PRELIMINARY ECOLOGICAL SURVEY FOR THE PROPOSED LUIPERDSHOEK POWERLINE, NORTHERN CAPE PROVINCE

Compiled for: **Royal Haskoning*DHV***

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SUBMITTED: MARCH 2013

1. BACKGROUND INFORMATION

Eskom Holdings SOC Limited – Western Region (hereafter referred to as Eskom) appointed Royal HaskoningDHV formerly trading as SSI Engineers & Environmental Consultants (Pty) (Ltd) to undertake the environmental authorization (Basic Assessment) for the construction of a new 13.7km 33kV powerline which will supply electricity to the 11kV Luiperdshoek powerline. A pole mounted transformer will also be installed.

The Luiperdshoek powerline will supply electricity for the historically disadvantaged farmers for their spraying pumps, work shops etc.. They currently utilise fuel driven generators for irrigation activities which have high cost implications. Royal HaskoningDHV as independent environmental consultants appointed Mr. C. L. Cook to undertake a preliminary ecological habitat assessment for the proposed new 13.7km 33kV Luipardshoek Powerline.

The purpose of this document is to highlight potential impacts on the biodiversity of the project mainly from a potential vegetation and faunal perspective. A brief site visitation was undertaken on the 20-21st February 2013. Special emphasis was be placed on the potential occurrence of Red Listed/Data plant or faunal (animal) species likely to occur in the sensitive rocky hill areas of the Luiperdshoek powerline adjacent to the Gariep (Orange) River.

1.1 Objectives of the Preliminary Ecological Survey

- To provide a description of the vegetation as well as fauna with special emphasis of threatened plant or animal species occurring or likely to occur on the proposed Luiperdshoek powerline.
- To describe the available habitats on site including areas of important conservation value or areas most likely to form important habitat for remaining threatened plant and animal species on or around the proposed Luiperdshoek powerline.

1.2 Scope of study

- A preliminary ecological (single site visit) survey with special emphasis on the current status of threatened plant and animal species (Red Listed/Data Species), within the proposed Luiperdshoek powerline alignment using historic as well as published distribution records.
- An assessment of the ecological habitats, evaluating conservation importance and significance with special emphasis on the current status of threatened animal species (Red Data Species), within the proposed Luiperdshoek powerline.
- Documentation of the findings of the study in a report.

1.3 Constraints of study

- Restricted to a single season site survey for only two days.
- Limitation of the available data bases for the area.
- The majority of threatened faunal species are extremely secretive including the Black-footed Cat and require intensive surveys conducted over extended periods.

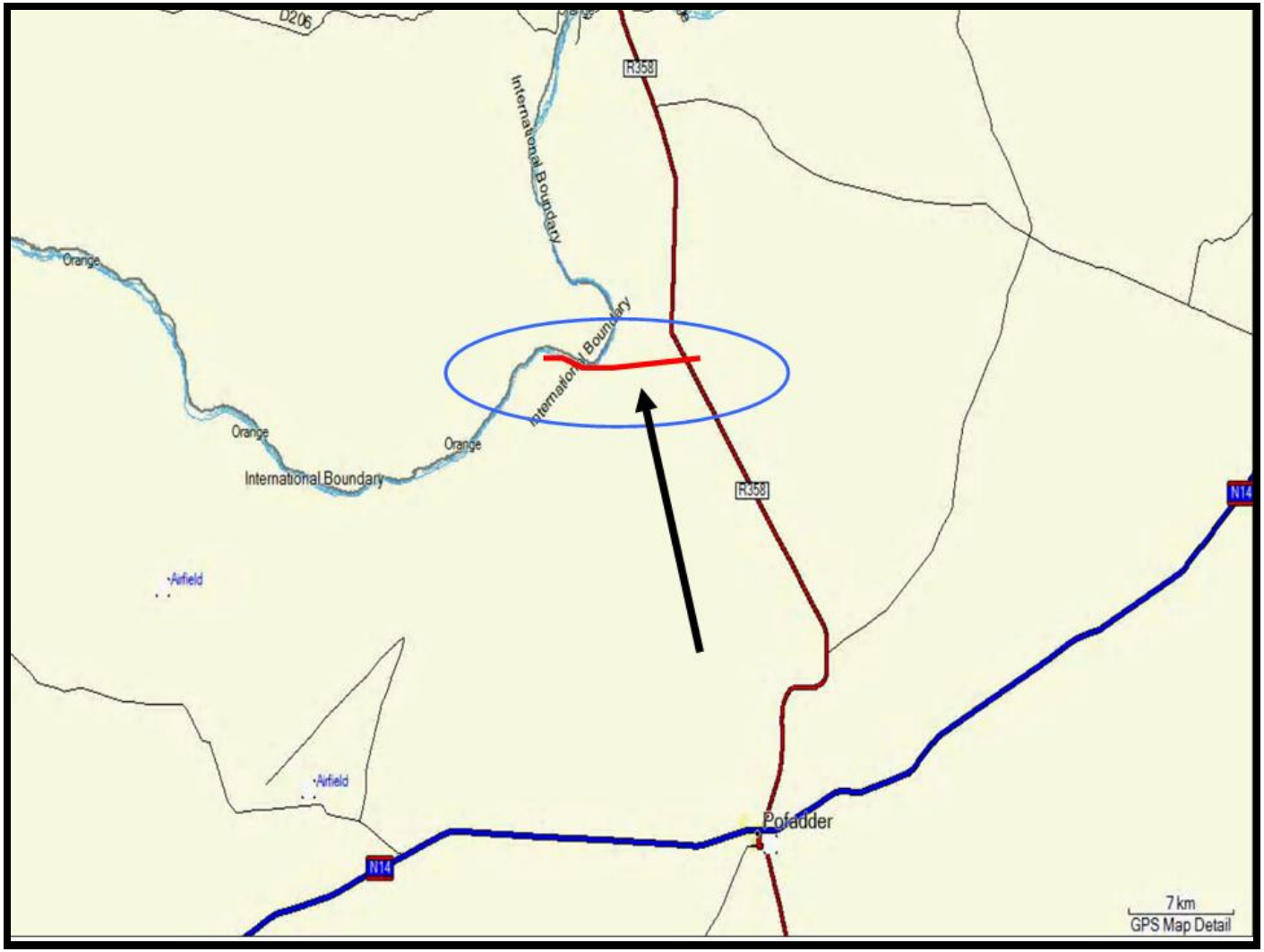

Figure1. Locality map of the proposed Luiperdshowk powerline alignments (red line) situated to the north of Pofadder.

Figure2. Google Image ™ of the proposed Luiperdshoek powerline alignments (red line) situated adjacent to the Orange River and the Namibian border.

2. METHODOLOGY

2.1 Predictive methods

A 1:50 000 map of the study area was provided showing existing infrastructure and the proposed alignments. This was used as far as possible in order to identify potential "hot-spots" along the corridors, e.g. Patches of undisturbed vegetation, rivers, non-perennial drainage lines and rocky hills and inselbergs. Satellite imagery of the area was obtained from Google Earth was studied in order to get a three dimensional impression of the topography and land use.

2.2 Literature Survey

A detailed literature search was undertaken to assess the current status of the vegetation as well as threatened plant species as well as fauna that have been historically known to occur in the Pofadder study area (2819 DA & 2819 DB) quarter degree grid cells, within which the proposed Luiperdshoek powerline alignment is located. The literature search was undertaken utilising *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford 2006) for the vegetation description as well as *National Red List of Threatened Plants of South Africa* (Raimondo *et al,* 2009). *The Mammals of the Southern African Subregion* (Skinner & Chimimba 2005) and *The Red Data Book of the Mammals of South Africa: A Conservation Assessment* (Friedmann and Daly (editors) 2004) for mammals. Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (eds). 2005. *Roberts- Birds of Southern Africa VIIth ed*. and BARNES, K.N. (ed.) (2000) *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland* for avifauna (birds). The *Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland* (Minter *et al.* 2004) for amphibians. The *Field Guide to the Snakes and other Reptiles of Southern Africa* (Branch 2001) and *South African Red Data Book-Reptiles and Amphibians* (Branch 1988) for reptiles.

2.3 Uncertainties in predicting results

- No comprehensive vegetation or faunal surveys were conducted but merely a brief field survey conducted over two days.
- The majority of threatened plant and animals species are extremely secretive and difficult to observe even during intensive field surveys conducted over several years. The majority of plant and animal species are extremely seasonal only emerging after sufficient rainfall events.
- Limitation of historic data and available databases for the Pofadder area.
- The presence of threatened species on site is assessed mainly on habitat availability and suitability as well as desk research (literature, personal records and previous surveys conducted in the Northern Cape as well as in similar habitats between1997-2012).

2.4 Gaps in the baseline data

- Little long-term, verified data of faunal species distribution on micro-habitat level along the proposed powerline alignment.
- Little long-term, verified data on impacts of existing power lines (bird-collisions etc.) in the study area on fauna.

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 LOCATION

The study area is located approximately 25km to the north of the town of Pofadder within the Northern Cape Province (Figure 1). The site is situated along the R358 towards the border town of Onseepkans. The Bushmanland Bioregion is separated from other bioregions within the Nama Karoo Biome by having low mean precipitation and high mean temperatures. The vegetation is dominated by arid shrublands and grasslands. The study area is located within the arid region of South Africa and annually receives between 45-80mm of rain. The rainfall peaks in late summer and early autumn, becoming more pronounced eastwards. Summer temperatures are often higher than 40°C and occasionally reaching 50°C at low altitudes. Frost is vary rare but occurs at higher altitudes (Mucina & Rutherford 2006)

3.2 VEGETATION

The study area for the proposed Luiperdshoek powerline is located within three vegetation units as defined by Mucina & Rutherford (2006) namely the **Eastern Gariep Plains Desert (Dg 9)**, **Eastern Gariep Rock Desert (Dg 10)** and the **Lower Gariep Alluvial vegetation (AZa 3)** (Figure 3).

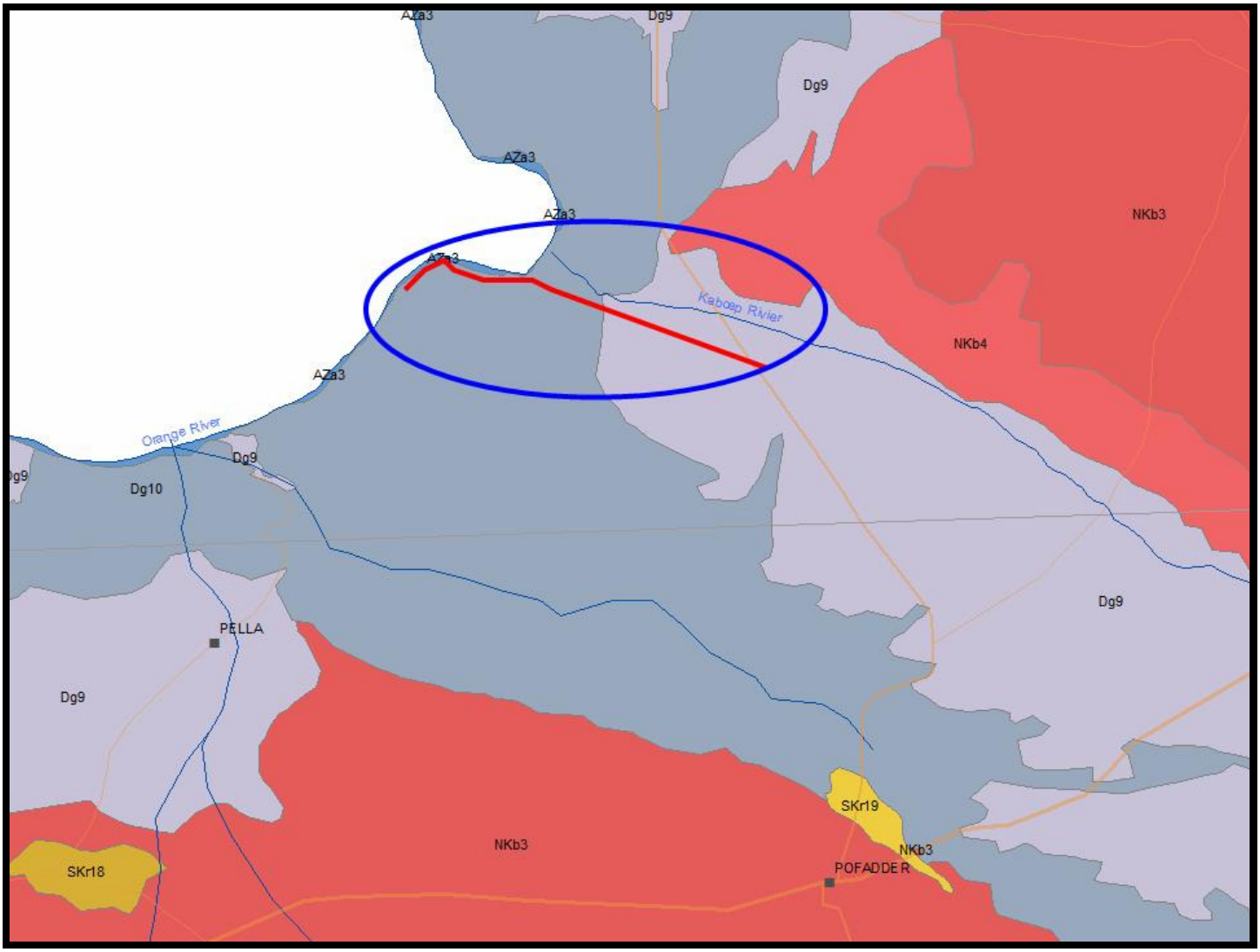

Figure3. Vegetation types of the study area (adapted from Mucina & Rutherford 2006).

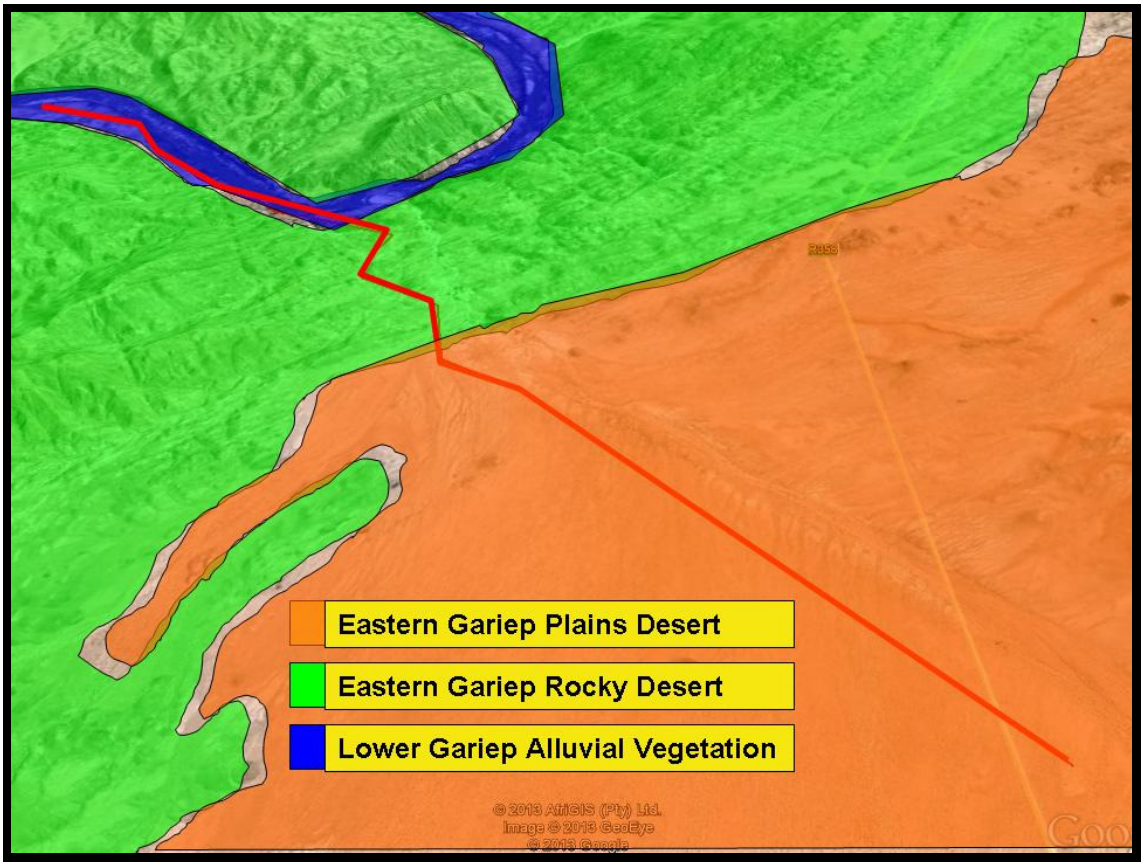

Figure4. **Vegetation units occurring within the Luiperdshoek powerline alignment.** Eastern Gariep Plains Desert occurs on the slightly undulating plains to the south of the Orange River. The Eastern Gariep Rocky Desert occurs on the rocky hills and slopes adjacent to the Orange River. Lower Gariep Alluvial Vegetation occurs within the riparian zone situated within the macro-channel banks and flood benches of the Orange River. Large sections have been historically transformed for irrigated Mango orchards as well as invaded by *Prosopis gladulosa* var. *tooreyana*.*

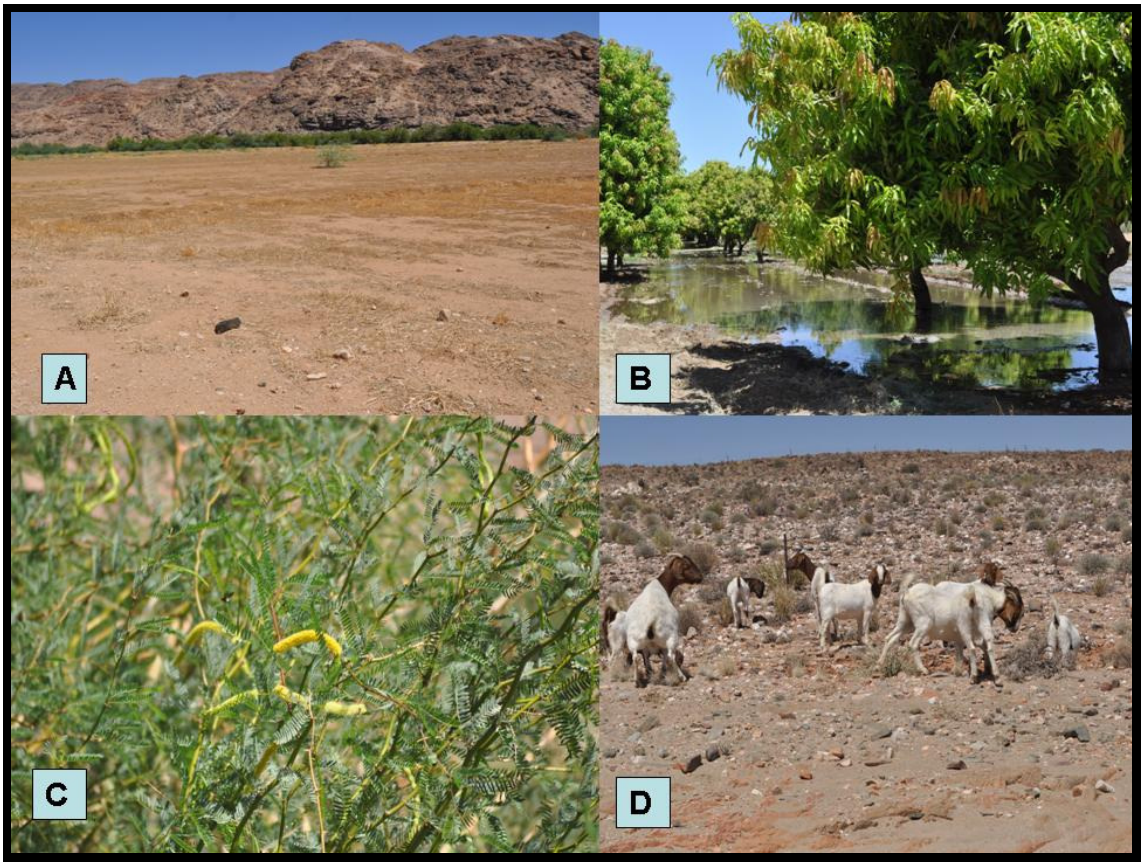

Figure5. A conglomerate of photographs displaying the current impacts on the vegetation around the Luiperdshoek powerline alignment. A: Large sections adjacent to the Gariep (Orange) River have been transformed by the ploughing of lands. **B:** Existing Mango orchards occur adjacent to the Gariep River. **C:** Extensive alien vegetation invasion especially along the riparian zone of the Gariep River as well as to a lesser extent along the non-perennial drainage lines. Vast stands of *Prosopis gladulosa* var. *tooreyana* have been recently cleared from the Gariep River and old orchards. **D:** Livestock grazing activities including goats and cattle have a high impact on the sparse vegetation.

3.3 EASTERN GARIEP PLAINS DESERT (Dg9)

Figure6. The vegetation around the proposed powerline alignment consists of heavily degraded Eastern Gariep Plains Desert. The vegetation is characterised by spinescent white grasses (*Stipagrostis* spp.) as well as scattered perennial dwarf shrubs including *Acacia melifera* subsp. *detinens*. A few scattered *Aloe dichotoma* occur to the south of the proposed alignment.

Eastern Gariep Plain Desert was formerly classified as **Namaqualand Broken Veld (VT 33)** (Acocks 1953) and **Orange River Nama Karoo (LR 51)** (Low & Rebelo 1996).

Distribution

Comprises the sheet wash plains east of the Richtersveld which lead down to the Orange River at Henkries, Goodhouse, Kabis, Klein Pella/Kambreek and the vicinity of Onseepkans. It also occurs on plains west of Pella to south of Vuurdoodberg Mountain in the west, forming a broad east-west passage between the mountains to the north that fringe or are close to the Orange River and more broken east-west line of hills and mountains to the south (Annakoppies, Grootberg, Witberg, Haramoebberge, Bantamberg and Amankop). Eastern Gariep Plains Desert is also found along the lower

reaches of the Kaboep River in the east and extends north of the Oringe River in Namibia. Altitude varies from roughly 250-900 m (Muucina & Rutherford 2006).

Vegetation and Landscape Features

Often sloping plains which sharply contrast with the surrounding rocky hills and mountains. Typical wash vegetation in the breaks between the mountains to the Orange River. Grassland dominated by 'white grasses', some spinescent (*Stipagrostis* species) on much of the flats with additional shrubs and herbs in the drainage lines or on more gravelly or loamy soils next to the mountains (Mucina & Rutherford 2006).

Geology

Quaternary sheet-wash alluvial deposits, sands, deep in places. Soils are red-yellow apedal, freely drained soils with a high base status. Land types Ag and Ae (Mucina & Rutherford 2006).

Dominant taxa in this vegetation type included:

Small Tree	*Parkinsonia africana, Acacia mellifera subsp. detinens*
Leaf & Stem-Succulent Shrubs	*Brownanthus pseudoschlichtianus, Psilocaulon subnodosum, Euphorbia greagria, Zygophyllum rigidum*
Shrubs	*Sisyndite spartea, Calicorema capitata, Gaillonia crocyllis, Hermbstaedtia glauca, Monechma spartiodes, Petalidium setosum*
Grasses	*Stipagrostis uiplumis, Stipagrostis hochstetteriana* var. *secalina, Stipagrostis obtusa, Schmidtia kalahariensis*
Forbs	*Codon royenii, Rogeria longiflora, Mesembryanthemum guerichianum, Cucumis africanus*
Red Listed Species	*Aloe dichotoma* and *Hoodia gordonii*

Conservation status:
Target is 34% with none conserved in statutory conservation areas. Few intact examples of this vegetation remain. Heavy grazing and arid climate combined with the ease of accessibility of the vegetation to stock mean the pastoral activities in the past have significantly altered the structure and composition of the vegetation of this unit. In some areas *Prosopis gladulosa* var. *tooreyana* shows potential to become a serious problem, especially around natural springs or aquifers as well as perennial (Orange River) and non-perennial drainage lines. Some very restricted areas are cultivated, mainly with date palms and grape vines (Mucina & Rutherford 2006).

The site is currently vacant and utilised for small-scale livestock grazing activities (cattle and goats). The vegetation has been heavily overgrazed in the past. The proposed powerline alignment follows an existing road and will result in a negligible short-long term impact on the associated vegetation. No red data plants were observed along the proposed alignment. A few scattered Quiver Trees (*Aloe dichotoma*) occur to the south of the proposed alignment. A single colony of *Hoodia gordonii* was observed beneath a spinescent shrub.

3.4 EASTERN GARIEP ROCKY DESERT (Dg 10)

Figure7. The proposed alignment follows an existing access road through the Eastern Gariep Rocky Desert. The vegetation has been degraded due to livestock grazing activities and wood harvesting activities. A few scattered *Boscia foetida* subsp. *foetida* were observed on the rocky ridges.

Eastern Gariep Rocky Desert was previously classified as **Namaqualand Broken Veld** (VT 33) (Acocks 1953) and **Orange River Nama Karoo** (LR 51) (Low and Rebelo 1996).

Distribution

All the rocky areas along the Orange River including Groot Pellaberge, Dabenorisberge, Abbasaberge and many smaller mountains between Pella and Vioolsdrif. It also occurs in some mountains away from the Orange River such as Haramoebberge and Witberg. Altitude around 250- 1 205m at the highest peak of the Groot Pella (Mucina & Rutherford 2006).

Vegetation and Landscape Features

Hills and mountains (up to 650 m of relative altitude from their base), mostly with bare rock outcrops and covered with very sparse shrubby vegetation in crevices. Separated by broad sheet-wash plains. Habitats are mainly controlled by topography, aspect, local climate and lithology. On the Groot Pellaberg (to the west of Pofadder) there is sparse shrubland on the southern foothills *Aloe dichotoma, Rhigozum trichotomum* and *Petalidium setosum*) and a higher cover of plants in the southern ravines and rocky drainage lines (*Abutilon pycnodon, Asparagus suaveolens, Ficus cordata, Searsia (Rhus) populifolia* and *Searsia viminalis*). On the higher southern slopes *Justicia orchioides* is often dominant, with localized grassland directly below the cliffs (*Enneapogon scaber, Triraphis ramosissima* and *Danthoniopsis ramosa*). The south-facing quartzite cliffs and steep slopes support chasmophytes* (cremnophytes*) such as Ficus ilicina, Aloe *dabenorisana* and *Boweia gariepinus*. On the summits and higher northern slopes there is a much higher preponderance of succulent plants including *Euphorbia avasmontana, Aloe dichotoma, Aloe microstigma* subsp. *microstigma, Pelargonium aridum* and *Kleinia longiflora*. Succulent plants are also important on the northern foothills and also include *Aloe dichotoma, Euphorbia avasmontana, Sarcostemma viminale* and the diminutive *Lapidaria margarethae* (Van Jaarsveld 1985).

Geology and Soils

Mainly leucocratic biotite granite in the east and quartz-feldspar gneiss of the Stalhoek Complex and lesser amounts of leucocratic biotite gneiss occur, with intercalations of calc-silicate rocks, mafic gneiss and a quartzite-schist association with the Hom Subgroup, Bushmanland Group. In the west the area consists of granodiorite, adamellite, lecogranite. Tonalite and diorite of the Vioolsdrif Suite and the intermediate and acid volcanics of the Haib Subgroup of the Orange River Group (all of the above of Mokolian age). Very rocky substrate with little or no soils. Land type Ic (Mucina & Rutherford 2006).

* plant that grows within crevices or cracks
* plant that grows on a cliff

Dominant taxa in this vegetation type include:

Small trees	*Acacia mellifera, Boscia foetida* subsp. *foetida, Ehretia rigida, Ziziphus mucronata, Euclea pseudebenus, Maerua gilgii, Prosopis gladulosa* var. *tooreyana**
Leaf & Stem-Succulent Shrubs	*Brownanthus pseudoschlichtianus, Ceraria fruticulosa, Psilocaulon subnodosum, Ruschia barnadii, Ceraria namaquense, Commiphora capensis, C. cervifolia, C. gracilifrondosa, C. namaensis, Euphorbia avasmontana, E. greagria, E. gariepina, E. virosa*
Shrubs	*Adenolopus gariepinus, Antherothamnus pearsonii, Aptosimum tragacanthoides, Barleria lancifolia, B. rigida, Cadaba aphylla, Diospyros acocksii, Hermania stricta, Petalidium setosum, Rhigozum obovatum, Seasris populifolia*
Grasses	*Enneapogon scaber, Schmidtaia kalahariensis, Stipagrostis anomala, S. ciliata, S. obtusa*
Forbs	*Abutilon pycnodon, Chascanum gariepense, Codon royenii, Rogeria longifolia, Tribulus cristatus, Boweia gariepensis, Mesembryanthemum guerichianum, Cleome angustifolia subsp. diandra, C. foliosa var. lutea*
Endemic Taxa	*Ozoroa namaquensis, Tylecodon sulphurous*
Red Data Species	*Aloe dichotoma* and *Boscia albitrunca* (protected tree species)

Conservation status:

Target is 34% with none conserved in statutory conservation areas of South Africa. This unit occurs to the north of the Orange River where it is potentially conserved through the ownership of the Farm Tsams by the Namibian Ministry of Environment and Tourism (Mucina & Rutherford 2006).

Figure8. A few scattered Shepherd's Tree (*Boscia albitrunca*) occur to the north and south of the proposed alignment. No indigenous tree species will be removed along the proposed Luiperdshoek alignment.

The site is currently vacant and utilised for small-scale livestock grazing activities (cattle and goats). The vegetation has been heavily overgrazed in the past. A few scattered Shepherd's Tree (*Boscia albitrunca*) which are a protected tree species occur to the north and south of the proposed alignment. No Quiver Trees (*Aloe dichotoma*) were recorded adjacent to the proposed alignment. The proposed powerline alignment follows an existing road and will result in a negligible short-long term impact on the associated vegetation. No red data plants were observed along the proposed alignment.

3.5 LOWER GARIEP ALLUVIAL VEGETATION (AZa 3)

Figure8. The riparian vegetation along the Gariep (Orange) River has been impacted on by previous agricultural activities. Large sections of the alluvial floodplain have been ploughed and converted into Mango orchards. The riparian zone is dominated by dense patches of the invasive *Prosopis gladulosa* var. *tooreyana*.*

Distribution

Northern Cape Province as a broad alluvium (flood-plains and islands) of the Orange (Gariep) River between Groblershoop and the mouth into the Atlantic Ocean at Oranjemund (Namibia). This river stretch is embedded within Desert (Oranjemund to roughly Pofadder) and Nama-Karoo (further upstream as far as Groblershoop). Altitude ranging from 0-1 000m (Mucina *et al.* 2006).

Vegetation and Landscape Features

Flat alluvial terraces and riverine islands supporting a complex of riparian thickets dominated by *Ziziphus mucronata, Euclea pseudebenus* and *Tamarix usneoides* and dense *Phragmites australis* reed beds. The sand banks and terraces along the river have been recently ploughed with the removal of several old Mango trees as well as dense thickets of *Prosopis gladulosa* var. *tooreyana**.

Geology, Soil and Hydrology

Recent alluvial deposits of the Orange River supporting soil forms such as Dundee and Oakleaf. The Orange River cuts through a great variety of Precambian metamorphic rocks. The Orange River is subjected to floods, especially in summer, as a result of high precipitation on the highveld. Lad type la (Mucina & Rutherford 2006).

Dominant taxa in this vegetation type include:

Small trees	*Acacia karroo, Euclea pseudebenus, Salix mucronata subsp. mucronata, Schotia afra var. angustifolia, Ziziphus mucronata, , Combretum erythrophyllum, Ficus cordata, Maurea gilgii, Posopsis glandulosa var. glandulosa*, Searsia lancea*
Shrubs	*Gymnosporia linearis, Tamarix unsneoides, Ehretia rigida, Euclea undulate, Sisyndite spartea, Asparagus laricinus*
Grasses	*Cynodon dactylon, Setaria verticillata, Cenchrus cilliaris, Cyperus leavigatus, Eragrostis echiniochloidea, Lecophrys mesocoma, Polypogon monspeliensis, Stipagrostis namequensis*
Forbs	*Amaranthus praetermissus, Coronopus integrifolius, Frankenia pulverulenta, Gnaphilium confine, Pseudogaphalium luteo-album*
Red Data Species	*Acacia erioloba* ("Declining") and protected tree species

Alien species within this vegetation type:

Salix babylonica; Eucalyptus camaldulensis; Nicotiana glauca, Nicotina longiflora, Prosopis glandulosa; Populus spp., *Argemone ochroleuca*

Conservation status: Endangered with a target of 31%. About 6% statutorily conserved in the Richtersveld and Augrabies Falls National Park. Some 50% transformed for agricultural purposes (vegetables and grapes) or alluvial diamond mining (Mucina and Rutherford 2006). The riparian vegetation along the Gariep (Orange) River has been historically impacted on. Previous as well as current agricultural activities occur within the alluvial floodplain and the vegetation is dominated by pioneer weedy plant and alien invasive species. A small remnant strip of indigenous riparian vegetation occurs along the edge of the macro-channel bank as well as beds of *Phragmites australis*. The proposed Lupierdshoek alignment follows an existing access road as well as the edge of the ploughed lands and will have no impact on the remaining indigenous riparian vegetation. A few scattered Camel Thorns (*Acacia erioloba*) occur adjacent to the lands as well as human settlements. No large indigenous tree species will be removed along the current alignment.

3.6 RED DATA / ENDEMIC SPECIES

A list of red listed plant and tree species recorded during brief site visit from the study area is included as Table 1 below:

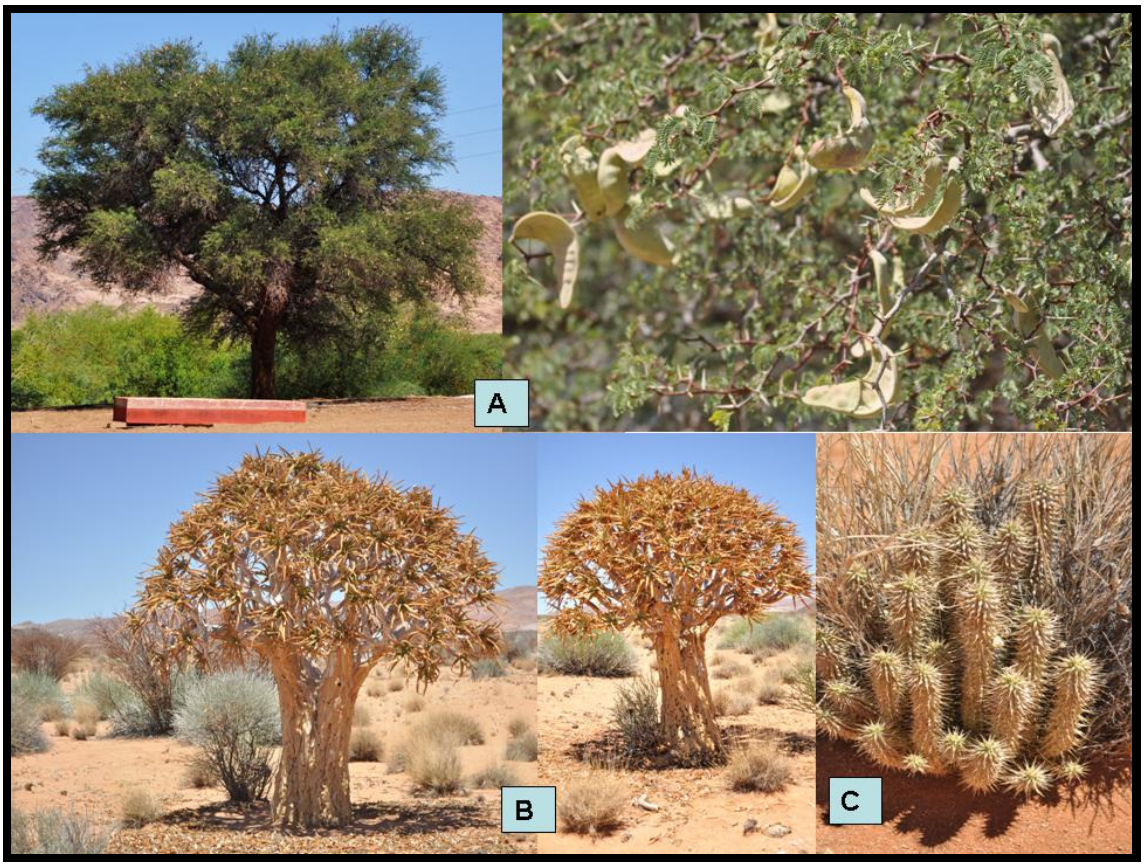

Figure9. A conglomerate of photographs displaying the red listed as well as protected tree species. A: Camel Thorn Red Listed 'Declining' and protected tree species; **B:** Quiver Tree (*Aloe dichotoma*) Red Listed 'Vulnerable' and **C:** *Hoodia gordonii* Red Listed 'Data Deficient'.

Table1. List of possible red data species occurring within suitable habitat within proposed Luiperdshoek powerline.

Genus	Species	Family	National Status Raimondo *et al.* (2009)	Assessment Rationale
Hoodia	*gordonii*	APOCYNACEAE	Data Deficient* (DDD)	A widespread species, EOO 850,000 km² that has undergone decline since 2001 as a result of indiscriminate harvesting for its appetite suppressant properties. International and national demand was particularly high between 2004 and 2006 and as a result of the high economic value of this species even remote areas of its distribution range are suspected to have been harvested. Unfortunately data do not exist to quantify the degree of decline to the population and as this species is widespread and can be locally common it is not possible to estimate overall population decline. Research on population recovery post harvesting and degree of impact of the harvesting over the past 10 years is required before this species can be accurately assessed.

* **Data Deficient - Insufficient Information (DDD):** A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.

Aloe	*dichotoma*	ASPHODELACEAE	Vulnerable* A3ce	Main threats include climate change, harvesting and trampling by livestock. Damage by baboons, scale insects and fungus has been observed, but none of these seem to cause mortality. Climate change models project a 36% decline in range in 100 years, assuming dispersal into newly suitable areas. Patterns of modelled declines have been supported by field and repeat photo studies. However no colonization of newly suitable areas has yet happened. Without dispersal, the models predict a 73% decline in 100 years, qualifying the species as Endangered (EN).

* **Vulnerable (VU):** A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.

Acacia	*erioloba*	FABACAE	Declining*	Concerns have been raised over the large volumes of *A. erioloba* wood being removed for commercial sale of firewood. Many trees are also killed as a result of bush encroachment control through pesticides. A study conducted in the northern Cape indicated that at present only dead trees are being harvested for firewood and only a very small percentage of the study area (<2%) was affected by clearing of *A. erioloba*.

* **Declining:** A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.

Figure10. Red data and protected species recorded along the proposed Luiperdshoek alignment.

3.7 DISCUSSION

The vegetation of this area is associated with the arid section of the rainfall gradient and occurs on the sheet washed plains stretching towards the rocky hills adjacent to the Orange River. The topography is fairly flat to slightly undulating without any major rock outcrops or mountains, forming the plateau to the north of the Orange River valley. An isolated granitic inselberg occurs to the south of the proposed alignment. The soils are coarse sands derived from the rocks of the Namaqualand belt of metamorphisation and granitisation, thus explaining the frequent but moderate to high erosion along the drainage lines and non-perennial or episodic rivers. The vegetation of the plains comprises a sparse grassland dominated by the 'white grasses' including *Stipagrostis* spp.; with the grasses more prominent during good rainfall years. Shrubs and herbs become more abundant along the non-perennial rivers and drainage lines.

The red listed 'vulnerable' Quiver Tree (*Aloe dichotoma*) was observed to the south of the proposed alignment. No Quiver Trees occurs within the proposed alignment. A single colony of *Hoodia gordonii* was observed approximately 50m to the south of the proposed alignment beneath a spinescent shrub.

Several rocky hills occur adjacent to the Orange River. The rocky hills vegetation is determined by the topography, aspects, local climate and lithology. The vegetation is sparse and dominated by shrubby vegetation. The Red Listed 'Vulnerable' Quiver Tree (*Aloe dichotoma*) as well as suitable habitat for 'Data Deficient' *Hoodia gordonii* occurs within the rocky hills.

The embankment of the Gariep River supports a distinct own vegetation type, a narrow band of riverine forest. The bank itself is made up of loose alluvial deposits, with a mixture of rounded stones and various sand textures. The vegetation type is a result of the elevated soil moisture levels within the macro-channel banks of the Gariep River with many hygrophytic plants present (e.g. *Phragmites australis, Equisetum ramosissimum, Salix mucronata* subsp. *capensis*, *Searsia* (*Rhus*) *pendulina* and *Tamarix usneoides*). Due to the proximity to the water, various weedy plants have also established here, e.g. *Nicotiana glauca**, *Ricinus communis**, *Solanum nigrum** and especially *Posopsis glandulosa var. glandulosa* and *Prosopis velutina*.* Large sections adjacent to the Garipe River have been transformed for agricultural purposes.

The protected and red listed 'Declining' Camel Thorn (*Acacia erioloba*) was observed adjacent to the existing ploughed lands as well as within the proposed alignment. The alignment must be shifted away from the few remaining Camel Thorn Trees (*Acacia erioloba*). The current alignment will impact on two Camel Thorn Trees.

The vegetation of the area comprising Eastern Gariep Plains and Rocky Desert is not statutorily protected in any conservation areas. The proposed Luiperdshoek powerline follows existing road reserves throughout the majority of the alignment. The proposed alignment does not bisect any endangered riparian vegetation along the Gariep or Orange River. The alignment should is restricted to transformed habitats such as the existing agricultural lands as well as previously alien invaded patches along the Gariep (Orange) River.

In terms of the National Forests Act 1998 (Act No 84 of 1998) the Camel Thorn (*Acacia erioloba*) and Shepherd's Tree (*Boscia albitrunca*) has been identified and declared as protected. The Department of Water Affairs and Forestry (now Department of Forestry and Fisheries) developed a list of protected tree species. In terms of Section 15(1) of the National Forests Act, 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated. Trees are protected for a variety of reasons, and some species require strict protection while others require control over harvesting and utilization. The Department of Agriculture, Forestry and Fisheries (DAFF) will have to be approached to obtain the required permits for the removal of any protected tree species.

It is highly unlikely that the proposed powerline alignment will have a significant impact on any red listed plant species. Due to the limited shrubby grassland vegetation along the majority of the alignment minimal vegetation clearance will be required during the operational phase. All the red listed and protected tree species are easily identifiable and the powerline should be re-routed where they occur and should not be impacted upon during the operational phase of the project (cutting and trimming).

4. PRELIMINARY FAUNAL HABITAT ASSESSMENT

The Nama-Karoo and Succulent Karoo, now almost devoid of large wild ungulates, holds some 10 million Sheep (*Ovis aries*) and Goats (*Capra hircus*). The once plentiful and diverse set of nomadic herbivores has been replaced by large encamped herds of small livestock with specialist feeding habits. Nearly 200 years of this treatment has had a devastating effect on the Karoo soils and vegetation. Prolonged heavy grazing is considered to suppress shoot/root formation and flowering in the Nama-Karoo and Succulent-Karoo flora, which leads to compositional changes and depletion and thinning out of the vegetation, particularly those components that the sheep find palatable (Milton *et al.* 1994). Changes in the structure and composition of the vegetation affect the associated fauna. Thinning of the already sparse vegetation layer has greatly accelerated rates of soil erosion. Although conditions have improved since the 1950's, vegetation changes in the Nama-Karoo and Succulent-Karoo are now difficult or even impossible to reverse. The changed herbivore community and the resultant impacts on the vegetation has led to lower productivity of karroid vegetation. This, in turn, is thought to have affected the food chain and ultimately reduced the density of tertiary predators, particularly mammals as well as large eagles. High livestock densities also pose considerable threat to wildlife, since high numbers of domesticated animals generally cause a displacement of game, as there is less suitable habitat available. Furthermore, wild predators and scavengers such as the Black-backed Jackal, Caracal, Leopard and the Cape vulture have been eradicated by livestock farmers who see these animals as a threat to their livelihoods. Poisoned carcasses are often used for this purpose; this method is indiscriminate and therefore poses considerable threat to all predators and scavengers; especially the threatened White-backed and Lappet-faced Vultures. Poaching and illegal hunting (dogs) are further reducing the remnant faunal populations.

No comprehensive faunal surveys were conducted and species lists provided in the Appendix are of species most likely to occur on the site compiled from previous surveys conducted in the area as well as published literature.

4.1 MAMMALS

Various mammal species are likely to occur within the study area. A probable mammal species list of mammals that are likely to occur in study area according to Skinner & (Chimimba 2006) with the assigned level of threat facing each particular species is included in the Appendix (see Table 4). A map was used to correlate the occurrence of the Red Data species with their approximate occurrence within the study area. According to Friedman & Daly (2004) and Skinner & Chimimba (2006), the majority of species within the study area are common and widespread and listed as species of least concern.

The area is currently utilised for pastoral livestock grazing activities as well as limited agricultural activities adjacent to the Orange River. The baiting and non-selective killing of predators has a negative impact on remaining populations. The use of wire snares as well as hunting dogs for high intensity poaching activities will significantly affect remaining mammal species such as rabbits and mongooses. Smaller mammal species are extremely vulnerable to snares and poaching activities as well as feral cats and dogs. Furthermore, got and cattle grazing observed within the study area influences the existence of small mammals in the area. According to Bergstrom (2004), the presence of livestock has a negative effect on both small mammal species richness and abundance. Secondary access roads and vehicles around the site as well as major road networks increase the risk of road fatalities of smaller mammal species such as the Yellow mongoose (*Cynictis penicillata*), scrub hares (*Lepus saxatilis*) and South African ground squirrels (*Xerus inauris*) as well as larger burrowing mammals such as Aardvark (*Orycteropus afer*), Porcupines (*Hysterix africaeaustralis*) and Bat-eared Foxes (*Octocyon megalotis*).

Figure11. Mammal species recorded during brief site survey included: A: Klipspringer (*Oreotragus oreotragus*)*, **B:** Chacma Baboons (*Papio hamadryas*), C: South African Ground Squirrel (*Xerus inauris*) and **D:** Dassie Rat (*Petromus typicus*) *.

Several mammal species have been downgraded since the conservation assessment undertaken by Friedman & Daly, (2004). Species downgraded to Least Concern included Dassie Rat (*Petromus typicus*), Honey Badger (*Mellivora capensis*), Geoffrey's Horeshoe Bat (*Rhinolophus clivosus*) and the Littledale's Whistling Rat (*Parotomys littledalei*) which were previously listed as 'Near Threatened'.

* Photographs taken by Paul da Cruz

According to Skinner and Chimimba (2005), the study area falls within the distribution ranges of one species which is placed into one of known threatened species (Vulnerable) namely the Black-footed Cat (*Felix nigriceps*)

Table2. Mammal species of conservation importance possibly occurring on the proposed site (using habitat availability and distribution as an indicator of presence)

SPECIES NAME	**COMMON NAME**	**ENDEMIC TO SA**	**CONSERVATION STATUS (SKINNER & CHIMIMBA 2005)**	***CRITERIA***
ORDER CARNIVORA				
Family Felidae *Felis nigripes*	Black-footed Cat	Yes	Vulnerable	C2a(i)

Black-footed Cat (*Felis nigripes*)

Figure12 The Black-footed or Small Spotted Cat (*Felis nigripes*) occurs in arid areas with adequate vegetative cover. Photograph taken by Beryl Wilson in the Benfontein Nature Reserve near Kimberley.

Distribution

The black-footed cat is endemic to the subregion, being found mainly in the Nama-Karoo and Succulent Karoo biomes. They are not common anywhere throughout their range (Skinner and Chimimba 2005).

Habitat

Throughout their range they are associated with arid country with an annual rainfall of about 100-500mm, particularly areas with an open habitat that provides some cover in the from of stands of tall grass or scrub bush to which they retreat if disturbed. They also use disused springhare (*Pedetes capensis*) or Aardvark (*Orycteropus afer*) holes, or dens under calcrete slabs, or hollowed out termite mounds in which to lie up during the day. They are independent of water but drink occasionally when it is available.

Food

Highly opportunistic hunters taking anything that is available but feed primarily on small vertebrates. Insects comprises only about 2% of prey mass while mammals comprised 78% of catches and birds 22%.

Reproduction

Very little information is known about this aspect of their life history. Breeding is probably seasonal from August to April. Two kittens are usually born. Mortality in kittens are high.

Suitable habitat occurs around the proposed alignments for Black-footed Cats. It is however highly unlikely that the proposed Luiperdshoek overhead feeder line forms critical habitat for Black-footed cats. The proposed Luiperdshoek overhead feeder line will have a **low, short-long term negative impact** on remaining mammal species if construction activities are restricted to the powerline servitude.

The following mitigation measure should be incorporated into the EMP; especially during the construction phase.

MAMMAL MANAGEMENT RECOMMENDATION*S*

- Due to extensive habitat transformation and degradation (overgrazing and soil erosion) within and immediately adjacent to the proposed alignment it is however unlikely that the study area comprises significant habitat for more than one species of threatened mammals.
- Activities should be restricted away from any rocky hills and outcrops as well as riparian habitats along the non-perennial drainage lines and the Orange River.
- No hunting or poaching activities must be allowed along the servitudes during the construction phase.

4.2 REPTILES

Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe even during intensive field surveys conducted over several seasons. The majority reptile species are sensitive to severe habitat alteration and fragmentation. Due to current agricultural activities in the area coupled with increased habitat degradation (overgrazing, soil erosion) and disturbances are all causal factors in the alteration of reptile species occurring in these areas. Rocky hills and rocky outcrops or koppies occur around the proposed Luiperdshoek alignment and provide favourable refuges for certain snake and lizard species (rupicolous species). Reptile species recorded within the rocky hills and koppies included Variegated Skink (*Trachylepis variegata*), Western Three-striped Skink (*Trachylepis occidentalis*), Western Rock Skink (*Trachylepis sulcata sulcata*), Southern Rock Agama (*Agama atra*) and Ancheita's Agama (*Agama anchietae*).

Suitable habitat occurs for the Karoo Girdled Lizard (*Karusasaurus polyzonus*) in the rocky hills and koppies, inhabiting fissures between rocks and under loosely embedded rocks. None were observed during brief site visit.

Figure13 Reptile Species recorded included (A, B & C) the rupicolous Southern Rock Agama (*Agama atra*) observed within the rocky hills and koppies, inhabiting fissures between rocks and under loosely embedded rocks and **D:** Western Rock Skink (*Trachylepis sulcata sulcata*)

Trees such as the large Camel Thorn (*Acacia erioloba*) offer suitable habitat for arboreal reptile species such as the Karasburg Tree Skink (*Trachylepis sparsa*) and the Kalahari Tree Skink (*Trachylepis spiroglaster*). Moribund (old abandoned or dead mounds) termite mounds offer important refuges for numerous frog, lizard and snake species. Large number of species of mammal, birds, reptiles and amphibians feed on the emerging alates (winged termites). These mass emergences coincide with the first heavy summer rains and the emergence of the majority of herpetofauna. Termite mounds also provide nesting site for numerous snakes, lizards (varanids) and frogs.

Favourable habitat exists throughout most of the study area for various snake species. Indiscriminate killing of all snake species is likely to have resulted in the disappearance of the larger and the more sluggish snake species within the study area. The frequent burning of the site will have a high impact on remaining reptiles. Fires during the winter months will severely impact on the hibernating species, which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks.

A list of reptile species (25) recorded from the 2819 DA and 2819 DB QDGC's is presented in the Appendix (see Table 5).

Threatened species

According to the outdated Branch (1988b) Red Data Book as well as the SARCA virtual museum reptile map no threatened species of reptile occurs within the study area. The Red Data book is currently being updated by the South African Reptile Conservation Assessment (SARCA). The following management recommendations should be incorporated into the environmental management plan (EMP) for the project.

REPTILE MANAGEMENT RECOMMENDATIONS

- No further rock removal should occur adjacent to the proposed tower pylons. No termite mounds should be intentionally destroyed.
- Trees including stumps; bark and holes in trees are vital habitats for numerous arboreal reptiles (chameleons, snakes, agamas, geckos and monitors).
- The removal of indigenous vegetation clearance must be kept to the minimum.
- Any lizards, geckos, agamids, monitors or snakes encountered should be allowed to escape to suitable habitat away from the disturbance. No reptile should be intentionally killed, caught or collected during any phase of the project.
- Several venomous snake species occur along the proposed alignments including Cape Cobra (*Naja nivea*), Horned Adder (*Bitis caudalis*), Common or Rhombic Night Adder (*Causus rhombeatus*) and Puff Adder (*Bitis arietans*).

- General avoidance of snakes if the best policy if encountered. Snakes should not be intentionally harmed or killed and allowed free movement away from the area.
- Appropriate foot wear (sturdy leather boots) should be worn in the field.

4.3 AMPHIBIANS

Amphibians are an important component of South Africa's exceptional biodiversity (Siegfried 1989) and are such worthy of both research and conservation effort. This is made additionally relevant by international concern over globally declining amphibian populations, a phenomenon currently undergoing intensive investigation but as yet is poorly understood (Wyman 1990; Wake 1991). Amphibians have declined dramatically in many areas of the world. These declines seem to have worsened over the past 25 years and amphibians are now more threatened than either mammals or birds, though comparisons with other taxa are confounded by a shortage of reliable data.

Most frogs have a biphasic life cycle, where eggs laid in water develop into tadpoles and these live in the water until they metamorphose into juvenile fogs living on the land. This fact, coupled with being covered by a semi-permeable skin makes frogs particularly vulnerable to pollutants and other environmental stresses. Consequently frogs are useful environmental bio-monitors (bio-indicators) and may acts as an early warning system for the quality of the environment

Breeding in African frogs is strongly dependent on rain, especially in the drier parts of the country where surface water only remains for a short duration. The majority of frog species in the Northern Cape Province can be classified as explosive breeders. Explosive breeding frogs utilise ephemeral or seasonally inundated grassy pans for their short duration reproductive cycles. Extremely limited historic data for frog species occurring within the 2819 DA & 2819 DB Quarter Degree Grid Squares (http://sarca.adu.org.za.) Only two frog species namely a Tremelo Sand Frog (*Tomopterna cryptotis*) and Marbled Rubber Frog (*Phrynomantis annectens*) were recorded during the South African Frog Atlas Project. A probable amphibian species list is presented in the Appendix (see Table 6).

HABITAT AVAILABLE FOR SENSITIVE OR ENDANGERED SPECIES

Figure14 The Giant Bullfrog has been recorded from sites to the south as well as north-east of Pofadder. No suitable breeding habitat in the form of seasonally inundated pans occurs along the proposed Luiperdshoek powerline alignment for any Giant Bullfrogs.

Giant Bullfrog (*Pyxicephalus adspersus*)

The Giant Bullfrog is currently assigned as a near-threatened species (IUCN Red List category) (Minter et al. 2004). Giant Bullfrogs have been recorded to the south (Brandvlei) as well as to the north of Augrabies National Parkduring previous surveys as well as during the South African Frog Atlas Project (SAFAP). Specimens recorded were of road fatalities, migrating adult males as well as a breeding locality in the Prieska area. Bullfrog density commonly varies within certain habitats (open grassland/karroid habitat). High densities are often associated with specific microhabitats or patches (hygrophytic or aquatic ephemerophytic grass and sedge dominated pans) that can be identified and randomly sampled. No seasonal pans or seasonally inundated grassland occurs within the proposed Luiperdshoek alignment. The powerline bisects several non-perennial drainage lines as well as the edge of the riparian zone of the Orange River. Seasonal pools situated within the non-

perennial drainage lines as well as seasonally inundated grasses within the flood plains of the Orange River offer the most suitable habitat for frogs in the areas. The steep banks and incised valley of the Orange River as well as mountainous rocky habitat may acts as a geographical barrier for certain frog species. The proposed Luipershoek powerline will most-likely have a **low-negligible; short-long term impact** on remaining frog species if restricted to the transformed or degraded vegetation units adjacent to the road reserves and agricultural lands.

AMPHIBIAN MANAGEMENT RECOMMENDATIONS

- Construction activities of the proposed Luiperdshoek powerline should be restricted to daylight hours reducing the potential impact on the nocturnal breeding activities of the majority of amphibian species.
- Ideally the installation of the new pylons should be undertaken during the dry winter months (May-September) when the majority of amphibian species are dormant.
- Activities around the adjacent non-perennial drainage lines must be strictly limited.

5. SENSITIVE HABITATS

5.1 THE GARIEP (ORANGE) RIVER AND NON-PERENNIAL DRAINAGE LINES WITH ASSOCIATED RIPARIAN ZONE

Rivers and streams/drainage lines are longitudinal systems with impacts affecting both upstream and downstream habitat. The entire seasonally inundated or non-perennial drainage lines and their associated indigenous dominated riparian vegetation must be considered as sensitive habitats. Any impact on the riverine area within the study area is therefore also likely to impact on upstream and downstream areas. Riparian zones have the capacity to act as biological corridors connecting areas of suitable habitat in birds (Whitaker & Metevecchi, 1997), mammals (Cockle & Richardson 2003) reptiles and amphibians (Maritz & Alexander 2007). Riparian zones may act as potential refugia for certain fauna and could allow for possible re-colonisation of rehabilitated habitats. The riparian vegetation plays a vital role in the re-colonisation of aquatic macro-invertebrates as well as reptiles and amphibians (Maritz & Alexander 2007).

The riparian vegetation provides vital refuge, foraging and migratory passages for species migrating to and away from the rivers. The riparian zone comprises plant communities contiguous to and affected by surface and subsurface hydrological features of perennial or intermittent water bodies (rivers and streams). The riparian vegetation is dependant on the river for a number of functions including growth, temperature control, seed dispersal, germination and nutrient enrichment. Riparian vegetation comprises a distinct composition of species, often different from that of the surrounding terrestrial vegetation. Tree species are positioned according to their dependence or affinity for water, with the more mesic species (water-loving) being located closest to the river channel, often with their roots in the water, and the less water-loving terrestrial species further away from the river.

The riparian zone, of which vegetation is a major component, has a number of important functions including:

- enhancing water quality in the river by the interception and breakdown of pollutants;
- interception and deposition of nutrients and sediments;
- stabilisation of riverbanks and macro-channel floor;
- flood attenuation;
- provision of habitat and migration routes for fauna and flora;
- provision of fuels, building materials and medicines for communities (if done on a sustainable basis); and
- recreational areas (fishing - rod and line not shade or gill nets; bird watching; picnic areas etc.).

All rivers including the Gariep (Orange) River as well as several smaller non-perennial drainage lines must be considered as a sensitive habitats due to ecological functioning as well as providing suitable habitat as well as biological or dispersal corridors for remaining faunal species.

5.2 ROCKY HILLS AND KOPPIES

The entire rocky hills and koppies must be considered as a sensitive habitat which provides important habitat for several amphibian, reptile and mammal species. Ridges and koppies are characterized by high spatial heterogeneity due to the range of differing aspects (north, south, east, west and variations thereof), slopes and altitudes all resulting in differing soil (e.g. depth, moisture, temperature, drainage, nutrient content), light and hydrological conditions. The temperature and humidity regimes of microsites vary on both a seasonal and daily basis (Samways & Hatton, 2000). Moist cool aspects are more conducive to leaching of nutrients than warmer drier slopes (Lowrey & Wright, 1987). Variation in aspect, soil drainage (Burnett *et al.*, 1998) and elevation/altitude (Primack, 1995) have been found to be especially important predictors of biodiversity. It follows that ridges will be characterized by a particularly high biodiversity, as such their protection will contribute significantly to the conservation of biodiversity in the area as well as the rest of the Northern Cape Province.

For example, a wide variety of bird groups utilize ridges, koppies and hills for feeding, roosting and breeding. These groups include some owls, falcons, nightjars, swifts, swallows, martins, larks, chats, thrushes, cisticolas, pipits, shrikes, starlings, sunbirds, firefinches, waxbills, buntings, canaries, eagles and vultures.

Ridges provide important habitat for sensitive species such as bats (roosting sites) and the eastern rock elephant shrew. Ridges and kloofs also form caves, an important habitat for highly specialized animals, e.g. bats. Variable microclimate conditions have resulted in a vast array of invertebrate communities associated with the high plant diversity characterizing ridges. Hills and koppies generally have more insects (both in terms of individuals and species) than the immediate surroundings (Samways & Hatton, 2000). All rocky hills and koppies as well as major rocky outcrops must be considered as a sensitive habitat with unique vegetation (*Aloe dichotoma*, *Hoodia gordonii*) as well as fauna (rupicolous species including the Dassie Rat, Rock Hyrax, Klipspringer).

From the brief site visitation as well as desktop study using inter alia aerial photographs and Google Earth ™ imagery the following four sensitivity categories of areas were identified:

High: Areas with high species richness and habitat diversity comprising natural indigenous plant species. These areas are ecologically valuable and important for ecosystem functioning. These areas should be avoided wherever possible.

Medium: An area with a relatively natural species composition; not a threatened or unique ecosystem; moderate species and habitat diversity. Development could be considered with limited impact on the vegetation / ecosystem.

Low-medium: Areas with relatively natural vegetation, though a common vegetation type. Could be developed with mitigation and expected low impact on ecosystem

Low: A totally degraded and transformed area with a low habitat diversity and ecosystem functioning; no viable populations of natural plants. Development could be supported with little to no impact on the natural vegetation / ecosystem.

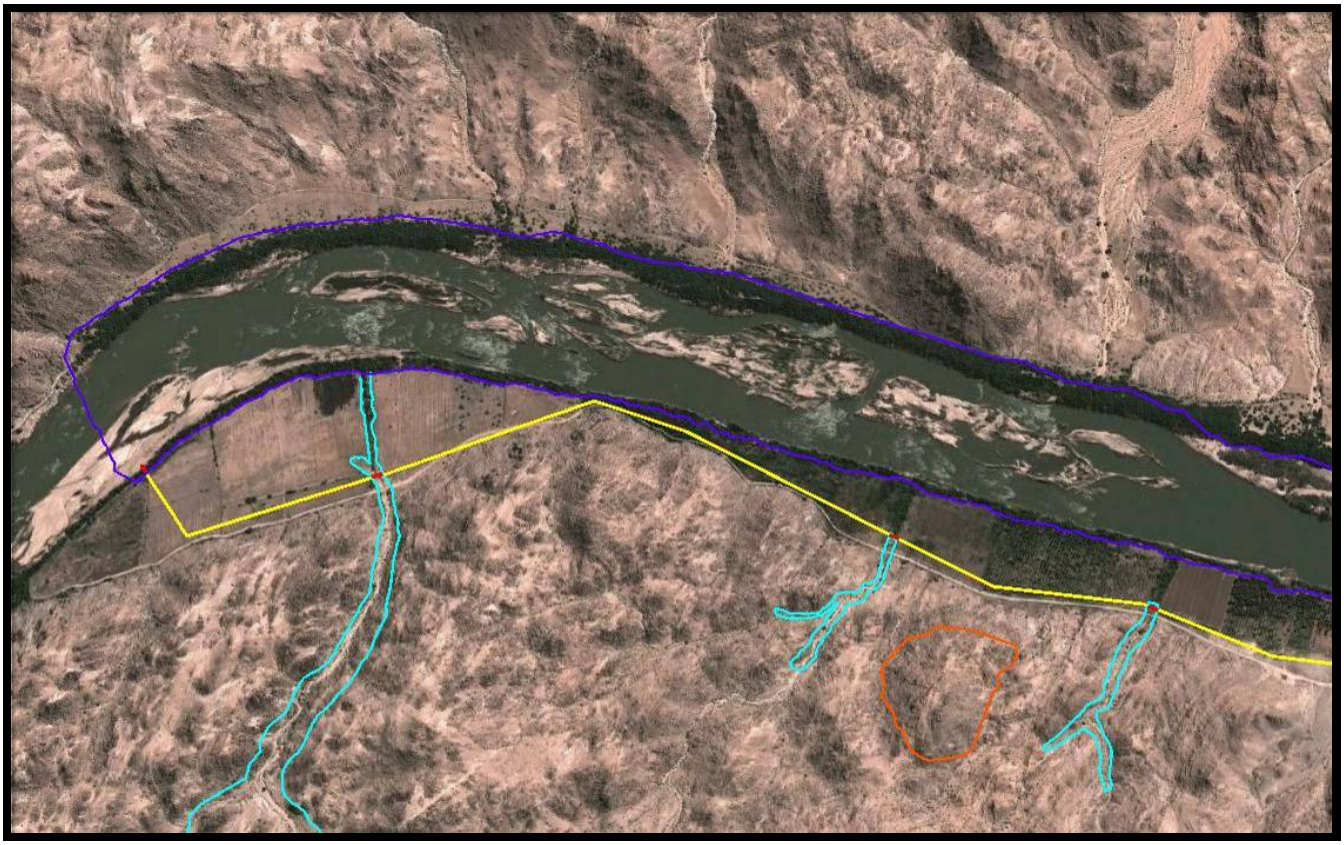

Figure15 The proposed northern most section of the Luiperdshoek alignment (yellow line) runs within close proximity to the riparian zone (Dark blue areas) of the Gariep River. All remaining indigenous riparian vegetation (Lower Gariep Alluvial Vegetation) along the Orange River must be considered as **high** sensitivity and conservation value. The proposed alignment (red areas) bisects several non-perennial drainage lines (light blue) which must be considered **medium-high** sensitivity.

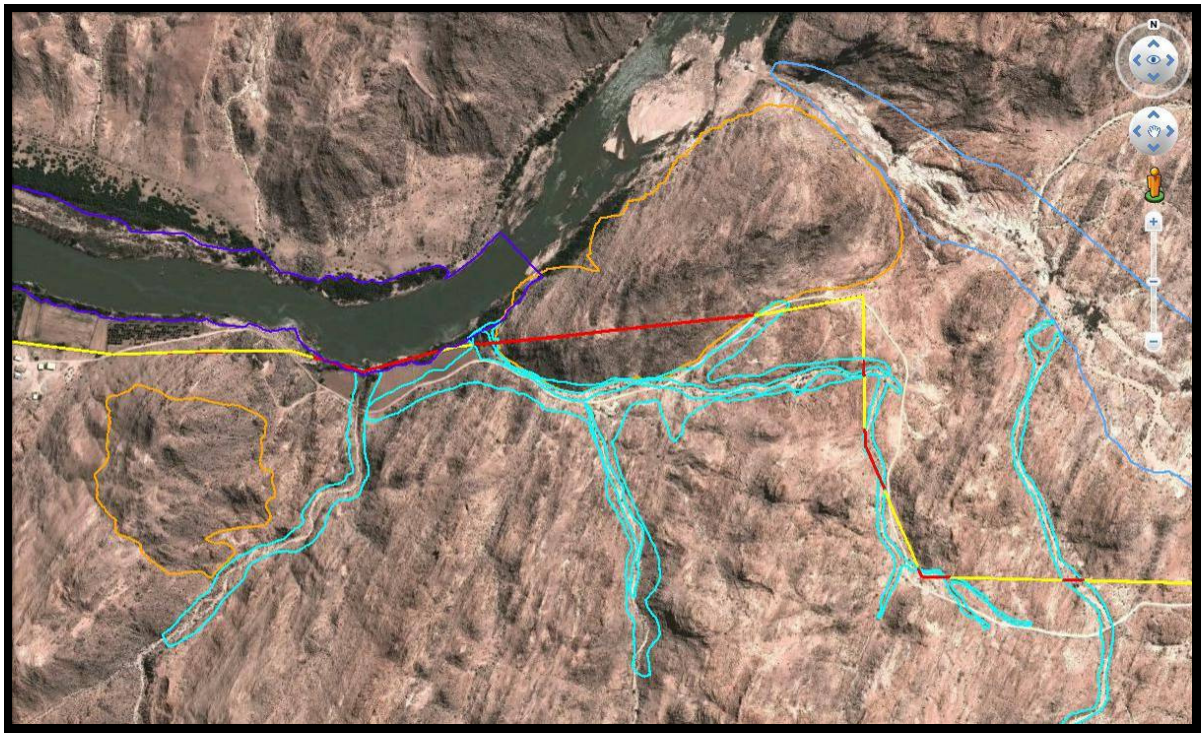

Figure16 The proposed central Luiperdshoek alignment (yellow line) runs within close proximity to the riparian zone (red areas) of the Orange River. All remaining indigenous riparian vegetation (Lower Gariep Alluvial Vegetation) along the Orange River must be considered as **high** sensitivity and conservation value. The proposed alignment bisects several non-perennial drainage lines (light blue) and river (dark blue) which must be considered **medium-high** sensitivity as well as a rocky hill. The yellow sections of the alignment are indicative of degraded areas with medium-low sensitivity whilst the red areas are sensitive habitat with medium-high sensitivity.

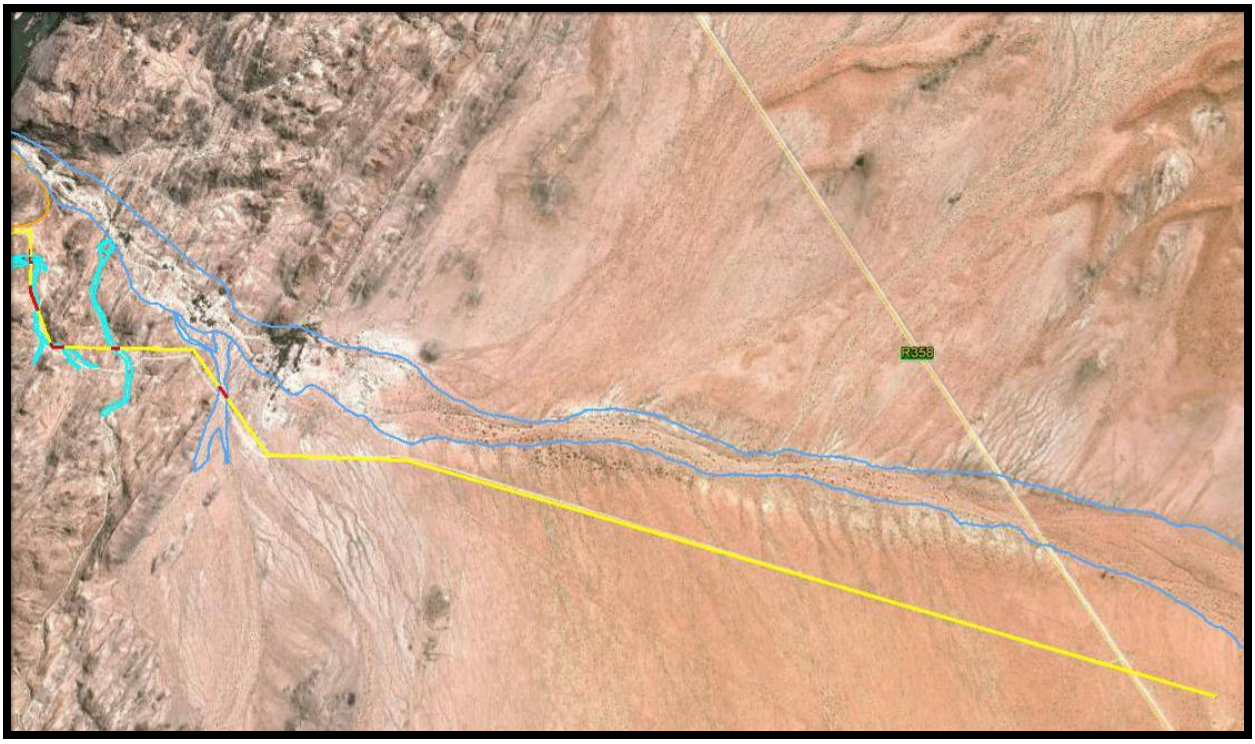

Figure17 The proposed southern section of the Luiperdshoek alignment follows and existing road reserve through the plains adjacent to a non-perennial river (Blue). The non-perennial river must be considered as **medium-high** sensitivity. The yellow line indicates vegetation and habitats of low sensitivity.

6. GENERIC DESCRIPTION OF POTENTIAL IMPACTS OF POWER LINES ON ASSOCIATED FAUNA AS WELL AS RECOMMENDED MITIGATORY MEASURES

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in Southern Africa are electrocution of birds (and other animals) and disturbance and habitat destruction during construction and maintenance activities.

6.1 Habitat destruction and disturbance

During the construction phase and maintenance of powerlines, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of servitudes. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. As the majority of the alignment occurs within succulent-karroid vegetation dominated by dwarf shrubs and grasses limited vegetation clearance will be required during the operational phase of the project. These activities have an impact on fauna breeding, foraging and roosting in or in close proximity of the servitude, both through modification of habitat and disturbance caused by human activity. The proposed impact will be of **medium-low; short-long term impact** on remaining (albeit) limited faunal species.

Mitigation and Recommendations

The following general recommendations are made to minimise the impacts of proposed powerline construction on the immediate environment and remaining **fauna**:

- The proposed alignment should be routed along the existing informal access road as well as degraded and transformed habitats.
- Close site supervision must be maintained during construction.
- During the **CONSTRUCTION** phase workers must be limited to areas under construction within the 22m reserve and access to the undeveloped areas, especially the surrounding open areas must be strictly regulated ("no-go" areas during construction activities).
- No Quiver Tree (*Aloe dichotoma*), Camel Thorn (*Acacia erioloba*), *Hoodia gordonii* or Shepherd's Tree (*Boscia albitrunca*) must be damged or removed.
- No indigenous riparian vegetation must be cleared along the Gariep River.
- Provision of adequate toilet facilities must be implemented to prevent the possible contamination of ground (borehole) water in the area. Mobile toilets must be provided in order to minimise unauthorised traffic of construction workers outside of the designated areas.
- All temporary stockpile areas including litter and dumped material and rubble must be removed on completion of construction. All alien invasive plant should be removed from the site to prevent further invasion.
- Firearms or any other hunting weapons must be prohibited on site.
- Contract employees must be educated about the value of wild animals and the importance of their conservation.
- Educational programmes for the contractor's staff must be implemented to ensure that project workers are alerted to the possibility of snakes being found during vegetation clearance. The construction team must be briefed about the management of snakes in such instances. In particular, construction workers are to go through ongoing refresher courses to ensure that threatened snakes, such as Southern African Python, are not killed or persecuted when found.
- Severe contractual fines must be imposed and immediate dismissal on any contract employee who is found attempting to snare or otherwise harm remaining faunal species.

- No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site.

6.2 VEGETATION/FLORA

All vegetation not interfering with the operation of the line shall be left undisturbed and this included all the spinescent shrubs and herbs. Collection of firewood and traditional medicinal plants is strictly prohibited. No area should be cleared of trees, bushes and other vegetation for the purpose of a camping site. The proposed Luiperdshoek alignment will have a low impact if the following mitigatory measures are implemented.

Management objective

- Minimal disturbance to vegetation where such vegetation does not interfere with construction and operation of the line
- No unnecessary destruction to surrounding vegetation
- Protection of any protected or endangered plant species
- Prevention of litigation concerning removal of vegetation

Measurable targets

- Adequate protection of remaining indigenous plant species
- No litigation due to removal of vegetation without the necessary permits

Mitigation and recommendation

Remaining indigenous bulbous geophytes should be retained or replanted wherever possible. Where herbicides are used to clear vegetation, specimen-specific chemicals should be applied to individual plants only. General spraying should be prohibited.

All alien vegetation should be eradicated along the servitude. Invasive species (*Prosopis glandulosa; Nicotiana* spp.) should be given the highest priority. No dumping of any materials in undeveloped open areas and neighbouring properties. Activities in the surrounding open undeveloped areas (especially the rocky hills and koppies, Gariep River and riparian zone as well as non-perennial drainage lines) must be strictly regulated and managed. It is imperative that the construction activities as well as vegetation clearance are restricted to the powerline servitude. The limitation of the disturbance of vegetation cover within the servitude will ameliorate

this impact. Impact will be short-long term depending on the amount of vegetation to be cleared. Excessive habitat destruction during construction could reduce the amount of habitat available. This impact is anticipated to be localised, of a long-term nature and of low significance, provided that appropriate mitigation measures are implemented (e.g. the limitation of vegetation clearance within sensitive areas). As the majority of the proposed alignments are situated within sparsely vegetated dwarf shrubland no vegetation removal will be required during the operational phase of the project.

6.3 REHABILITATION

A suitably qualified rehab specialist should be appointed for the commencement of rehabilitation activities. The specialist should identify areas requiring rehabilitation as well as appropriate seed mixes which are required. Photographic records of the servitude and access roads prior to construction activities and after the construction phase will be taken to assess the level of rehabilitation and re-vegetation.

6.4 Surrounding Farming Activities

Domestic Livestock

Construction activities must be planned carefully so as not to interfere with the calving and lambing season for most animal species. The Contractor's workforce will have to be very careful not to disturb the animals as this may lead to fatalities which will give rise to claims from the Landowners. Interference with any wildlife without the applicable permits shall not be allowed. The Contractor shall under no circumstances interfere with livestock without the Landowner being present. This includes the moving of livestock where they interfere with construction activities. Should the Contractors workforce obtain any livestock for eating purposes, they must be in possession of a written note from the Landowner. Speed limits must be restricted especially on dirt roads (30km/hr) preventing unnecessary road fatalities of surrounding livestock.

Management objective

- Minimise disruption of surrounding farming activities
- Minimise disturbance of fauna
- Minimise interruption of breeding patterns of fauna

Measurable targets

- No hunting and poaching or intentional killing of animals (including snakes, scorpions, spiders)
- No stock losses where construction is underway
- No complaints from Landowners or Nature Conservation
- No litigation concerning stock losses and animal deaths

6.5 ACCESS ROADS

Planning of access routes must be done in conjunction between the Contractor, Eskom and the Landowner. All access to private farmland must be negotiated in advance with land-owners. All agreements reached shall be documented in writing and no verbal agreements should be made. The condition of existing access / private roads to be used shall be documented with photographs.

The Contractor shall properly mark all access roads. Markers shall show the direction of travel as well as tower numbers to which the road leads. Unnecessary traversing of adjacent open areas is discouraged especially within the non-perennial drainage lines as well as riparian zone and floodplain of the Orange River. Where required, speed limits shall be indicated on the roads (30km). All speed limits shall be strictly adhered to at all time.

Vehicle access to the powerline servitude must as far as possible be limited to existing roads. If a new access roads need to be constructed it should follow cleared areas such as livestock pathways.

6.6 VEGETATION CLEARANCE

Management objective

- Minimise damage to surrounding vegetation
- Minimise damage to topsoil
- Successful rehabilitation of barren areas

Measurable targets

- No damage to vegetation outside the powerline servitude as well as around poles
- No loss of topsoil
- No visible erosion three months after completion of the contract
- All disturbed areas successfully rehabilitated three months after completion of the contract

The object of vegetation clearing is to trim, cut or clear the minimum number of trees and vegetation necessary for the safe mechanical construction and electrical operation of the transmission line. Only an 8m strip may be cleared flush with the ground to allow vehicular passage during construction. No scalping shall be allowed on any part of the servitude road unless absolutely necessary.

Vegetation clearing on tower sites must be kept to a minimum. Only a few large indigenous tree species occur adjacent to the proposed alignment and vegetation is dominated by limited dwarf shrubs and grasses and will result in minimal vegetation clearance. Any alien invasive trees with large root systems shall be cut manually and removed, as the use of a bulldozer will cause major damage to the soil when the root systems are removed. Stumps shall be treated with herbicide. Smaller vegetation can be flattened with a machine, but the blade should be kept above ground level to prevent scalping. Any vegetation cleared on a tower site shall be removed or flattened and not be pushed to form an embankment around the tower.

Disturbed areas of natural vegetation as well as cut and fills must be rehabilitated immediately to prevent soil erosion as well as alien invasive vegetation invasion. This is especially relevant adjacent to the non-perennial drainage lines. The use of herbicides shall only be allowed after a proper investigation into the necessity, the type to be used, the long-term effects and the effectiveness of the agent. Eskom's approval for the use of herbicides is mandatory. Application shall be under the direct supervision of a qualified technician. All surplus herbicide shall be disposed of in accordance with the supplier's specifications. All alien vegetation in the total servitude and densifiers creating a fire hazard shall be cleared and treated with herbicides.

It is recommended that a contractor for vegetation clearing should comply with the following parameters:

- The contractor should be made aware of the possible presence of red listed plant species namely *Hoodia gordonii*, Quiver Tree (*Aloe dichotoma*) and Camel Thorn (*Acacia erioloba*).
- The contractor must have the necessary knowledge to be able to identify protected species Camel Thorn (*Acacia erioloba*; Shepherd's Tree (*Boscia albitrunca*) as well indigenous species not interfering with the operation of the line due to their height and growth rate. This includes *Aloe dichotoma, Hoodia gordonii and Boscia albitrunca.*
- The contractor must also be able to identify declared weeds and alien species (*Prosopis glandulosa*, Nicotiana* spp.) that can be totally eradicated.
- The contractor must be in possession of a valid herbicide applicators license.

6.7 Fire Prevention

The frequent burning of the vegetation will have a high impact on remaining reptile species. Fires during the winter months will severely impact on the hibernating species, which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks.

Management objective

- Minimise risk of veld fires
- Minimise damage to grazing
- Prevent runaway fires

Measurable targets

- No veld fires started by the Contractor's work force
- No claims from Landowners for damages due to veld fires
- No litigation

Mitigation and recommendations

No open fires shall be allowed on site under any circumstance. The Contractor shall have fire-fighting equipment available on all vehicles working on site, especially during the winter months.

6.8 Threatened animals

At a local Pofadder-Luiperdshoek scale the study site and surrounding areas comprises limited suitable habitat for any threatened animal species.

Mitigation and recommendations

As a precautionary mitigation measure it is recommended that the developer and construction contractor as well as an environmental control officer should be made aware of the possible presence of certain threatened animal species (Black-footed Cat) prior to the commencement of construction activities. In the event that any of the above-mentioned species are discovered the animal should not be interfered with and allowed to move away from the construction activities.

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8. APPENDIX

Table3. GPS co-ordinates of the protected and red listed plants observed during brief site visitation adjacent to the Luiperdshoek powerline alignment.

GPS Co-Ordinates		Species
S28° 55' 44.9"	E19° 20' 44.0"	*Hoodia gordonii*
S28° 54' 57.0"	E19° 17' 49.8"	*Boscia albitrunca*
S28° 54' 46.6"	E19° 17' 49.3"	*Boscia albitrunca*
S28° 54' 38.1"	E19° 17' 48.9"	*Boscia albitrunca*
S28° 54' 35.7"	E19° 17' 50.3"	*Boscia albitrunca*
S28° 54' 39.8"	E19° 16' 56.6"	*Acacia erioloba*
S28° 54' 41.2"	E19° 16' 54.3"	*Acacia erioloba*
S28° 54' 37.9"	E19° 16' 28.8"	*Acacia erioloba*
S28° 54' 39.2"	E19° 16' 28.8"	*Acacia erioloba*
S28° 54' 39.6"	E19° 16' 25.5"	*Acacia erioloba*
S28° 54' 33.7"	E19° 16' 05.9"	*Acacia erioloba*
S28° 54' 26.7"	E19° 14' 46.0"	*Acacia erioloba*

Table4. Mammal species historically recorded in the area according to Skinner & Chimiba (2005). Actual species lists will most likely contain far fewer species due to high levels of habitat transformation and degradation as well as high levels of human disturbances (hunting and poaching activities). This is especially pertinent to the larger mammal species including predatory species which are considered problem animals to adjacent livestock farmers.

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS (Skinner & Chimimba 2005)
Cape Serotine Bat	*Neoromicia capensis*	Least Concern
Egyptian Slit-faced Bat	*Nycteris thebiaca*	Least Concern
Geoffrey's Horseshoe Bat	*Rhinolophus clivosus*	Least Concern
Egyptian Free-tailed Bat	*Tadarida aegyptiaca*	Least Concern
Reddish-grey Musk Shrew	*Crocidura cyanea*	Data Deficient
Cape Hare	*Lepus capensis*	Least Concern
*Scrub Hare	*Lepus saxatilis*	Least Concern
Namaqua Rock Mouse	*Aethomys namaquensis*	Least Concern
Short-tailed Gerbil	*Desmodillus auricularis*	Least Concern
Hairy-footed Gerbil	*Gerbillurus paeba*	Least Concern
Spectacled Dormouse	*Graphiurus ocularis*	Least Concern
Large-eared Mouse	*Malacothrix typica*	Least Concern
Multimammate Mouse	*Mastomys coucha*	Least Concern
Karoo Bush Rat	*Otomys unisulcatus*	Least Concern
Brant's Whistling Rat	*Parotys bransii*	Least Concern
Littledale's Whistling Rat	*Parotomys littledalei*	Least Concern
Dassie Rat	*Petromus typicus*	Least Concern
Pygmy Rock Mouse	*Pteromyscus collinus*	Least Concern
Striped Mouse	*Rhabdomys pumillio*	Least Concern
Round-eared Elephant-Shrew	*Marcoscelides proboscideus*	Least Concern

*Cape Ground Squirrel	*Xerus inauris*	Least Concern
Springhare	*Pedetes capensis*	Least Concern
*Porcupine	*Hystrix africaeaustralis*	Least Concern
*Rock Hyrax	*Procavia capensis*	Least Concern
Suricate	*Suricata suricatta*	Least Concern
Small Grey mongoose	*Galerella pulverulenta*	Least Concern
Yellow Mongoose	*Cynictis penicillata*	Least Concern
Striped Polecat	*Ictonyx striatus*	Least Concern
Small-spotted Genet	*Genetta genetta*	Least Concern
African Wild Cat	*Felis silverstris*	Least Concern
Black-footed Cat	***Felis nigripes***	**Vulnerable C2a(i)**
*Black-Backed Jackal	*Canis mesomelas*	Least Concern
Caracal	*Caracal caracal*	Least Concern
Honey Badger	*Mellivora capensis*	Lower Risk/ Least Concern
Bat-eared Fox	*Otocyon megalotis*	Least Concern
Leopard	*Panthera pardus*	Least Concern
Cape Fox	*Vulpes chama*	Least Concern
Aardwolf	*Proteles critatus*	Least Concern
Common Duiker	*Sylvicapra grimmia*	Least Concern
*Steenbok	*Raphicerus campestris*	Least Concern
Klipspringer	*Oreotragus oreotragus*	Least Concern
Springbok	*Antidorcas marsupialis*	Least Concern
Gemsbok	*Oryx gazella*	Least Concern
Aardvark	*Orycteropus afer*	Least Concern
Chacma Baboon	*Papio hamadryas*	Least Concern

Table5. Reptile species likely to occur on the site using habitat availability as an indicator for possible species presence. Actual species list will probably contain fewer species due to high levels of habitat transformation and degradation. According to the Southern African Reptile Conservation Assessment 25 species found for the combined locus = 2819DA, 2819DB

Family	Genus	Species	Subspecies	Common name	Red list category	Atlas region endemic
Agamidae	*Agama*	*aculeata*	*aculeata*	Common Ground Agama	Not Evaluated	0
Agamidae	*Agama*	*anchietae*		Anchieta's Agama	Not Evaluated	0
Agamidae	*Agama*	*atra*		Southern Rock Agama	Not Evaluated	0
Colubridae	*Boaedon*	*capensis*		Brown House Snake	Not Evaluated	0
Colubridae	*Psammophis*	*notostictus*		Karoo Sand Snake	Not Evaluated	0
Colubridae	*Telescopus*	*semiannulatus*	*polystictus*	Damara Tiger Snake	Not Evaluated	0
Cordylidae	*Karusasaurus*	*polyzonus*		Karoo Girdled Lizard	Not Evaluated	0
Elapidae	*Naja*	*nivea*		Cape Cobra	Not Evaluated	0
Gekkonidae	*Chondrodactylus*	*angulifer*	*angulifer*	Common Giant Ground Gecko	Not Evaluated	0
Gekkonidae	*Chondrodactylus*	*bibronii*		Bibron's Gecko	Not Evaluated	0
Gekkonidae	*Lygodactylus*	*bradfieldi*		Bradfield's Dwarf Gecko	Not Evaluated	0
Gekkonidae	*Pachydactylus*	*montanus*		Namaqua Mountain Gecko	Not Evaluated	0
Gekkonidae	*Pachydactylus*	*rugosus*		Common Rough	Not Evaluated	0

				Gecko		
Gekkonidae	*Ptenopus*	*garrulus*	*maculatus*	Spotted Barking Gecko	Not Evaluated	0
Lacertidae	*Pedioplanis*	*inornata*		Plain Sand Lizard	Not Evaluated	0
Lacertidae	*Pedioplanis*	*lineoocellata*	*lineoocellata*	Spotted Sand Lizard	Not Evaluated	0
Leptotyphlopidae	*Namibiana*	*occidentalis*		Western Thread Snake	Not Evaluated	0
Scincidae	*Acontias*	*lineatus*		Striped Dwarf Legless Skink	Not Evaluated	0
Scincidae	*Trachylepis*	*occidentalis*		Western Three-striped Skink	Not Evaluated	0
Scincidae	*Trachylepis*	*sparsa*		Karasburg Tree Skink	Not Evaluated	0
Scincidae	*Trachylepis*	*spilogaster*		Kalahari Tree Skink	Not Evaluated	0
Scincidae	*Trachylepis*	*sulcata*		Western Rock Skink	Not listed	0
Scincidae	*Trachylepis*	*sulcata*	*sulcata*	Western Rock Skink	Not Evaluated	0
Scincidae	*Trachylepis*	*variegata*		Variegated Skink	Not Evaluated	0
Viperidae	*Bitis*	*arietans*	*arietans*	Puff Adder	Not Evaluated	0

Red listing source: 1996 IUCN global listing

Table6. List of frog species recorded during the South African Frog Atlas Project (SAFAP) and of species likely to occur on the site according to Minter *et al.* 2004. Actual species lists will most likely contain far fewer species due to extensive habitat transformation as well as habitat degradation due to high levels of overgrazing, soil erosion and riparian zone degradation.

Common Name	Species	Breeding Requirements
Common River Frog	*Amietia (Afrana) angolensis*	Rivers and permanent water (springs, ponds and farm dams).
Cape River Frog	*Amietia (Afrana) fuscigula*	Permanent waterbodies including springs, farm dams and rivers
Bushveld Rain Frog	*Breviceps adspersus*	Terrestrial breeder eggs deposited in an underground chamber.
Marbled Rubber Frog	*Phrynomantis annectens*	Associated with granitic inselbergs and rocky outcrops. Seasonal pools of rainwater trapped in these rocky outcrops provide breeding habitat.
Tremelo Sand Frog	*Tomopterna cryptotis*	Shallow permanent streams or vleis in grassland
Tandy's Sand Frog	*Tomopterna tandyi*	Small streams, pans, temporary rainpools and is commonly associated with farm dams.
Bubbling Kassina	*Kassina senegalensis*	Open vleis, pans, dams in grassland
Boettger's Caco	*Cacosternum boettgeri*	Marsh, vleis, inundated grassland
Karoo Toad	*Vandijkophrynus (Bufo)gariepinus*	Permanent and temporary waterbodies such as streams, dams. Roadside rainpools, quarries, pans, seepages and spongy bogs.
Guttural Toad	*Amietophrynus* (*Bufo*) *gutturalis*	Open vleis, pans, ponds, dams, slow streams
Common Platanna	*Xenopus laevis*	Open vleis, pans, ponds, dams, slow streams