertaken prior to commencement of the construction phase in order to either apply for permits for the destruction of protected species, or to mark species for removal as part of a rescue plan. This impact feature can

therefore be mitigated. Destruction of protected floral species (*Vachellia erioloba, Vachellia haematoxylon* and *Boscia albitrunca*) is inevitable and permits to remove the affected individuals will have to be sought through the relevant authorities.

These mitigation measures are also applicable to any overhead power lines that are to be constructed. Each tower footprint and the proposed servitude areas should be searched for the occurrence of RDL or protected biodiversity. This also goes for the establishment of construction yards, camps and stockpile areas associated with the power line developments.

9.2. Operations phase

9.2.1. Change in vegetation structures

Disturbance impacts carried over from the construction phase opens up opportunity for encroachment of exotic vegetation. *Prosopis glandulosa* is problematic within the riparian zones of the Kuruman River associated with the proposed development area and recruitment and invasion will be enhanced following disturbances. This feature should be monitored and future recruitment will require management in order to control it. The cumulative impact of this feature is medium to large at the catchment scale.

9.2.2. Displacement of sensitive faunal species from perpetual disturbance factors

Sensitive faunal species that inhabit the local area could be displaced through perpetual disturbance impacts within the localised area that never existed in the past. There is a vast amount of open habitat within the region of similar type and ecological status. Therefore the cumulative rating of an impact of this nature at the site is regarded as minimal. The amount of alternative available habitat within the immediate vicinity also means that the overall impact significance of this impact is regarded as being minimal. Perpetual disturbance impacts are thought to be minimal over the long term (throughout the duration of the operations phase), which reduces the overall significance of this impact.

9.2.3. Impacts imposed by overhead power lines

The greatest impact imposed on local fauna by the existence of overhead power lines is the risk of collisions, especially by larger avifaunal species. As a low density of overhead power lines within the region is generally low, the cumulative impact of this is regarded as also being low. One of the most important threats to RDL avifaunal species is, however, deaths through collisions with overhead infrastructure. The watercourse associated with the Kuruman River, together with the riparian zones, would be utilised as a migratory route for avifaunal species. The proposed overhead power lines do cross over this habitat feature and therefore mitigation measures are applicable. Mitigation measures to abate this impact include the fitment of bird flappers at 10 m intervals along the earth wires within areas that have been identified as major avifaunal migratory routes. Avifaunal species utilised watercourses and ridge complexes as navigational aids and therefore lines that cross over these habitat types should be fitted with bird flappers. These devices are aimed at making the earth more visible to flying birds so that evasive action can be taken to avoid a collision.

10. CONCLUSIONS & RECOMMENDATIONS

Following completion of the desktop review, field survey and impact evaluations, the following general conclusions can be offered:

- The survey area generally does not suffer a high degree of transformation at present and has retained a high present ecological state (PES) and incorporates habitat units that are regarded as inherently ecologically sensitive that support a wide diversity of fauna and flora;
- The proposed development activities will result in limited transformation of the habitat;
- No RDL faunal or floral features were noted during the field survey, but individuals of protected tree species will be impacted by the proposed development;
- Impact evaluations showed that the impacts range from medium through to low significance ratings due to the various aspects pertaining to the project. Some impacts cannot be realistically mitigated for and aspects such as destruction of vegetation and habitat within areas directly related to the substation site as well as services associated with this site are an inevitable consequence of a development of this nature. Other impacts have been shown to be abated by implementation of mitigation measures to reduce their overall significance;
- The analysis of the preferred alternatives showed that the overall Alternative 3 was proposed and, after presentation of the two further deviations of Alt 3, it was found that Alt 3B is preferred;
- The overall cumulative impact of the development is considered *low*.

11. REFERENCES

ACEE (2001). **The management of wildlife interactions with overhead power lines.** ESKOM African Centre for Energy and Environment. Southern African Power Pool Environmental Sub-Committee Training Manual, 2003. ESKOM Resources & Strategy, Johannesburg.

Acocks, J.P.H. (1988) **Veld types of South Africa.** Memoirs of the botanical survey of South Africa No. 57. Botanical Research Institute, South Africa.

ADU (2015) The Animal Demographic Unit is thanked for data downloaded from http://sabca.adu.org.za (butterfly data) and http://sarca.adu.org.za (reptile data), University of Cape Town, South Africa.

Ansara, T. M. (2004) **Determining the ecological status and possible anthropogenic impacts on the grass owl (*Tyto capensis*) populations in the East Rand Highveld, Gauteng.** MSc. Dissertation, Rand Afrikaans University, Johannesburg.

Avian Power Line Interaction Committee (APLIC) (2006). **Suggested practices for avian protection on power lines. The State of the Art in 2006.** Edison Electric Institute, APLIC, and the California Energy Commission. Washington D.C. and Sacramento, CA.

Bologna, F.F., Britten, A.C. and Vosloo, H.F. (2001). **Current research into the reduction of the number of transmission line faults on the ESKOM MTS.** TSI-Eskom Enterprises, Transmission Group, Eskom. Proceedings of the 2nd South African Electric Power Research Conference '*Powering the African Renaissance*', 13 June 2001.

Branch, B. (1998) **Field guide to snakes and other reptiles of southern Africa.** Struik Publishers, Cape Town.

Bredenkamp, G. and van Rooyen, N. **39. Moist cool Highveld grassland - Grassland Biome.** *In:* Low, A.B. and Rebelo, A.G. (eds) (1998). **Vegetation of South Africa, Lesotho and Swaziland.** Department of Environmental Affairs & Tourism, Pretoria. pp 39.

Bromilow, C. (2001) **Problem plants of South Africa.** Briza Publications, Pretoria.

Carruthers, V. (2001) **Frogs and frogging in southern Africa.** Struik Publishers, Cape Town.

Channing, A. (2001). **Amphibians of central and southern Africa.** Cornell University, London.

Clara, J. (2004) **Chapter 9: Overview of servitude and environmental management.** *In:* Bittern, A. C., Bisnath, S., Marshall, E., Reynders, J. P., Pillay, T. and Cretchley, D. (Editors) (2004) **The fundamental and practice of overhead line maintenance: 132 kV and above.** Eskom Power Series, Vol 2, Crown Publications CC, Johannesburg.

Coates-Palgrave, K. (2000) **Trees of southern Africa – second edition.** Struik Publishers, Cape Town.

Coetzee, K. (2005) **Caring for natural rangelands.** University of Kwazulu-Natal Press, South Africa.

Cook, C.D.K. (2004) **Aquatic and wetland plants of southern Africa.** Backhuys Publishers Leiden, The Netherlands.

Cretchley, D. and Clara, J. (2005) **Chapter 5: Environmental impact management.** *In:* Bisnath, S., Bittern, A. C., Bisnath, S., Cretchley, D. H., Muftic, D., Pillay, T. and Vajeth, R. (Editors) (2004) **The planning, design and construction of overhead power lines: 132 kV and above.** Eskom Power Series, Vol 1, Crown Publications CC, Johannesburg.

CSIR (2004). **2004 Eastern Cape State of the Environment Report.** CSIR Division of Water, Environment and Forestry Technology. Durban, South Africa. Produced on behalf of the Eastern Cape Department of Economic Affairs, Environment and Tourism, Bisho.

Davis, B. and Day, J. (1998) **Vanishing waters.** University of Cape Town Press, Cape Town, South Africa.

Department of Water Affairs and Forestry. (2005) **A practical field procedure for identification and delineation of wetlands and riparian areas (edition 1).** DWAF, Pretoria.

Dippenaar-Schoeman, A.S. (2002) **Baboon and trapdoor spiders of southern Africa.** ARC Handbook, No. 13. Agricultural Research Council, Pretoria.

Dippenaar-Schoeman, A.S. and Jocqué, R. (1997) **African spiders – An identification manual.** Plant Protection Research Institute Handbook No. 9. Biosystematics Division, ARC – Plant Protection Research Institute, Pretoria.

Du P. Bothma, J. (Editor) (2002) **Game ranch management - 4th ed.** Van Schaik Publishers, Pretoria.

Du Preez, L. and Carruthers, V. (2009) **A complete guide to the frogs of southern Africa.** Struik Nature Publishers, Cape Town.

Filmer, M. and Duigan, L. (1991) **Southern African spiders – An identification guide.** Struik Publishers, Cape Town.

Friedmann, Y. and Daly, B, (editors) (2004) **Red Data Book of the mammals of South Africa: a conservation assessment: CBSG southern Africa, Conservation Breeding Specialist Group (SSC/IUCN).** Endangered Wildlife Trust, South Africa.

Gibbon, G., John Voelcker Bird Book Fund (2002) **Roberts' multimedia birds of southern Africa – version 3**. Southern African Birding CC, Westville, South Africa.

Goldblatt, P., Turner, R.C. & Naidoo, K. (2006) ***Moraea elegans* Jacq. National Assessment: Red List of South African Plants version 2013.1.** Accessed on 2013/10/12.

Google Earth® (2015) is acknowledged for the use of aerial imagery.

Harrison, J. A., Allan, D. G., Underhill, L. G., Herremans, M, Tree, A. J., Parker, V. and Brown, C. J. (editors) (1997). **The atlas of southern African birds, Volumes 1 and 2.** Birdlife South Africa, Johannesburg.

Henderson, L. (2001) **Alien weeds and invasive plants – A complete guide to declared weeds and invaders in South Africa.** Plant Protection Research Institute, Agricultural Research Council Handbook No 12. Pretoria.

Henning, S. F. and Henning, G. A. (1989) **South African red data book – butterflies.** South African National Scientific Programmes Report No. 158, Foundation for Research Development, Pretoria.

Hockey, P.A.R., Dean, W.R.J. and Ryan, P.G. (Eds) (2005) **Roberts' birds of southern Africa. VIIth Edition.** The Trustees of the John Voelcker Bird Book Fund, Cape Town.

Langer, R. H. M. and Hill, G. D. (1991) **Agricultural plants – second edition.** Cambridge University Press, Cambridge.

Low, A.B. and Rebelo, A.G. (eds) (1998) **Vegetation of South Africa, Lesotho and Swaziland.** Department of Environmental Affairs & Tourism, Pretoria.

Marais, J. (2004) **A complete guide to the snakes of southern Africa.** Struik Publishers, Cape Town.

Minter, L. R., Burger, M., Harrison, J. A., Braack, H. H., Bishop, P. J. and Kloepfer, D. (Eds) (2004) **Atlas and red data book of the frogs of South Africa, Lesotho and Swaziland.** SI/MAB Series #9. Smithsonian Institute, Washington, DC.

Newman, K. (1998) **SAPPI Newman's birds of southern Africa.** Southern Book Publishers, Halfway House (Midrand).

Pooley, E. (1998) **A field guide to wild flowers Kwazulu-Natal and the eastern region.** Natal Flora Publications Trust.

SANBI (2006) **Vegetation map of South Africa, Lesotho and Swaziland.** Mucina, L. and Rutherford, M.C. (Editors). Strelitzia 19, South African National Biodiversity Institute, Kirstenbosch Research Centre, Claremont, South Africa.

SANBI (2015) The South African National Biodiversity Institute is thanked for the use of data from the National Herbarium, Pretoria (PRE) Computerised Information System (PRECIS). Information downloaded from www.posa.sanbi.org during May 2012.

SANBI BGIS (2015) The South African National Biodiversity Institute is thanked for the use of data from the SANBI Biodiversity GIS website for species distribution maps, maps on ecological features and further biodiversity aspects relating to the project (www.bgis.sanbi.org).

Schmidt, E., Lötter, M. and McClelland, W. (2002) **Trees and shrubs of Mpumalanga and Kruger National Park.** Jacana Publishers, Johannesburg, South Africa.

Scott-Shaw, R. (1999) **Rare and threatened plants of Kwazulu-Natal and neighbouring regions – a plant Red Data Book.** Biodiversity Division, Scientific Services Directorate, Kwazulu-Natal Nature Conservation Service, Pietermaritzburg.

Skinner, J.D. and Smithers, R.H.N. (1990) **The mammals of the southern African sub region.** University of Pretoria, Pretoria.

Smallie, J. (2007) **Tabor-Witkop 400kV power line, Eskom Transmission, Bird impact assessment study.** Contract report for Strategic Environmental Focus (SEF) by the Endangered Wildlife Trust (EWT), Johannesburg.

Soil Classification Working Group (1991) **Soil classification – a taxonomic system for South Africa.** Memoirs of the Agricultural Natural Resources of South Africa No. 15, The soil and Irrigation Research Institute, Department of Agricultural Development, Pretoria.

Stuart, C. and Stuart, T. (1993) **Field guide to the mammals of southern Africa.** Struik Publishers, Cape Town.

Stuart, C. and Stuart, T. (1994) **A field guide to the tracks and signs of southern and east African wildlife.** Southern Book Publishers, Halfway House, South Africa.

Tainton, N. (Editor) (1999) **Veld management in South Africa.** University of Natal Press, Pietermaritzburg.

Tarboton, W. and Tarboton, M. (2002) **A fieldguide to the dragonflies of South Africa.** Warwick & Michèle Tarboton, Modimolle, South Africa.

Tarboton, W. and Tarboton, M. (2005) **A fieldguide to the damselflies of South Africa.** Warwick & Michèle Tarboton, Modimolle, South Africa.

Threatened Species Programme (2005) **Red Data List of South African Plant Species.** Available online: http://www.redlist.org.

Van Oudtshoorn, F. (1999) **Guide to grasses of southern Africa.** Briza Publications, Pretoria.

Van Rooyen, C. (2004) **Chapter 11: The management of wildlife interactions with overhead lines.** *In:* Bittern, A. C., Bisnath, S., Marshall, E., Reynders, J. P., Pillay, T. and Cretchley, D. (Editors) (2004) **The fundamental and practice of overhead line maintenance: 132 kV and above.** Eskom Power Series, Vol 2, Crown Publications CC, Johannesburg.

Van Rooyen. C. (2009) **Bird impact assessment study: Single 132kV line from Tarlton Substation to Magalies Substation and a double 132kV line from Magalies Substation to Springfarms Substation.** Contract report for Eskom Distribution Division, Central Region. Chris van Rooyen Consulting, Randburg.

Van Wyk, A.E. and Smith , G.F. (2001) **Regions of Floristic endemism in southern Africa: A review with emphasis on succulents.** Umdaus Press, Pretoria.

Van Wyk, B. and Malan, S. (1998) **Field guide to the wild flowers of the Highveld.** Struik Publishers, Cape Town.

Van Wyk, B. and Smith , G. (1996) **Guide to the aloes of South Africa.** Briza Publications, Pretoria.

Van Wyk, B. van Wyk, P. and van Wyk, B. (2000) **Photographic guide to trees of southern Africa.** Briza Publications, Pretoria.

Van Wyk, B., van Oudtshoorn, B. and Gericke, N. (1997) **Medicinal plants of South Africa.** Briza Publications, Pretoria.

Vosloo, H. (2004) **Chapter 10: Vegetation management.** *In:* Bittern, A. C., Bisnath, S., Marshall, E., Reynders, J. P., Pillay, T. and Cretchley, D. (Editors) (2004) **The fundamental and practice of overhead line maintenance: 132 kV and above.** Eskom Power Series, Vol 2, Crown Publications CC, Johannesburg.

Vosloo, H. F and van Rooyen, C. (2001) **Investigation into biological induced line faults on Eskom's transmission system.** Cigré 4th Southern African Regional Conference. Oct 2001, Cape Town, South Africa.

Woodhall, S. (2005) **Field guide to butterflies of South Africa.** Struik Publishers, Cape Town.

APPENDIX A – VEGETATION TYPE DESCRIPTIONS PERTAINING TO PROPOSED DEVELOPMENT AREA

The following vegetation descriptions are adapted from Mucina & Rutherford, 2006.

A.1. Kathu Bushveld

Also known as VT 16 Kalahari Thornveld and Shrub Bushveld (100%) (Acocks 1953). LR 30 Kalahari Plains Thorn Bushveld (86%) (Low & Rebelo 1996).

Distribution

Kathu Bushveld is distributed in the Northern Cape Province, where it occurs on plains from Kathu and Dibeng in the south, through Hotazel, vicinity of Frylinckspan to the Botswana border roughly between Van Zylsrus and McCarthysrus. It occurs within an altitude range of 960-1 300 m.

Vegetation & landscape features

It is characterised by a medum-tall tree layer with *Vachellia erioloba* in places, but mostly open. It includes *Boscia albitrunca* as the prominent trees. The shrub layer is generally the most important with, for example, *Senegalia* (=*Acacia*) *mellifera*, *Diospyros lycioides* and *Lycium hirsutum*. The grass layer is variable in cover.

Geology & Soils

Aeolian red sand and surface calcrete, deep (>1.2 m) sandy soils of Hutton and Clovelly soil forms. Land types mainly Ah and Ae, with some Ag.

Climate

Summer and autumn rainfall with very dry winters. Mean annual precipitation of about 220-380 mm. Frost is frequent in winter. Mean monthly maximum and minimum temperatures for Sishen is 37.0°C and -2.2°C for December and July, respectively.

Table 8: Dominant and diagnostic floral species of the vegetation unit.

Trees/Shrubs	Forbs/Herbs	Grasses/Sedges/Reeds
Tall trees: *Acacia erioloba (d)* Small Trees: *Acacia mellifera subsp. detinens (d)* *Boscia albitrunca (d)* *Terminalia sericea* Tall Shrubs: *Diospyros lycioides subsp. lycioides (d)* *Dichrostachys cinerea* *Grewia flava* *Gymnosporia buxifolia* *Rhigozum brevispinosum* Low Shrubs: *Aptosimum decumbens* *Grewia retinervis* *Nolletia arenosa* *Sida cordifolia* *Tragia dioica.*	Herbs: *Acrotome inflata* *Erlangea misera* *Gisekia africana* *Heliotropium ciliatum* *Hermbstaedtia fleckii* *H. odorata* *Limeum fenestratum* *L. viscosum* *Lotononis platycarpa* *Senna italica subsp. arachoides* *Tribulus terrestris*	Graminoids: *Aristida meridionalis (d)* *Brachiaria nigropedata (d)* *Centropodia glauca (d)* *Eragrostis lehmanniana (d)* *Schmidtia pappophoroides (d)* *Stipagrostis ciliata (d)* *Aristida congesta* *Eragrostis biflora* *E. chloromelas* *E. heteromera* *E. pallens* *Melinis repens* *Schmidtia kalahariensis* *Stipagrostis uniplumis* *Tragus berteronianus*

Biogeographically Important Taxa (Kalahari endemics) Small Tree: Acacia luederitzii var. luederitzii. Graminoids: Anthephora argentea, Megaloprotachne albescens, Panicum kalaharense. Herb: Neuradopsis bechuanensis. Conservation Least threatened. Target 16%. None conserved in statutory conservation areas. More than 1% already trans-formed, including the iron ore mining locality at Sishen, one of the biggest open-cast mines in the world. Erosion is very low. Remark One of the most strikingly dominant areas of fairly tall Acacia erioloba is centred on the town of Kathu, which was built around many of these trees. Reference Smit (2000).

A.2. Gordonia Duneveld

(Synonyms: VT 16 Kalahari Thornveld and Shrub Bushveld (91 %) (Acocks 1953) LR 28 Shrubby Kalahari Dune Bushveld (65%) (Low & Rebelo 1996)).

Gordonia Duneveld occurs on parallel dunes about 3-8 m above the plains and is characterised by open shrubland with ridges of grassland dominated by *Stipagrostis amabilis* on the dune crests and *Acacia haematoxylon* on the dune slopes, also with *Acacia mellifera* on lower slopes and *Rhigozum trichotomum* in the inter-dune stratum. It is distributed in the Northern Cape Province within areas incorporating dunes and comprises the largest part of the South African side of the Kgalagadi Transfrontier Park. It also occurs

south of the Molopo River border with Botswana (west of Van Zylsrus), interleaving with Kalahari Karroid Shrubland in the west (south of Rietfontein to the Orange River area) and in the south (around Upington and north of Groblershoop). It also occurs as a number of loose dune cordons south of the Orange River near Keimoes and between Upington and Putsonderwater. The eastern boundary of the unit is found at the longitude of Pearson's Hunt, but outliers do occur near Niekerkshoop in the southeast and Floradora in the northeast. It occurs at an altitude of 800-1 200 m.

It is considered least threatened and has a target conservation value of 16%. Approximately 14% is statutorily conserved in the Kgalagadi Transfrontier Park. Very little of the unit is transformed. Erosion is generally low throughout the unit, but considerable destabilisation of dunes has taken place within isolated areas as a consequence of overstocking.

Geology & Soils

Gordonia Duneveld is formed on aeolian sand underlain by superficial silcretes and calcretes of the Cenozoic Kalahari Group. It is formed on fixed parallel sand dunes.

Climate Summer and autumn rainfall with very dry winters. MAP about 120-260 mm. Frost fairly frequent to frequent in winter. Mean monthly maximum and minimum temperatures for Vrouenspan 41.5°C and -4.0°C for December and July, respectively. See also climate diagram for SVkd 1 Gordonia Duneveld.

Table 9: Dominant and diagnostic floral species of the vegetation unit.

Trees & Shrubs	Forbs	Grasses
Acacia mellifera subsp. *detinens,* *Grewia flava,* *Rhigozum trichotomum,* *Aptosimum albomarginatum,* *Monechma incanum,* *Requienia sphaerosperma,* *Lycium bosciifolium,* *Lycium pumilum,* *Talinum caffrum*	*Hermbstaedtia fleckii,* *Acanthosicyos naudinianus,* *Hermannia tomentosa,* *Limeum arenicolum,* *Limeum argute-carinatum,* *Oxygonum dregeanum* subsp. *canescens* var. *canescens,* *Sericorema remotiflora,* *Sesamum triphyllum,* *Tribulus zeyheri*	*Schmidtia kalahariensis,* *Brachiaria glomerata,* *Bulbostylis hispidula,* *Centropodia glauca,* *Eragrostis lehmanniana,* *Stipagrostis ciliata,* *Stipagrostis obtusa,* *Stipagrostis uniplumis*

Biogeographically Important Taxa (Kalahari endemics) Tall Shrub: Acacia haematoxylon (d). Graminoids: Stipagrostis amabilis (d), Anthephora argentea, Megaloprotachne albescens. Herbs: Helichrysum arenicola, Kohautia ramosissima, Neuradopsis austro-africana.

A.3. Southern Kalahari Mekgacha

Southern Kalahari Mekgacha is distributed in the Northern Cape and North-West Provinces, where it occurs in valleys (including beds and adjacent slopes) of the intermittent rivers draining the dry savanna south of the Bakalahari Schwelle (broad interfluve at 1 000-1 100 m altitude) in the South African part of the Kalahari region. The major mekgacha of the region include the Nossob, Auob, Molopo and Kuruman Rivers. A more extensive (endorheic) system of mekgacha is found north of the Bakalahari Schwelle in central Botswana. Altitude ranging from 850 m to mainly 1 100 m, with a few occurrences as high as 1 500 m.

Vegetation & Landscape Features

It is characterised by sparse, patchy grasslands, sedgelands and low herblands dominated by C4 grasses (*Panicum, Eragrostis, Enneapogon, Tragus, Chloris, Cenchrus*) on the bottom of (mostly) dry riverbeds. Low shrublands dominate in places with patches of taller shrubland (with *Schotia afra*) on the banks of the rivers. Relatively tall *Acacia erioloba* trees can form a dominant belt along some of the rivers, for example the middle and lower reaches of the Kuruman River. In some other rivers the taller trees are scattered.

Geology, SoilS & Hydrology

The river channels are embedded within prevalently sandy Kalahari sediments that cover the Precambrian metamorphic crust of the area. The substrate of the dry riverbeds are silty, sandy and rocky, poorly drained and rich in nutrients though the ionic composition of the soils in particular rivers show considerable differences. The banks of the dry rivers can cut deep into duricrust (calcrete or silcrete and various transitions between these end-members, and in places also ferricretes), sometimes vertical bluffs (steep cliffs) of a few metres high may develop (Werger 1978, Thomas & Shaw 1991). The mekgacha may stay without any water for a very long time and floods (sometimes of considerable magnitude) occur only in response to dramatic short-term precipitation events, for example the Nossob was in flood in 1806, 1963 and 1987 and the Auob was in flood in 1973, 1974 and 2000 (Thomas & Shaw 1991; H. Bezuidenhout, personal communication). Some of the rivers such as the Kuruman must experience effective subsurface flow of water judging from the near-continuous belt of trees.

Climate

Subarid region with seasonal, summer-rainfall regime with a slight shift of the major peak towards late summer (February–March). Overall MAP 240 mm (ranging from 180 mm at southwestern boundary to as much as 420 mm further north). High thermic continentality is obvious from the extreme differences

between the mean daily maximum and minimum temperatures in January and July: 34°C and 1°C, respectively, great daily temperature differences (sometimes reaching amplitude between 25°C and 30°C, especially in transitional climatic periods) as well as the fairly frequent occurrence of frost.

Table 10: Dominant and diagnostic floral species of the vegetation unit.

Trees & Shrubs	Forbs	Grasses
Tall Shrubs *Lebeckia linearifolia* (d) *Sisyndite spartea* (d) *Deverra denudata* subsp. *aphylla* Herbs: *Amaranthus dinteri* subsp. *dinteri* *Amaranthus praetermissus* *Amaranthus schinzianus* *Boerhavia repens* *Chamaesyce inaequilatera* *Cucumis africanus* *Geigeria ornativa* *Geigeria pectidea* *Heliotropium lineare* *Indigofera alternans* *Indigofera argyroides* *Kohautia cynanchica* *Lotononis platycarpa* *Osteospermum muricaturn* *Platycarpha carlinoides* *Radyera urens* *Stachys spathulata* *Tribulus terrestris*	Succulent Herb: *Zygophyllum simplex* (d)	*Cenchrus ciliaris* (d) *Chloris virgata* (d) *Enneapogon desvauxii* (d) *Eragrostis annulata* (d) *Eragrostis bicolor* (d) *Odyssea paucinervis* (d) *Panicum coloratura* (d) *Eragrostis porosa* *Panicum impeditum* *Sporobolus nervosus*
Rocky slopes of river canals		
Tall Tree: *Acacia erioloba* (d) Low Shrubs: *Aptosimum lineare* *Pechuel-Loeschea leubnitziae*		*Setaria verticillata* (d) *Enneapogon scaber* *Oropetium capense* *Stipagrostis uniplumis* *Tragus racemosus*

Conservation

Least threatened. Target 24%. Already 18% statutorily conserved in the Kgalagadi Transfrontier Park and Molopo Nature Reserve. About 2% has been transformed by road building. The mekgacha are under strong utilisation pressure, both from wildlife (to graze and for salt licks) and domestic animals (grazing, browsing and animal penning). Alien woody *Prosopis* species occur as invasive plants in places.

APPENDIX B – POTENTIAL BIODIVERSITY LISTS FOR THE REGION.

Table 11: Potential mammalian species biodiversity list based on the historical distributions of species (*from* Friedmann & Daly, 2004).

Order	Species	Common name	RDL status
Artiodactyla	*Alcelaphus buselaphus*	Red Hartebeest	
Artiodactyla	*Antidorcas marsupialis*	Springbok	
Perissodactyla	*Ceratotherium simum*	White Rhinoceros	
Artiodactyla	*Connochaetes taurinus taurinus*	Blue Wildebeest	
Artiodactyla	*Giraffa camelopardalis*	Giraffe	
Artiodactyla	*Oreotragus oreotragus*	Klipspringer	
Artiodactyla	*Oryx gazella*	Gemsbok	
Artiodactyla	*Raphicerus campestris*	Steenbok	
Artiodactyla	*Sylvicapra grimmia*	Common Duiker	
Artiodactyla	*Taurotragus oryx*	Eland	
Artiodactyla	*Tragelaphus strepsiceros*	Kudu	
Hyracoidea	*Procavia capensis*	Rock Hyrax	
Carnivora	*Canis mesomelas*	Black-backed Jackal	
Carnivora	*Caracal caracal*	Caracal	
Carnivora	*Cynictis penicillata*	Yellow Mongoose	
Carnivora	*Felis nigripes*	Black-footed Cat	
Carnivora	*Felis silvestris*	African Wild Cat	
Carnivora	*Galerella sanguinea*	Slender Mongoose	
Carnivora	*Genetta genetta*	Small-spotted Genet	
Carnivora	*Ictonyx striatus*	Striped Polecat	
Carnivora	*Mellivora capensis*	Honey Badger	NT
Carnivora	*Otocyon megalotis*	Bat-eared Fox	
Carnivora	*Panthera pardus*	Leopard	
Carnivora	*Proteles cristatus*	Aardwolf	
Carnivora	*Suricata suricatta*	Suricate	
Carnivora	*Vulpes chama*	Cape Fox	
Chiroptera	*Miniopterus schreibersii*	Schreibers' Long-fingered Bat	NT
Chiroptera	*Neoromicia capensis*	Cape Serotine Bat	
Chiroptera	*Sauromys petrophilus*	Flat-headed Free-tail Bat	
Chiroptera	*Tadarida aegyptiaca*	Egyptian Free-tailed Bat	
Insectivora	*Crocidura cyanea*	Reddish-grey Musk Shrew	DD
Insectivora	*Crocidura hirta*	Lesser Red Musk Shrew	DD
Lagomorpha	*Lepus capensis*	Cape Hare / Desert Hare	
Lagomorpha	*Lepus saxatilis*	Scrub / Savannah Hare	
Primata	*Papio ursinus*	Chacma Baboon	
Rodentia	*Aethomys chrysophilus*	Red Veld Rat	
Rodentia	*Aethomys namaquensis*	Namaqua Rock Mouse	
Rodentia	*Cryptomys damarensis*	Damaraland Mole-rat	
Rodentia	*Cryptomys hottentotus*	Common Mole-rat	
Rodentia	*Dendromus melanotis*	Grey Climbing Mouse	
Rodentia	*Desmodillus auricularis*	Short-tailed Gerbil	
Rodentia	*Gerbillurus paeba*	Hairy-footed Gerbil	
Rodentia	*Hystrix africaeaustralis*	Porcupine	
Rodentia	*Malacothrix typica*	Large-eared Mouse	
Rodentia	*Mastomys coucha*	Multimammate Mouse	
Rodentia	*Mus indutus*	Desert Pygmy Mouse	
Rodentia	*Otomys irroratus*	Vlei Rat	
Rodentia	*Pedetes capensis*	Springhare	
Rodentia	*Rhabdomys pumilio*	Striped Mouse	

Order	Species	Common name	RDL status
Rodentia	*Saccostomus campestris*	Pouched Mouse	
Rodentia	*Tatera brantsii*	Highveld Gerbil	
Rodentia	*Tatera leucogaster*	Bushveld Gerbil	DD
Rodentia	*Thallomys nigricauda*	Black-tailed Tree Rat	
Rodentia	*Xerus inauris*	Cape Ground Squirrel	
Rodentia	*Zelotomys woosnami*	Woosnam's Desert Rat	
Tubulidentata	*Orycteropus afer*	Aardvark	

Table 12: Complete bird species list for the survey area based on historical distribution data. Habitat abbreviations are given in Table 13.

Rob	English Name	Species	General Status	Obs	RDL Status	Habitats
1	Ostrich	*Struthio camelus*	R-C			BW, Ki, Gr, Ko, Ds, Fy, Fa
8	Dabchick	*Tachybaptus ruficollis*	R-C			Wa
58	Reed Cormorant	*Phalacrocorax africanus*	R-C			Wa
62	Grey Heron	*Ardea cinerea*	R-C			Wa
63	Blackheaded Heron	*Ardea melanocephala*	R-C	x		Gr, Fa, Wa
67	Little Egret	*Egretta garzetta*	R-C	x		Wa
71	Cattle Egret	*Bubulcus ibis*	R-C	x		BW, Gr, Fa, Wa
76	Blackcrowned Night Heron	*Nycticorax nycticorax*	R-C			Wa
78	Little Bittern	*Ixobrychus minutus*	R/NBM-U			Wa
81	Hamerkop	*Scopus umbretta*	R-C			Wa
83	White Stork	*Ciconia ciconia*	NBM-C			BW, Ki, Gr, Ko, Mo, Fa
84	Black Stork	*Ciconia nigra*	R-U/R		NT	RC, Fa, Wa
89	Marabou Stork	*Leptoptilos crumeniferus*	R-R/LC		NT	BW, Wa
91	Sacred Ibis	*Threskiornis aethiopicus*	R-C	x		Gr, Fa, Wa
94	Hadeda Ibis	*Bostrychia hagedash*	R-A	x		Fo, BW, Gr, To, Fa, Wa
95	African Spoonbill	*Platalea alba*	R(n)-C			Wa
96	Greater Flamingo	*Phoenicopterus ruber*	R(n)-LA		NT	Wa, Ms
97	Lesser Flamingo	*Phoenicopterus minor*	R(n)-LA		NT	Wa, Ms
102	Egyptian Goose	*Alopochen aegyptiacus*	R-A	x		Fa, Wa
103	South African Shelduck	*Tadorna cana*	E-C			Wa
104	Yellowbilled Duck	*Anas undulata*	R-A			Wa
108	Redbilled Teal	*Anas erythrorhyncha*	R-C			Wa
113	Southern Pochard	*Netta erythrophthalma*	R-C			Wa
116	Spurwinged Goose	*Plectropterus gambensis*	R-VC			Fa, Wa
118	Secretarybird	*Sagittarius serpentarius*	R-U		NT	BW, Ki, Gr, Ko, Ds, Fy, Mo, Fa
122	Cape Vulture	*Gyps coprotheres*	E-LC		VU	BW, Ki, Gr, Ko, Ds, Fy, Mo, Fa
123	Whitebacked Vulture	*Gyps africanus*	R-C		VU	BW, Ki, Ko, Ds
124	Lappetfaced Vulture	*Torgos tracheliotus*	R-U		VU	BW, Ki, Ko, Ds
126	Black Kite	*Milvus migrans*	NBM-LC			BW, Ko, Ds, Fa
126	Yellowbilled Kite	*Milvus aegyptius*	BM-C			Fo, BW, Gr, To, Fa
127	Blackshouldered Kite	*Elanus caeruleus*	R(n)-C	x		BW, Gr, Ko, Ds, Fa
131	Black Eagle	*Aquila verreauxii*	R-U			Mo, RC
132	Tawny Eagle	*Aquila rapax*	R-LC		VU	BW, Ki
136	Booted Eagle	*Hieraaetus pennatus*	R/NBM-C			BW, Ki, Gr, Ko, Fy, Mo, Fa
140	Martial Eagle	*Polemaetus bellicosus*	R-U		VU	BW, Ki, Gr, Ko, Ds
142	Brown Snake Eagle	*Circaetus cinereus*	R-U			BW
143	Blackbreasted Snake Eagle	*Circaetus pectoralis*	R-U			BW, Ki, Ko, Ds, Fa
146	Bateleur	*Terathopius ecaudatus*	R-LC		VU	BW, Ki
148	African Fish Eagle	*Haliaeetus vocifer*	R-C			Wa, Ms

Rob	English Name	Species	General Status	Obs	RDL Status	Habitats
149	Steppe Buzzard	*Buteo vulpinus*	NBM-C			BW, Gr, Ko, Fa
152	Jackal Buzzard	*Buteo rufofuscus*	E-C			Gr, Ko, Ds, Mo, RC, Fa
159	Little Banded Goshawk	*Accipiter badius*	R-C			BW
161	Gabar Goshawk	*Melierax gabar*	R-C			BW, Ki, To, Fa
162	Pale Chanting Goshawk	*Melierax canorus*	Er-C			BW, Ki, Ko, Ds
166	Montagu's Harrier	*Circus pygargus*	NBM-R			Ki, Gr
168	Black Harrier	*Circus maurus*	E-U		NT	Ki, Gr, Ko, Ds, Fy, Mo, Fa
169	Gymnogene	*Polyboroides typus*	R-C			Fo, BW, Ko, RC
171	Peregrine Falcon	*Falco peregrinus*	R/NBM-R		NT	Fo, Gr, Ko, Ds, Mo, RC, To
172	Lanner Falcon	*Falco biarmicus*	R-C		NT	BW, Ki, Ko, Ds, Fy, Mo, RC, To, Fa
178	Rednecked Falcon	*Falco chicquera*	R-R			BW, Ki, Ko, Ds
179	Western Redfooted Kestrel	*Falco vespertinus*	NBM-R			BW, Ki, Gr, Fa
181	Rock Kestrel	*Falco rupicolis*	R-C			Ki, Gr, Ko, Ds, Fy, Mo, RC, Fa
182	Greater Kestrel	*Falco rupicoloides*	R-C			BW, Ki, Gr, Ko, Ds, Fa
183	Lesser Kestrel	*Falco naumanni*	NBM-VC		VU	Gr, Ko, To, Fa
186	Pygmy Falcon	*Polihierax semitorquatus*	R-C			Ki
193	Orange River Francolin	*Scleroptila levaillantoides*	R-C	x		Ki, Gr, Mo, Fa
194	Redbilled Francolin	*Pternistis adspersus*	Er-C			BW, Ki
200	Common Quail	*Coturnix coturnix*	R/BM/NBM-C	x		Ki, Gr, Ko, Mo, Fa
203	Helmeted Guineafowl	*Numida meleagris*	R-VC	x		BW, Ki, Gr, Ko, Fa
205	Kurrichane Buttonquail	*Turnix sylvatica*	R(n)-U/LC			BW, Gr, Fa
210	African Rail	*Rallus caerulescens*	R/BM-C			Wa
226	Common Moorhen	*Gallinula chloropus*	R-C			Wa
228	Redknobbed Coot	*Fulica cristata*	R-A			Wa
230	Kori Bustard	*Ardeotis kori*	R-R		VU	BW, Ki, Gr, Ko, Ds
232	Ludwig's Bustard	*Neotis ludwigii*	Er-U		VU	Gr, Ko, Ds
237	Redcrested Korhaan	*Eupodotis ruficrista*	Es-C			BW, Ki
239	Whitewinged Korhaan	*Eupodotis afraoides*	E-VC	x		Ki, Ko, Ds
247	Chestnutbanded Plover	*Charadrius pallidus*	R-U		NT	Wa, Ms
249	Threebanded Plover	*Charadrius tricollaris*	R-C			Wa, Ms
252	Caspian Plover	*Charadrius asiaticus*	NBM-U			BW, Ki, Gr
255	Crowned Plover	*Vanellus coronatus*	R-C	x		BW, Ki, Gr, Ko, Fy, To, Fa
258	Blacksmith Plover	*Vanellus armatus*	R-VC			Gr, Wa
264	Common Sandpiper	*Actitis hypoleucos*	NBM-C			Gr, Wa, Ms
266	Wood Sandpiper	*Tringa glareola*	NBM-C			Wa
269	Marsh Sandpiper	*Tringa stagnatilis*	NBM-C			Wa, Ms
270	Greenshank	*Tringa nebularia*	NBM-C			Wa, Ms
272	Curlew Sandpiper	*Calidris ferruginea*	NBM-VC			Wa, Ms
274	Little Stint	*Calidris minuta*	NBM-C			Wa, Ms
281	Sanderling	*Calidris alba*	NBM-C			Wa, Ms
284	Ruff	*Philomachus pugnax*	NBM-C			Gr, Wa
286	Ethiopian Snipe	*Gallinago nigripennis*	R-LC			Gr, Wa
290	Whimbrel	*Numenius phaeopus*	NBM-C			Wa, Ms
294	Pied Avocet	*Recurvirostra avosetta*	R-LC			Wa, Ms
295	Blackwinged Stilt	*Himantopus himantopus*	R-C			Wa, Ms
297	Spotted Dikkop	*Burhinus capensis*	R-C	x		BW, Ki, Gr, Ko, Ds, Fy, To, Fa, Ms
299	Burchell's Courser	*Cursorius rufus*	Er-U			Ki, Gr, Ko, Ds, Fy, Fa
300	Temminck's Courser	*Cursorius temminckii*	R-U			BW, Ki, Gr, Fa
301	Doublebanded Courser	*Rhinoptilus africanus*	R-LC			Ki, Gr, Ko, Ds
303	Bronzewinged Courser	*Rhinoptilus chalcopterus*	R/BM-U			BW, Ki
305	Blackwinged Pratincole	*Glareola nordmanni*	NBM-LA		NT	Gr
339	Whitewinged Tern	*Chlidonias leucopterus*	NBM-A			Wa
344	Namaqua Sandgrouse	*Pterocles namaqua*	Er-C	x		Ki, Ko, Ds

Rob	English Name	Species	General Status	Obs	RDL Status	Habitats
345	Burchell's Sandgrouse	*Pterocles burchelli*	E-C			Ki
347	Doublebanded Sandgrouse	*Pterocles bicinctus*	Er-C			BW, Ki, Ko, Ds
348	Feral Pigeon	*Columba livia*	R-A			To, Fa
349	Rock Pigeon	*Columba guinea*	R-C			Mo, RC, To, Fa
352	Redeyed Dove	*Streptopelia semitorquata*	R-C			Fo, BW, To, Fa
354	Cape Turtle Dove	*Streptopelia capicola*	R-VC	x		BW, Ki, Gr, Ko, Ds, Fy, To, Fa
355	Laughing Dove	*Streptopelia senegalensis*	R-VC	x		BW, Ki, Gr, Ko, Ds, Fy, To, Fa
356	Namaqua Dove	*Oena capensis*	R-VC	x		BW, Ki, Gr, Ko, Ds, To, Fa
375	African Cuckoo	*Cuculus gularis*	BM-U			BW, Ki
378	Black Cuckoo	*Cuculus clamosus*	BM-C			Fo, BW, To, Fa
380	Great Spotted Cuckoo	*Clamator glandarius*	NBM-U			BW
381	Striped Cuckoo	*Clamator levaillantii*	BM-U			Fo, BW
382	Jacobin Cuckoo	*Clamator jacobinus*	BM-C			BW, Ki
386	Diederik Cuckoo	*Chrysococcyx caprius*	BM-VC			BW, Ki, Gr, Ko, Fy, To, Fa
392	Barn Owl	*Tyto alba*	R-C			BW, Ki, Gr, Ko, Ds, Fy, RC, To, Fa
396	African Scops Owl	*Otus senegalensis*	R-C			BW, Ki
397	Whitefaced Owl	*Ptilopsus granti*	R-C			BW, Ki
398	Pearlspotted Owl	*Glaucidium perlatum*	R-C			BW, Ki
401	Spotted Eagle Owl	*Bubo africanus*	R-C			Fo, BW, Ki, Gr, Ko, Ds, Fy, RC, To, Fa
402	Giant Eagle Owl	*Bubo lacteus*	R-U			BW, Ki
404	Eurasian Nightjar	*Caprimulgus europaeus*	R-U			BW, Ki, To, Fa
406	Rufouscheeked Nightjar	*Caprimulgus rufigena*	BM-C			BW, Ki, Ko, Ds, Fa
411	Eurasian Swift	*Apus apus*	NBM-C			BW, Ki, Gr, Ko, Ds, Fy, Mo, RC, To, Fa
415	Whiterumped Swift	*Apus caffer*	BM-VC			Ko, Ds, Mo, RC, To, Fa
417	Little Swift	*Apus affinis*	R/BM-VC			BW, Gr, Ko, Ds, Fy, Mo, RC, To, Fa
418	Alpine Swift	*Tachymarptis melba*	BM-C			BW, Ki, Gr, Ko, Ds, Fy, Mo, RC, Fa
425	Whitebacked Mousebird	*Colius colius*	E-C	x		Ko, Ds, To
426	Redfaced Mousebird	*Urocolius indicus*	R-C			BW, Ko, Fy, To, Fa
431	Malachite Kingfisher	*Alcedo cristata*	R-C			Wa
437	Striped Kingfisher	*Halcyon chelicuti*	R-C			BW
438	Eurasian Bee-eater	*Merops apiaster*	NBM/BM-C			BW, Ki, Gr, Ko, Ds, Fa
445	Swallowtailed Bee-eater	*Merops hirundineus*	R-LC			BW, Ki, Ko, Ds
446	Eurasian Roller	*Coracias garrulus*	NBM-C			BW, Ki, Gr, Fa
447	Lilacbreasted Roller	*Coracias caudata*	R/LM-C			BW, Ki
449	Purple Roller	*Coracias naevia*	R-U			BW, Ki
451	African Hoopoe	*Upupa africana*	R(n)-C	x		BW, Ki, Ko, Ds, To, Fa
454	Scimitarbilled Woodhoopoe	*Rhinopomastus cyanomelas*	R-C			BW, Ki
457	Grey Hornbill	*Tockus nasutus*	R-C	x		BW, Ki
459	Southern Yellowbilled Hornbill	*Tockus leucomelas*	Er-C	x		BW, Ki
465	Pied Barbet	*Tricholaema leucomelas*	Er-C	x		BW, Ki, Gr, Ko, Ds, To, Fa
481	Bennett's Woodpecker	*Campethera bennettii*	R-U			BW
483	Goldentailed Woodpecker	*Campethera abingoni*	R-C			Fo, BW, Ki, RC, To
486	Cardinal Woodpecker	*Dendropicos fuscescens*	R-C	x		Fo, BW, Ki, Ko, Ds, Fy, RC, To, Fa
487	Bearded Woodpecker	*Dendropicos namaquus*	R-C			BW
493	Monotonous Lark	*Mirafra passerina*	Er-C			BW, Ki
495	Eastern Clapper Lark	*Mirafra fasciolata*	Er-C			Ki, Gr, Ko, Fa
497	Fawncoloured Lark	*Calendulauda africanoides*	R-C	x		BW, Ki
498	Sabota Lark	*Calendulauda sabota*	Er-C			BW, Ki, Gr, Ko, Ds, RC
505	Dusky Lark	*Pinarocorys nigricans*	NBM-U			BW

Rob	English Name	Species	General Status	Obs	RDL Status	Habitats
506	Spikeheeled Lark	*Chersomanes albofasciata*	Er-C	x		Ki, Gr, Ko, Ds
507	Redcapped Lark	*Calandrella cinerea*	R(n)-C			BW, Ki, Gr, Ko, Ds, Fy, Mo, Fa
508	Pinkbilled Lark	*Spizocorys conirostris*	Er-C	x		Ki, Gr, Ko, Fa
511	Stark's Lark	*Spizocorys starki*	Er-C			Ko, Ds
516	Greybacked Finchlark	*Eremopterix verticalis*	Er-VC			Ki, Gr, Ko, Ds, Fa
518	Eurasian Swallow	*Hirundo rustica*	NBM-A			BW, Ki, Gr, Ko, Ds, Fy, Mo, To, Fa, Wa
520	Whitethroated Swallow	*Hirundo albigularis*	BM-C			Gr, RC, To, Fa
523	Pearlbreasted Swallow	*Hirundo dimidiata*	R/BM-C			BW, Fa
524	Redbreasted Swallow	*Hirundo semirufa*	BM-C			BW, Gr, Fa
526	Greater Striped Swallow	*Hirundo cucullata*	BM-C			Ki, Gr, Ko, Fy, Mo, RC, To, Fa
528	South African Cliff Swallow	*Hirundo spilodera*	Ebm-LC			BW, Gr, Fa
529	Rock Martin	*Hirundo fuligula*	R-C			Ki, Mo, RC, To, Fa
532	Sand Martin	*Riparia riparia*	NBM-C			Gr, Fa, Wa
533	Brownthroated Martin	*Riparia paludicola*	R-C			Gr, Wa
534	Banded Martin	*Riparia cincta*	BM-U			Gr, Fa, Wa
541	Forktailed Drongo	*Dicrurus adsimilis*	R-C	x		BW, Ki, RC, To, Fa
543	Eurasian Golden Oriole	*Oriolus oriolus*	NBM-U			BW, Ki, Fa
547	Black Crow	*Corvus capensis*	R-C			BW, Gr, Ko, Ds, Mo, Fa
548	Pied Crow	*Corvus albus*	R-A	x		BW, Gr, Ko, Ds, To, Fa
552	Ashy Tit	*Parus cinerascens*	Er-U			BW, Ki
557	Cape Penduline Tit	*Anthoscopus minutus*	Er-C			BW, Ki, Ko, Ds, Fy, Fa
563	Pied Babbler	*Turdoides bicolor*	E-C			BW, Ki
567	Redeyed Bulbul	*Pycnonotus nigricans*	Er-VC			BW, Gr, Ko, Ds, To, Fa
580	Groundscraper Thrush	*Psophocichla litsipsirupa*	R-C			BW, Ki, To, Fa
583	Shorttoed Rockthrush	*Monticola brevipes*	Er-U			RC, To
586	Mountain Chat	*Oenanthe monticola*	Er-C			Ko, Ds, Mo, RC, To, Fa
587	Capped Wheatear	*Oenanthe pileata*	R/BM-C	x		BW, Ki, Gr, Ko, Fa
589	Familiar Chat	*Cercomela familiaris*	R-C			BW, Ki, Gr, Ko, Ds, Fy, Mo, RC, To, Fa
595	Anteating Chat	*Myrmecocichla formicivora*	E-C	x		Ki, Gr, Ko, Fa
596	Stonechat	*Saxicola torquata*	R-VC	x		Gr, Fy, Mo, Fa
614	Karoo Robin	*Cercotrichas coryphoeus*	E-C	x		Ko, Fy
615	Kalahari Robin	*Cercotrichas paena*	Er-C			BW, Ki
619	Garden Warbler	*Sylvia borin*	NBM-C			Fo, BW, To
621	Titbabbler	*Parisoma subcaeruleum*	Er-C			BW, Ki, Ko, Ds
625	Icterine Warbler	*Hippolais icterina*	NBM-C			BW, Ki
631	African Marsh Warbler	*Acrocephalus baeticatus*	BM-C			Wa
643	Willow Warbler	*Phylloscopus trochilus*	NBM-VC			Fo, BW, Ki, To, Fa
651	Longbilled Crombec	*Sylvietta rufescens*	R-C	x		BW, Ki, Ko
653	Yellowbellied Eremomela	*Eremomela icteropygialis*	R-U			BW, Ki, Ko, Ds
664	Fantailed Cisticola	*Cisticola juncidis*	R-VC			Gr, Fa
665	Desert Cisticola	*Cisticola aridulus*	R-C			Gr, Fa
677	Levaillant's Cisticola	*Cisticola tinniens*	R-C	x		Gr, Fa, Wa
685	Blackchested Prinia	*Prinia flavicans*	Er-C			BW, Ki, Gr, Ds, To, Fa
688	Rufouseared Warbler	*Malcorus pectoralis*	E-C			Ki, Ko, Ds
689	Spotted Flycatcher	*Muscicapa striata*	NBM-C			BW, Ki, Ko, To, Fa
695	Marico Flycatcher	*Bradornis mariquensis*	Er-C			BW, Ki
697	Chat Flycatcher	*Bradornis infuscatus*	Er-C			Ki, Ko, Ds
698	Fiscal Flycatcher	*Sigelus silens*	E-C	x		BW, Ko, To
703	Pririt Batis	*Batis pririt*	Er-C			Ki, Ko, Ds
706	Fairy Flycatcher	*Stenostira scita*	E-C			BW, Ko, Fy, Mo, To, Fa
713	Cape Wagtail	*Motacilla capensis*	R-C	x		Gr, Fy, To, Fa, Wa

Rob	English Name	Species	General Status	Obs	RDL Status	Habitats
716	Grassveld Pipit	*Anthus cinnamomeus*	R-C			BW, Gr, Fa
719	Buffy Pipit	*Anthus vaalensis*	R-U			Ki, Gr, Fa
721	Rock Pipit	*Anthus crenatus*	E-LC	x		Ko, Mo, RC
731	Lesser Grey Shrike	*Lanius minor*	NBM-C			BW, Ki, Gr
732	Fiscal Shrike	*Lanius collaris*	R-C	x		BW, Ki, Gr, Ko, Ds, Fy, Mo, To, Fa
733	Redbacked Shrike	*Lanius collurio*	NBM-C			BW, Ki, Gr, Fa
739	Crimsonbreasted Shrike	*Laniarius atrococcineus*	Er-C	x		BW, Ki, Ko, Ds
741	Brubru	*Nilaus afer*	R-C	x		BW
743	Threestreaked Tchagra	*Tchagra australis*	R-C	x		BW
746	Bokmakierie	*Telophorus zeylonus*	Er-C	x		Gr, Ko, Ds, Fy, RC, To, Fa
756	Whitecrowned Shrike	*Eurocephalus anguitimens*	Er-C			BW, Ki
759	Pied Starling	*Spreo bicolor*	E-C			Gr, Ko, Fy, Mo, To, Fa
760	Wattled Starling	*Creatophora cinerea*	R(n)-LA			BW, Ki, Gr, Ko, Ds, To, Fa
764	Glossy Starling	*Lamprotornis nitens*	Er-C			BW, Ki, Ko, Ds, To, Fa
770	Palewinged Starling	*Onychognathus nabouroup*	Er-C			Ko, Ds, RC
779	Marico Sunbird	*Cinnyris mariquensis*	R-C			BW, To
788	Dusky Sunbird	*Cinnyris fusca*	Er-C			Ko, Ds
796	Orange River White-eye	*Zosterops pallidus*	E-VC			Fo, BW, Ko, Fy, To, Fa
798	Redbilled Buffalo Weaver	*Bubalornis niger*	R-LC			BW
799	Whitebrowed Sparrowweaver	*Plocepasser mahali*	R-VC	x		BW, Ki, Fa
800	Sociable Weaver	*Philetairus socius*	E-C	x		BW, Ki
801	House Sparrow	*Passer domesticus*	R-VC	x		To, Fa
802	Great Sparrow	*Passer motitensis*	R-U			BW, Ki, Ds
803	Cape Sparrow	*Passer melanurus*	Er-VC	x		BW, Ki, Ko, Ds, Fy, To, Fa
804	Southern Greyheaded Sparrow	*Passer diffusus*	Er-C			BW, Ki, Ko, To, Fa
806	Scalyfeathered Finch	*Sporopipes squamifrons*	Er-C			BW, Ki, Ko, Ds, Fa
814	Masked Weaver	*Ploceus velatus*	R-C			BW, Ki, Gr, Ko, Ds, Mo, To, Fa, Wa
821	Redbilled Quelea	*Quelea quelea*	R(n)-LA			BW, Ki, Gr, Fa
824	Red Bishop	*Euplectes orix*	R-C			Gr, To, Fa, Wa
834	Melba Finch	*Pytilia melba*	R-C			BW, Ki, Ko, Ds
842	Redbilled Firefinch	*Lagonosticta senegala*	R-C			BW, Gr, Ko, To, Fa
845	Violeteared Waxbill	*Granatina granatina*	Er-LC			BW, Ki, Fa
846	Common Waxbill	*Estrilda astrild*	R-C			Gr, To, Fa, Wa
847	Blackcheeked Waxbill	*Estrilda erythronotos*	R-LC			BW, Ki
856	Redheaded Finch	*Amadina erythrocephala*	Er-VC			Gr, Fa
861	Shafttailed Whydah	*Vidua regia*	Er-C			BW, Ki, Ko
870	Blackthroated Canary	*Serinus atrogularis*	R-C			BW, Ki, Gr, Ko, Ds, Fy, To, Fa
878	Yellow Canary	*Serinus flaviventris*	Er-C			Ki, Gr, Ko, Ds, Fy, Mo, To, Fa
884	Goldenbreasted Bunting	*Emberiza flaviventris*	R-U	x		BW, To, Fa
885	Cape Bunting	*Emberiza capensis*	R-C			Ko, Ds, Fy, Mo, RC
887	Larklike Bunting	*Emberiza impetuani*	Er-VC			Ko, Ds, Fy

Table 13: Abbreviation explanations.

Status	Occurrence	Endemic Status	Red Data Species	Habitats
R = Resident **BM** = Breeding Migrant **NBM** = Non-breeding migrant **V** = Vagrant	**A** = Abundant **VC** = Very Common **C** = Common **U** = Uncommon **R** = Rare	**E** = wholly endemic species **Er** = species with range largely confined to Southern Africa **Es** = endemic sub-species which is potentially a full	**RE** = regionally extinct **CR** = critically endangered **EN** = endangered **VU** = vulnerable **NT** = near threatened.	**Fo** = Forest **BW** = Bushveld and Woodland **Ki** = Kalahari **Gr** = Grassland **Ko** = Karoo **Ds** = Desert **Fy** = Fynbos

Status	Occurrence	Endemic Status	Red Data Species	Habitats
		species **Ebr** = species with breeding range wholly confined to Southern Africa.		**Mo** = Mountains **RC** = Rocks and Cliffs **To** = Towns and Gardens **Fa** = Farmland **Wa** = Wetland (Inland Water) **Mp** = Marine pelagic **Ms** = Marine Shoreline

Table 14: Potential reptilian biodiversity species list based on the distribution ranges of species recorded from the region (*from* Branch, 1998 and ADU, 2009).

Family	Species	Common name	Red list category
Agamidae	*Agama aculeata aculeata*	Common Ground Agama	Least Concern (SARCA 2014)
Agamidae	*Agama atra*	Southern Rock Agama	Least Concern (SARCA 2014)
Amphisbaenidae	*Monopeltis mauricei*	Maurice's Worm Lizard	Least Concern (SARCA 2014)
Chamaeleonidae	*Chamaeleo dilepis dilepis*	Common Flap-neck Chameleon	Least Concern (SARCA 2014)
Colubridae	*Dispholidus typus typus*	Boomslang	Least Concern (SARCA 2014)
Colubridae	*Philothamnus semivariegatus*	Spotted Bush Snake	Least Concern (SARCA 2014)
Colubridae	*Telescopus semiannulatus semiannulatus*	Eastern Tiger Snake	Least Concern (SARCA 2014)
Cordylidae	*Karusasaurus polyzonus*	Karoo Girdled Lizard	Least Concern (SARCA 2014)
Elapidae	*Aspidelaps scutatus scutatus*	Speckled Shield Cobra	Least Concern (SARCA 2014)
Elapidae	*Dendroaspis polylepis*	Black Mamba	Least Concern (SARCA 2014)
Elapidae	*Naja nigricincta woodi*	Black Spitting Cobra	Least Concern (SARCA 2014)
Elapidae	*Naja nivea*	Cape Cobra	Least Concern (SARCA 2014)
Gekkonidae	*Chondrodactylus angulifer*	Giant Ground Gecko	Least Concern (IUCN 2009)
Gekkonidae	*Chondrodactylus angulifer angulifer*	Common Giant Ground Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Chondrodactylus bibronii*	Bibron's Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Colopus wahlbergii*	Kalahari Ground Gecko	Not evaluated
Gekkonidae	*Colopus wahlbergii wahlbergii*	Kalahari Ground Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Lygodactylus*		Not listed
Gekkonidae	*Lygodactylus capensis capensis*	Common Dwarf Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Pachydactylus capensis*	Cape Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Ptenopus garrulus garrulus*	Common Barking Gecko	Least Concern (SARCA 2014)
Lacertidae	*Heliobolus lugubris*	Bushveld Lizard	Least Concern (SARCA 2014)
Lacertidae	*Nucras intertexta*	Spotted Sandveld Lizard	Least Concern (SARCA 2014)
Lacertidae	*Pedioplanis lineoocellata lineoocellata*	Spotted Sand Lizard	Least Concern (SARCA 2014)
Lacertidae	*Pedioplanis namaquensis*	Namaqua Sand Lizard	Least Concern (SARCA 2014)
Lamprophiidae	*Atractaspis bibronii*	Bibron's Stiletto Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Boaedon capensis*	Brown House Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Lycophidion capense capense*	Cape Wolf Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Prosymna sundevallii*	Sundevall's Shovel-snout	Least Concern (SARCA 2014)
Lamprophiidae	*Psammophis notostictus*	Karoo Sand Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Psammophis trinasalis*	Fork-marked Sand Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Pseudaspis cana*	Mole Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Xenocalamus bicolor bicolor*	Bicoloured Quill-snouted Snake	Least Concern (SARCA 2014)
Pelomedusidae	*Pelomedusa subrufa*	Central Marsh Terrapin	Least Concern (SARCA 2014)

Family	Species	Common name	Red list category
Scincidae	*Acontias kgalagadi kgalagadi*	Striped Blind Legless Skink	Least Concern (SARCA 2014)
Scincidae	*Acontias lineatus*	Striped Blind Legless Skink	Not listed
Scincidae	*Trachylepis occidentalis*	Western Three-striped Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis punctatissima*	Speckled Rock Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis punctulata*	Speckled Sand Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis spilogaster*	Kalahari Tree Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis sulcata*	Western Rock Skink	Not listed
Scincidae	*Trachylepis sulcata sulcata*	Western Rock Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis variegata*	Variegated Skink	Least Concern (SARCA 2014)
Testudinidae	*Psammobates oculifer*	Serrated Tent Tortoise	Least Concern (SARCA 2014)
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	Least Concern (SARCA 2014)
Varanidae	*Varanus albigularis albigularis*	Rock Monitor	Least Concern (SARCA 2014)
Viperidae	*Bitis arietans arietans*	Puff Adder	Least Concern (SARCA 2014)

Table 15: Potential amphibian species biodiversity list based on the historical recording of species from the region (*from* Minter, *et al.,* 2004).

Family	Species	Common name	Red list category
Brevicepitidae	*Breviceps adspersus*	Bushveld Rain Frog	Least Concern
Bufonidae	*Amietophrynus poweri*	Power's Toad	Least Concern
Bufonidae	*Vandijkophrynus gariepensis gariepensis*	Karoo Toad (subsp. gariepensis)	Not listed
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina	Least Concern
Pipidae	*Xenopus laevis*	Common Platanna	Least Concern
Pyxicephalidae	*Amietia quecketti*	Queckett's River Frog	Least Concern
Pyxicephalidae	*Cacosternum boettgeri*	Common Caco	Least Concern
Pyxicephalidae	*Tomopterna cryptotis*	Tremelo Sand Frog	Least Concern

Table 16: The full floral species reference list from POSA (SANBI, 2015), together with additional species observed during the field survey.

Family	Exot	Species	Threat status	SA Endemic	Obs
ACANTHACEAE		Monechma genistifolium (Engl.) C.B.Clarke subsp. australe (P.G.Mey.) Munday	LC	No	
AIZOACEAE		Galenia africana var. africana	LC	No	x
AMARANTHACEAE		Hermbstaedtia fleckii (Schinz) Baker & C.B.Clarke	LC	No	x
AMARANTHACEAE		Leucosphaera bainesii	LC	No	x
AMARANTHACEAE		Sericorema remotiflora (Hook.f.) Lopr.	LC	No	x
AMARYLLIDACEAE		Crinum minimum	LC	No	x
ANACARDIACEAE		Searsia dregeana (Sond.) Moffett	LC	No	
ANACARDIACEAE		Searsia erosa (Thunb.) Moffett	LC	No	
ANACARDIACEAE		Searsia lancea	LC	No	x
ASPARAGACEAE		Asparagus cooperi	LC	No	x
ASTERACEAE		Berkheya ferox O.Hoffm. var. tomentosa Roessler	LC	No	
ASTERACEAE		Dimorphotheca zeyheri Sond.	LC	No	x

Family	Exot	Species	Threat status	SA Endemic	Obs
ASTERACEAE		Geigeria ornativa O.Hoffm. subsp. ornativa	LC	No	x
ASTERACEAE		Pentzia calcarea Kies	LC	No	
BIGNONIACEAE		Rhigozum trichotomum	LC	No	x
CAPPARACEAE		Cleome angustifolia Forssk. subsp. diandra (Burch.) Kers	LC	No	
CHENOPODIACEAE	*	Salsola kali L.	Not Evaluated	No	
CHENOPODIACEAE		Salsola patentipilosa Botsch.	LC	No	x
CONVOLVULACEAE		Merremia verecunda Rendle	LC	No	
CUCURBITACEAE		Acanthosicyos naudinianus (Sond.) C.Jeffrey	LC	No	
CYPERACEAE		Cyperus margaritaceus Vahl var. margaritaceus	LC	No	
FABACEAE		Crotalaria orientalis subsp. orientalis	LC	No	x
FABACEAE		Crotalaria virgultalis Burch. ex DC.	LC	No	
FABACEAE		Cullen tomentosum (Thunb.) J.W.Grimes	LC	No	x
FABACEAE		Indigofera alternans DC. var. alternans	LC	No	x
FABACEAE		Melolobium candicans (E.Mey.) Eckl. & Zeyh.	LC	No	
FABACEAE		Melolobium humile Eckl. & Zeyh.	LC	No	
FABACEAE	*	Prosopis glandulosa Torr. var. glandulosa	Not Evaluated	No	x
FABACEAE	*	Prosopis velutina Wooton	Not Evaluated	No	
FABACEAE		Tephrosia burchellii Burtt Davy	LC	No	x
FABACEAE		Vachellia (=Acacia) erioloba (E.Mey.) P.J.H.Hurter	LC (protected)	No	x
FABACEAE		Vachellia (=Acacia) haematoxylon (Willd.) Seigler & Ebinger	LC (protected)	No	x
FABACEAE		Vachellia hebeclada subsp. hebeclada	LC	No	x
GISEKIACEAE		Gisekia pharnacioides L. var. pharnacioides	LC	No	
HYACINTHACEAE		Ornithogalum seineri	LC	No	x
IRIDACEAE		Moraea longistyla (Goldblatt) Goldblatt	LC	No	
IRIDACEAE		Moraea pallida (Baker) Goldblatt	LC	No	
LAMIACEAE		Stachys spathulata Burch. ex Benth.	LC	No	
LOPHIOCARPACEAE		Corbichonia rubriviolacea (Friedrich) C.Jeffrey	LC	No	
MALVACEAE		Grewia flava DC.	LC	No	x
MOLLUGINACEAE		Limeum myosotis H.Walter var. myosotis	LC	No	
OROBANCHACEAE		Striga gesnerioides (Willd.) Vatke	LC	No	
POACEAE		Anthephora argentea Gooss.	LC	No	
POACEAE		Aristida adscensionis L.	LC	No	x
POACEAE		Aristida congesta Roem. & Schult. subsp. congesta	LC	No	x
POACEAE		Aristida stipitata Hack. subsp. spicata (De Winter) Melderis	LC	No	x
POACEAE		Aristida vestita Thunb.	LC	No	
POACEAE		Brachiaria marlothii (Hack.) Stent	LC	No	
POACEAE		Chrysopogon serrulatus Trin.	LC	No	
POACEAE		Coelachyrum yemenicum (Schweinf.) S.M.Phillips	LC	No	
POACEAE	*	Cymbopogon pospischilii (K.Schum.) C.E.Hubb.	Not Evaluated	No	
POACEAE		Cynodon dactylon (L.) Pers.	LC	No	x
POACEAE		Enneapogon cenchroides (Licht. ex Roem. & Schult.) C.E.Hubb.	LC	No	x

Family	Exot	Species	Threat status	SA Endemic	Obs
POACEAE		Enneapogon desvauxii P.Beauv.	LC	No	x
POACEAE		Eragrostis echinochloidea Stapf	LC	No	x
POACEAE		Eragrostis lehmanniana Nees var. lehmanniana	LC	No	x
POACEAE		Eragrostis pallens Hack.	LC	No	x
POACEAE		Eragrostis trichophora Coss. & Durieu	LC	No	
POACEAE		Eustachys paspaloides (Vahl) Lanza & Mattei	LC	No	x
POACEAE		Fingerhuthia africana Lehm.	LC	No	x
POACEAE		Megaloprotachne albescens C.E.Hubb.	LC	No	
POACEAE		Pogonarthria squarrosa (Roem. & Schult.) Pilg.	LC	No	x
POACEAE		Schmidtia kalahariensis Stent	LC	No	x
POACEAE		Setaria verticillata (L.) P.Beauv.	LC	No	x
POACEAE		Sporobolus fimbriatus (Trin.) Nees	LC	No	x
POACEAE		Stipagrostis amabilis	LC	No	x
POACEAE		Stipagrostis ciliata (Desf.) De Winter var. capensis (Trin. & Rupr.) De Winter	LC	No	x
POACEAE		Tragus racemosus (L.) All.	LC	No	x
POACEAE		Tricholaena monachne (Trin.) Stapf & C.E.Hubb.	LC	No	
POLYGALACEAE		Polygala leptophylla Burch. var. leptophylla	LC	No	
POLYGALACEAE		Polygala seminuda Harv.	LC	No	
POLYGONACEAE		Oxygonum delagoense Kuntze	LC	No	
RICCIACEAE		Riccia albolimbata S.W.Arnell		No	
SANTALACEAE		Thesium hystrix A.W.Hill	LC	No	
SCROPHULARIACEAE		Selago mixta Hilliard	LC	No	
SOLANACEAE		Lycium bosciifolium	LC	No	x
SOLANACEAE		Lycium cinereum	LC	No	x
SOLANACEAE		Solanum supinum	LC		x

APPENDIX C – IMPACT RATING SIGNIFICANCE METHODOLOGIES & CALCULATIONS.

For each potential impact, the **EXTENT** (spatial scale), **MAGNITUDE**, **DURATION** (time scale), **PROBABILITY** of occurrence, **IRREPLACEABLE** loss of resources and the **REVERSIBILITY** of potential impacts are assessed. The assessment of the given criteria will be used to determine the significance of each impact, with and without the implementation of the proposed mitigation measures. The scales to be used to assess these variables and to define the rating categories are tabulated in Table 17 and Table 18 below.

Table 17: Evaluation components, ranking scales and descriptions (criteria).

Evaluation component	Ranking scale and description (criteria)
MAGNITUDE of NEGATIVE IMPACT (at the indicated spatial scale)	**10 - Very high**: Bio-physical and/or social functions and/or processes might be *severely* altered. **8 - High**: Bio-physical and/or social functions and/or processes might be *considerably* altered. **6 - Medium**: Bio-physical and/or social functions and/or processes might be *notably* altered. **4 - Low** : Bio-physical and/or social functions and/or processes might be *slightly* altered. **2 - Very Low**: Bio-physical and/or social functions and/or processes might be *negligibly* altered. **0 - Zero**: Bio-physical and/or social functions and/or processes will remain *unaltered.*
MAGNITUDE of POSITIVE IMPACT (at the indicated spatial scale)	**10 - Very high (positive)**: Bio-physical and/or social functions and/or processes might be *substantially* enhanced. **8 - High (positive)**: Bio-physical and/or social functions and/or processes might be *considerably* enhanced. **6 - Medium (positive)**: Bio-physical and/or social functions and/or processes might be *notably* enhanced. **4 - Low (positive)**: Bio-physical and/or social functions and/or processes might be *slightly* enhanced. **2 - Very Low (positive)**: Bio-physical and/or social functions and/or processes might be *negligibly* enhanced. **0 - Zero (positive)**: Bio-physical and/or social functions and/or processes will remain *unaltered.*
DURATION	**5 - Permanent** **4 - Long term**: Impact ceases after operational phase/life of the activity > 20 years. **3 - Medium term**: Impact might occur during the operational phase/life of the activity – 5 - 20 years. **2 - Short term**: Impact might occur during the construction phase - < 5 years. **1 - Immediate**
EXTENT (or spatial scale/influence of impact)	**5 - International**: Beyond National boundaries. **4 - National**: Beyond Provincial boundaries and within National boundaries. **3 - Regional**: Beyond 5 km of the proposed development and within Provincial boundaries. **2 - Local**: Within 5 km of the proposed development. **1 - Site-specific**: On site or within 100 m of the site boundary. **0** - None
IRREPLACEABLE loss of resources	**5 – Definite** loss of irreplaceable resources. **4 – High** potential for loss of irreplaceable resources. **3 – Moderate** potential for loss of irreplaceable resources. **2 – Low** potential for loss of irreplaceable resources. **1 – Very low** potential for loss of irreplaceable resources. **0 - None**
REVERSIBILITY of impact	**5 –** Impact **cannot** be reversed. **4 – Low** potential that impact might be reversed. **3 – Moderate** potential that impact might be reversed. **2 – High** potential that impact might be reversed. **1 –** Impact **will be** reversible. **0 –** No impact.

Evaluation component	Ranking scale and description (criteria)
PROBABILITY (of occurrence)	**5 - Definite**: >95% chance of the potential impact occurring. **4 - High probability**: 75% - 95% chance of the potential impact occurring. **3 - Medium probability**: 25% - 75% chance of the potential impact occurring **2 - Low probability**: 5% - 25% chance of the potential impact occurring. **1 - Improbable**: <5% chance of the potential impact occurring.
CUMULATIVE impacts	**High**: The activity is one of several similar past, present or future activities in the same geographical area, and might contribute to a very significant combined impact on the natural, cultural, and/or socio-economic resources of local, regional or national concern. **Medium**: The activity is one of a few similar past, present or future activities in the same geographical area, and might have a combined impact of moderate significance on the natural, cultural, and/or socio-economic resources of local, regional or national concern. **Low**: The activity is localised and might have a negligible cumulative impact. **None**: No cumulative impact on the environment.

Once the evaluation components have been ranked for each potential impact, the significance of each potential impact will be assessed (or calculated) using the following formula:

SP (significance points) = (magnitude + duration + extent + irreplaceable + reversibility) x probability

The maximum value is 150 SP (significance points). The unmitigated and mitigated scenarios for each potential environmental impact are rated as per Table 18 below.

Table 18: Definition of significance ratings (positive and negative).

Significance Points	Environmental Significance	Description
125 – 150	**Very high (VH)**	An impact of very high significance will mean that the project cannot proceed, and that impacts are irreversible, regardless of available mitigation options.
100 – 124	**High (H)**	An impact of high significance which could influence a decision about whether or not to proceed with the proposed project, regardless of available mitigation options.
75 – 99	**Medium-high (MH)**	If left unmanaged, an impact of medium-high significance could influence a decision about whether or not to proceed with a proposed project. Mitigation options should be relooked.
40 – 74	**Medium (M)**	If left unmanaged, an impact of moderate significance could influence a decision about whether or not to proceed with a proposed project.
<40	**Low (L)**	An impact of low is likely to contribute to positive decisions about whether or not to proceed with the project. It will have little real effect and is unlikely to have an influence on project design or alternative motivation.
+	**Positive impact (+)**	A positive impact is likely to result in a positive consequence/effect, and is likely to contribute to positive decisions about whether or not to proceed with the project.