

***PROPOSED ROOILYF WAYLEAVE AGREEMENT PLAN:
WAYLEAVE FOR WATER PIPELINE TO SOLAFRICA THERMAL
ENERGY (PTY) LTD:
PROPOSED PIPELINE ON PTN 5 OF THE FARM BOK POORT 390
& PTN 7 OF THE FARM SAND DRAAI 391:***

FAUNA & FLORA ECOLOGICAL SURVEY.

PREPARED FOR

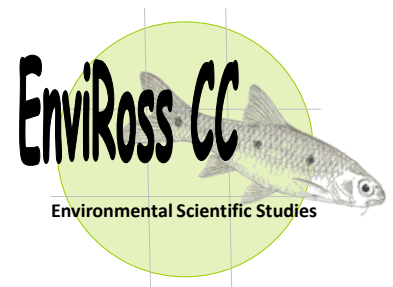
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Declaration

This report has been prepared according to the requirements of Section 33 (2) of the Environmental Impact Assessments Regulations, 2006 (GNR 385). We (the undersigned) declare the findings of this report free from influence or prejudice.

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Executive Summary

EnviRoss CC was requested to undertake an ecological survey encompassing the terrestrial fauna and flora components and significance of the impacts emanating from the proposed SolAfrica (Pty) Ltd water pipeline from the farm Sand Draai 391 Portions 0 and 5 to farm Bok Poort 390 Portion 0 near Upington in the Northern Cape Province. Two alternative localities for a pump station are also proposed on the farm Sand Draai 391. The field survey was undertaken during May 2012.

The ecological assessment study was undertaken to determine the overall condition and ecological status of the vegetation types of the proposed development area as well as the occurrences (and possible potential habitat) of any RDL faunal or floral or otherwise protected floral species. The findings of this report were used to propose recommendations and mitigation actions for the construction, management and decommissioning phases of the proposed development activities pertaining to various ecological processes. Various ecological study sites throughout the survey area were chosen as focal points for the field assessment that represented the diversity of available habitats applicable to the proposed development activities that would aid in determining the conservational relevance of the area to the conservation of RDL faunal and floral species within the area.

A desktop study to gain background information on the physical habitat and potential faunal and floral biodiversity lists of the proposed development site and surrounding areas was initially undertaken. These lists included features cited by various literature and database sources applicable to the area and a description of the physical habitat and vegetation types represented within the region. This information was then cross-referenced with the data from the habitat assessments done during the field survey.

Vegetation status and general area assessment.

A desktop study was undertaken to gain background information for the area. The area falls predominantly within the Nama-Karoo Biome and is therefore has a relatively arid climate. Four vegetation types are intersected, namely Kalahari Karroid Shrubland, *Gordonia* Duneveld, Bushmanland Arid Grassland and Lower Gariep Alluvial Vegetation. These vegetation units were found to have suffered varying degrees of transformation and degradation through historical infrastructure development (Transnet servitude and railway), a water pipeline and impacts emanating from livestock grazing and trampling.

No Red Data Listed floral species are noted from the area (SANBI, 2012) and none were observed during the field survey. It is also considered unlikely that the proposed development activities will impact on any RDL floral species.

Two protected tree species, namely *Acacia haematoxylon* and *Acacia erioloba* were noted to be relatively abundant along the proposed pipeline alignment route. A permit will therefore be required to remove or otherwise damage the individuals of this species.

Faunal assessment.

Faunal diversity was assessed initially as a desktop study and then a field assessment through visual observations and evaluations of suitable habitats. The results of the desktop study, showing the conservation status of the species recorded from the region are presented in [Table 1](#)~~Table 1~~~~Table 1~~.

Table 1: Summary of RDL faunal species status for the proposed development site.

Taxon	Total species	Total spp of conservational concern	Conservation Status*					
			CE	EN	VU	NT	Ra	DD
Mammals	54	7	1	0	0	6	0	3
Birds	240	17	0	0	7	10	0	0
Reptiles	69	0	0	0	0	0	0	0
Amphibians	8	0	0	0	0	0	0	0
Invertebrates	X [^]	Various groups**						
Totals:		24	1	0	7	16	0	3

*CE-Critically endangered; EN-Endangered; VU-Vulnerable; NT-Near threatened RA-Rare & DD-Data deficient.

#POC – Probability of Occurrence.

**The total number of RDL invertebrates includes the Mygalomorph spiders, scorpions, butterflies, dragonflies, as a group due to lack of data resources.

[^]The total number of invertebrates at the site is not quantifiable during a survey of this nature.

No RDL faunal species were observed during the field survey. The close proximity of the proposed pipeline alignment route to a roadway and railway means that the regular disturbance features would largely displace any RDL or otherwise sensitive faunal species from the immediate vicinity.

Conclusions and general mitigation recommendations.

The following salient conclusions were drawn and recommendations made on completion of the survey:

- The area earmarked for development does not incorporate any areas of particular ecological sensitivity through the association with existing infrastructure (Transnet servitude, railway, existing pipeline) and the transformation of the land and vegetation structures through farming activities (livestock and agriculture). The riparian zones of the Orange River, regardless of present ecological state, is considered an inherently sensitive habitat unit and therefore the impact footprint within this area should be limited as far as possible;
- Two alternative localities have been proposed for the associated pump station. Alternative 2 falls within an existing agricultural field. Alternative 2 falls within an area that has retained some natural features. The ecological impact would be greatest at Alternative 1 and therefore Alternative 1 is the preferred option;
- No Red Data Listed faunal or floral species were noted during the field survey and the habitat quality and present land use is presumed to largely exclude the possibility of these species occurring where they would be impacted by the development activities;
- An impact significance assessment was undertaken, which is presented in [Table 6](#)~~Table 6~~~~Table 7~~, wherein the impacts have been shown to be readily mitigated to reduce the impacts to within acceptable limits;
- Mitigation measures have been proposed in [Table 7](#)~~Table 7~~~~Table 8~~, [Table 8](#)~~Table 8~~~~Table 9~~ and [Table 9](#)~~Table 9~~~~Table 10~~ for the construction, operations and decommissioning phases of the proposed development, respectively.
- It is felt that the implementation of the proposed mitigation measures will allow for the retention of the long term and overall ecological integrity and functionality of the proposed development site and immediate surrounding area.

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GLOSSARY OF TERMS & ACRONYMS.

Alien vegetation – Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally.

Biome – A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate.

Bush encroachment – A state where undesirable woody elements gain dominance within a grassland, leading to depletion of the grass component. Typically due to disturbances and transformations as a consequence of veld mismanagement (overgrazing, incorrect burning, etc.).

°C – Degrees Celsius.

EMP – Environmental Management Plan

Endangered – Organisms in danger of extinction if causal factors continue to operate.

Endemic species – Species that are only found within a pre-defined area. There can therefore be sub-continental (e.g. southern Africa), national (South Africa), provincial, regional or even within a particular mountain range.

ENPAT – Environmental Potential Atlas. A GIS-based dataset for South Africa developed by DEAT (2001), where biophysical and political features are mapped.

Exotic vegetation – Vegetation species that originate from outside of the borders of the biome. Usually international in origin.

Ex situ conservation – Where a plant (or community) cannot be allowed to remain in its original habitat and is removed and cultivated to allow for its ongoing survival.

Extrinsic – Factors that have their origin outside of the system.

GDACE – Gauteng Department of Agriculture, Conservation and Environment (now known as GDARD).

GDARD – Gauteng Department of Agriculture and Rural Development (formerly GDACE).

ha – Hectares.

Indigenous vegetation – Vegetation occurring naturally within a defined area.

Increaser 1 grass – Grass species that increase in density when veld is underutilised.

Increaser 2 grass – Grass species that increase in density in over utilised, trampled or disturbed veld.

Increaser 3 grass – Grass species that increase in density in over and under-utilised veld.

In situ conservation – Where a plant (or community) is allowed to remain in its natural habitat with an allocated buffer zone to allow for its ongoing survival.

Karoid vegetation – A shrub-type vegetation that dominates in grasslands that have seen historical disturbances. Mainly due to over-grazing and mismanaged burning regimes. The shrubby vegetation eventually becomes dominant and out-competes the grassy layer.

m – Metres.

mm – Millimetres.

MAMSL – Metres above mean sea level.

MAP – Mean annual precipitation.

MAPE – Mean annual potential for evaporation.

MASMS – Mean annual soil moisture stress.

MAT – Mean annual temperature.

MPDACE – Mpumalanga Department of Agriculture, Conservation and Environment.

Orange Listed – Species that are not Red Data Listed, but are under threat and at risk of becoming RDL in the near future. Usually allocated to species with conservation status of *Near threatened*, *Declining*, *Rare* and *Data Deficient*.

PES – Present Ecological State.

POC – Probability of occurrence.

PRECIS – Pretoria Computer Information Systems. Records of plant species occurring within the QDS.

Pioneer species – A plant species that is stimulated to grow after a disturbance has taken place. This is the first step in natural veld succession after a disturbance has taken place.

QDS – Quarter degree square (1:50,000 topographical mapping reference).

Rare – Organisms with small populations at present.

RDL (Red Data listed) species – Organisms that fall into the *Extinct, Critically Endangered, Endangered, Vulnerable* categories of ecological status.

RDSIS – Red data sensitivity index score.

SANBI – South African National Biodiversity (formerly *Botanical*) Institute.

SoER – State of Environment Report.

Veld retrogression – The ongoing and worsening ecological integrity state of a veld.

1. INTRODUCTION AND TERMS OF REFERENCE.

Enviross CC was requested to undertake an ecological investigation, encompassing the terrestrial fauna and flora composition for the proposed water pipeline alignment route that is required for the proposed SolAfrica Thermal Energy (Pty) Ltd Concentrated Solar Thermal Power (CSP) Plant. The proposed alignment route runs parallel in association with a Transnet servitude (a gravel roadway) from the Orange River on Portion 7 of the Farm Sand Draai 391, through Portion 5 of the Farm Bok Poort 390 to the Eskom Garona Substation located approximately 12 km to the northeast ([Figure 2](#)~~Figure 2~~~~Figure 2~~). It falls within the Gordonia Administrative District. The proposed alignment route is to run along the inside of the northern boundary fence of the farm associated with the servitude, largely due to the presence of an existing pipeline.

The survey area incorporates a diversity of habitat types, ranging from riparian zones (on the banks of the Orange River), through savanna and grassland habitat incorporating parallel vegetated dune features, dry grassland plains and mixed savannas. There are no wetlands or aquatic habitat features associated with the survey area, excepting for the southern association with the riparian areas of the Orange River.

Surrounding land use is utilised almost exclusively for game farming, livestock rearing and, closer to the river, irrigated agricultural crops.



Figure 1: Various views of impacting features associated with the proposed pipeline alignment route.

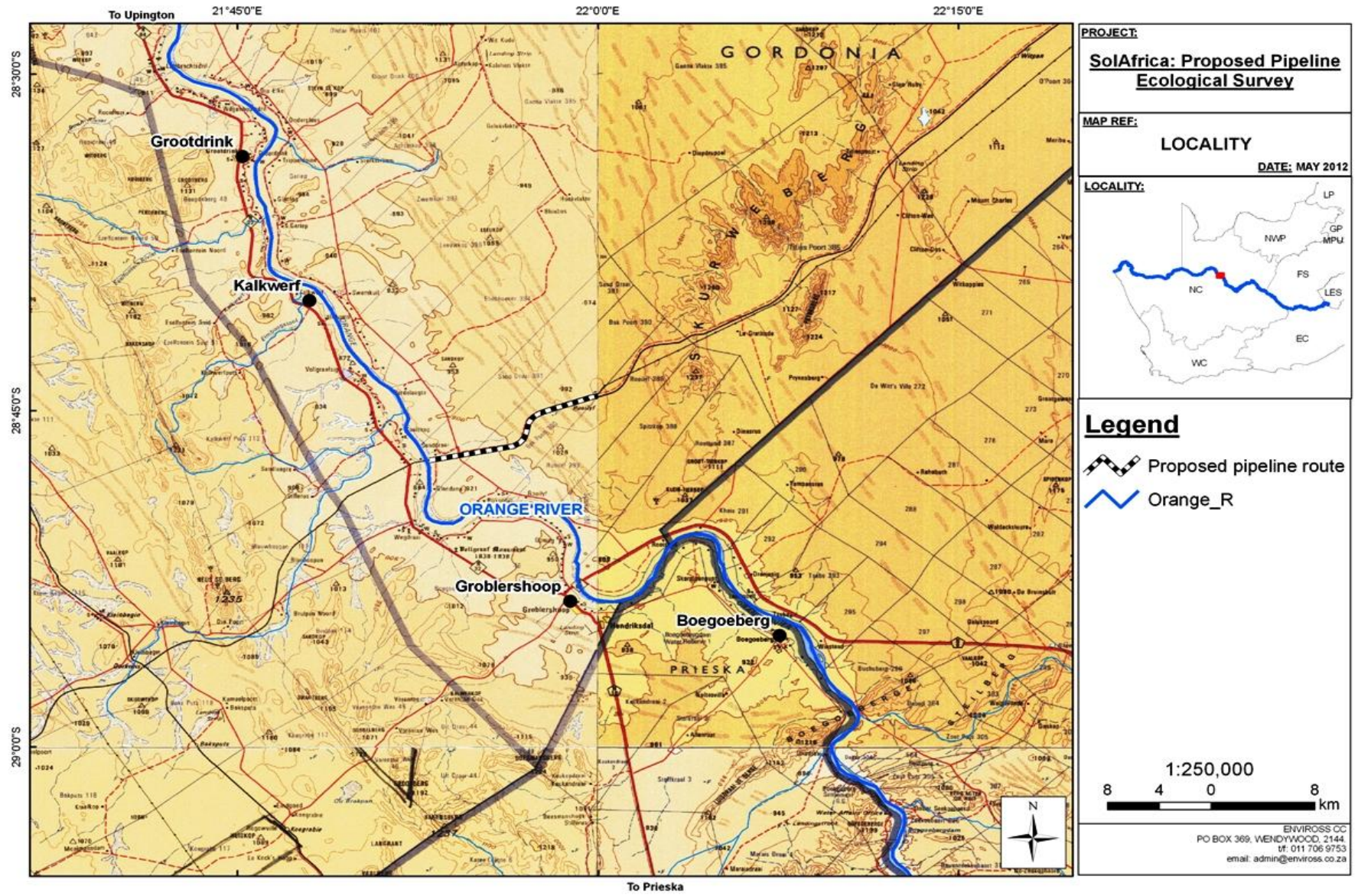


Figure 2: Locality of the proposed development area.

2. SCOPE OF WORK.

The *Scope of Work* encompassed a terrestrial fauna and flora ecological survey for the areas pertaining to the proposed pipeline alignment route and to assess the two alternative sites for the proposed pump station. Special emphasis was to be placed on species of conservational importance (Red Data listed species) as well as evaluating the site for habitat that potentially would support such species. A general site condition was to be presented in terms of vegetation ecological integrity, together with areas of particular ecological sensitivity being indicated and mapped. The loss of natural migrational corridors, open spaces and sensitive habitats were also to be assessed, with the quantification of the significance of any negative ecological impacts and to propose mitigation measures to abate these impacts upon conclusion of the study.

3. METHODS OF INVESTIGATION.

3.1 Desktop Study.

Initially a desktop study was undertaken to gather background information regarding the site and its surrounding areas. Relevant authorities were consulted regarding conservational species lists as well as all the latest available literature utilised to gain a thorough understanding of the area and its surrounding habitats. This information and further literature reviews were then used to determine the potential biodiversity lists for the proposed development site and surrounding areas. This information incorporated (amongst others) data on vegetation types, habitat suitability and biodiversity potential coupled to this information. Information sources included online resources of the Animal Demographic Unit (ADU), Bird Atlas Project, South African Reptile Conservation Assessment (SARCA), South African Frog Atlas Project (SAFAP), Plants of Southern Africa (POSA), and various literature and GIS bases.

3.2 Site Descriptions and Assessments.

3.2.1 Floral community structures & general site survey.

A site survey was undertaken during May 2012 to determine the ecological status of the proposed development route and the surrounding area. A reconnaissance 'walkabout' was initially undertaken to determine the general habitat types found throughout the study area and, following this, specific study sites were chosen that were representative of the habitats found within the area - special emphasis was placed on potential areas that may support RDL species. The linear nature of the proposed development made investigating the entire impact area on foot impracticable and therefore specific study sites were chosen that best represented the diversity of the available habitat types.

3.2.2 Vegetation surveys.

Vegetation surveys were undertaken by first identifying different vegetation units and then analysing the floral species communities and composition. Thorough site searches within these designated survey areas were undertaken to identify any protected species or the potential occurrence of any protected species. These sites were investigated to also identify the occurrence of the *dominant* plant communities, species and habitat diversities and present ecological condition.

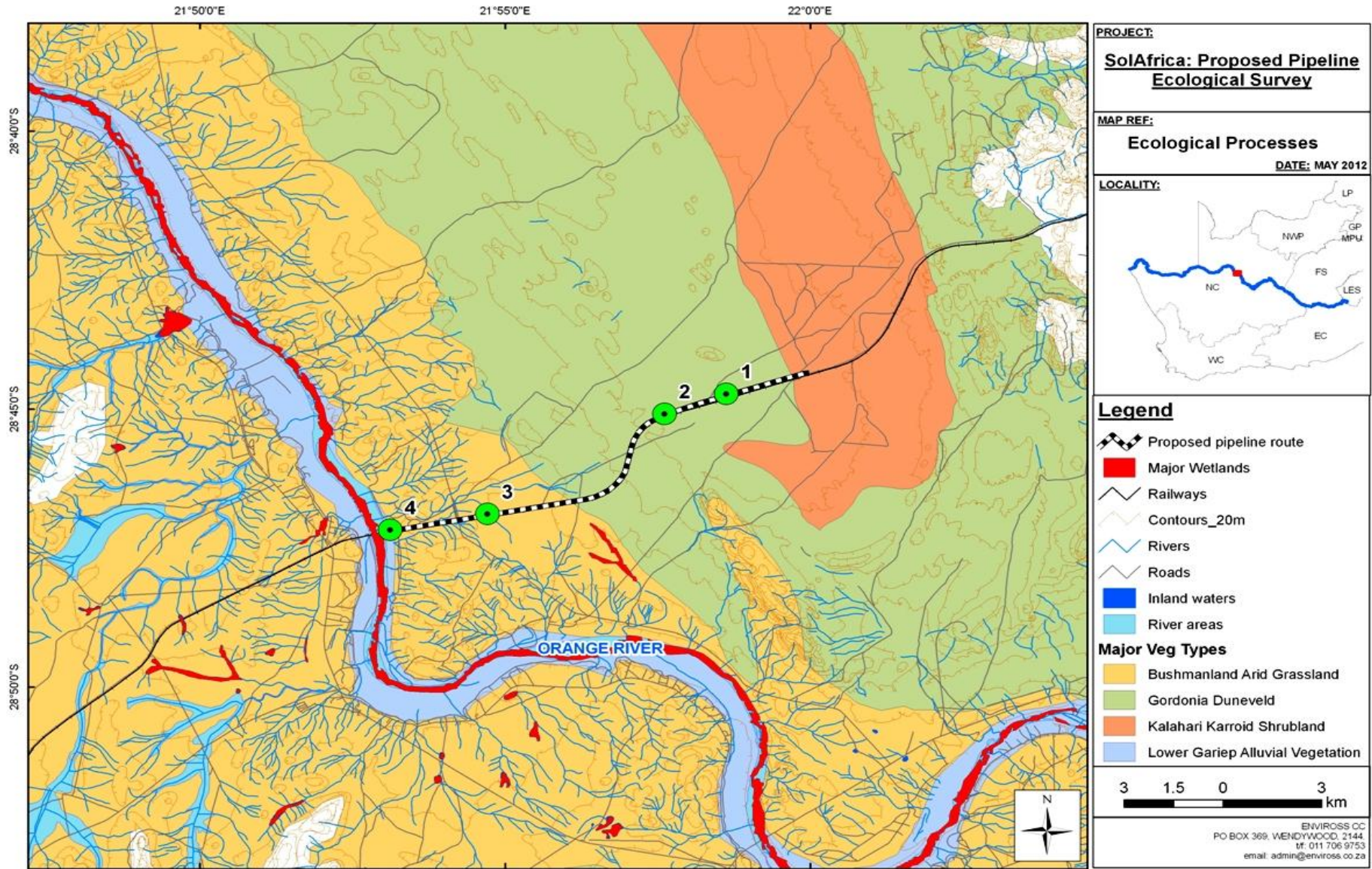


Figure 3: Ecological processes and habitat units pertaining to the subject property.

3.2.3 Faunal surveys.

A desktop survey was initially undertaken to determine if any RDL invertebrate species had historical records in association with the proposed development route and immediate surrounding areas. A “walk about” throughout the proposed development area was undertaken to assess the potential of the habitats of supporting various RDL species. Methodical searches were undertaken within strategic areas. Burrow excavations and rock turning were further methodologies employed during the invertebrate survey. The presence of any faunal inhabitants of the area was also assessed through direct visual observation or indirectly, by identifying them through calls, tracks, scats and burrows, with emphasis being placed on determining if any RDL species occur within the study area. No trapping was undertaken.

Butterfly species that were observed throughout the property were visually identified. Potential habitat was also identified through observations of potential food plants and specific habitat requirements for known RDL species from the area.

4. RESULTS & DISCUSSIONS.

4.1 Vegetation types.

The proposed development area falls predominantly within the Savanna and Nama-Karoo biomes. The major vegetation units represented throughout the survey area are presented in Table 2.

Table 2: The main vegetation units associated with the development site and surrounding areas and their associated synonyms (Mucina & Rutherford, 2006; Low & Rebelo, 1998 and Acocks, 1988).

Biome	Bioregion	Vegetation types	Conservational Status	Synonyms
Nama-Karoo Biome	Bushmanland	Kalahari Karroid Shrubland	Least threatened	Kalahari Thornveld and Shrub Bushveld (Acocks, 1988); Karroid Kalahari Bushveld (Low & Rebelo, 1998); 32c. <i>Acacia mellifera</i> subsp. <i>detinens</i> Veld (Acocks, 1988)
		Bushmanland Arid Grassland	Least threatened	Arid Karoo and Desert False Grassland; Orange River Broken Veld (Acocks, 1988); Orange River Nama-Karoo (Low & Rebelo, 1996)
Savanna Biome	Kalahari Duneveld	Gordonia Duneveld	Least threatened	Kalahari Thornveld and Shrub Bushveld (Acocks, 1988); Shrubby Kalahari Dune Bushveld (Low & Rebelo, 1998)
Inland Azonal Vegetation		Lower Gariep Alluvial Vegetation	Endangered	-

Conservational concerns associated with each vegetation type (but not necessarily associated with the project area) are presented in Table 3. The distribution of different vegetation community structures throughout the subject property is governed by the geological and pedological features (soil types and structures and soil moisture content), climatological and topographical features of the site and surrounding area. The topographical features govern exposure to sunlight and shielding areas from winds, frost and fires and also allows for greater moisture retention within these shielded areas. Other areas are exposed to higher sunlight and heat intensity, which results in greater desiccation and therefore limits these areas to

floral communities that are specifically adapted to surviving exposure to frost, fires and winds. Steep topographical features also govern accessibility for livestock, so some areas are subjected to greater grazing pressure. Geological features within an area govern the soil types, rate of erosion and therefore deposition of soils within an area. The type of soils (amongst other features) then also determines the moisture retention as well as the chemical composition within an area. Floral species, through evolutionary processes, have become adapted to surviving and exploiting these different habitat regions. Regions that share topographical, climatological and geological features therefore have a certain community of floral species that dominate and have become diagnostic of the region and can be delineated into vegetation types or units. The whole of South Africa, Lesotho and Swaziland has been delineated into these vegetation units and recorded in Mucina and Rutherford (2006), which is the most recent literature work. Further details of the vegetation types associated with the survey area are provided in Appendix B.

Table 3: The vegetation types associated with the survey area and particular conservational concerns (Mucina & Rutherford, 2006).

Vegetation types	Conservational Status	Conservational concerns
Kalahari Karroid Shrubland	Least threatened	South-western distribution limit of <i>Dinebra retroflexa</i>
Bushmanland Arid Grassland	Least threatened	Bushmanland endemics: <i>Tridentea dwequensis</i> . Other endemics: <i>Dinteranthus pole-evansii</i> , <i>Larryleachia dinteri</i> , <i>Larryleachia marlothii</i> , <i>Ruschia kenhardtensis</i> , <i>Lotononis oligocephala</i> , <i>Nemesia maxii</i>
Gordonia Duneveld	Least threatened	Kalahari endemics: <i>Acacia haematoxylon</i> , <i>Stipagrostis amabilis</i> , <i>Anthephora argentea</i> , <i>Megaloprotachne albescens</i> , <i>Helichrysum arenicola</i> , <i>Kohautia ramosissima</i> , <i>Neoradopsis austro-africana</i>
Lower Gariep Alluvial Vegetation	Endangered	Exotic encroachment: <i>Prosopis</i> species, <i>Nicotiana glauca</i> and <i>Argemone ochroleuca</i> that have invaded the alluvia in places.

4.2 Climate.

The climate of the Nama-Karoo is essentially continental and is little effected by the ameliorating influences of the oceans. Nama-Karoo is an arid biome. Most of the rivers are non-perennial. Apart from the Orange River and the few permanent streams in the southwest that originate in higher-rainfall neighbouring areas, the few perennial streams that originate in the Nama-Karoo are limited to the most mesic east (Mucina & Rutherford, 2006). Table 4 presents the main climatic units of the various bioregions and vegetation types within the area.

Table 4: Background climatic information on the respective vegetation types.

Bioregion	Vegetation types	Altitude (m)	MAP* (mm)	MAT* (°C)	MAPE* (mm)	MASMS* (%)
Bushmanland	Kalahari Karroid Shrubland	700 – 1,100	156	18.4	2878	86
	Bushmanland Arid Grassland	600 – 1,200	133	17.4	2771	86
Kalahari Duneveld	Gordonia Duneveld	800 – 1,200	182	18.6	2912	86
Alluvial Vegetation	Lower Gariep Alluvial Vegetation	0 – 1,000	131	19.2	2888	-
Average values			150.5	18.4	2862.25	86

*MAP – Mean annual precipitation; MAT – Mean annual temperature; MAPE – Mean annual potential evaporation; MASMS – Mean annual soil moisture stress (% of days when evaporative demand was more than double the soil moisture supply).

The development site and surrounding area is therefore represented by an arid region, typified by relatively high and low extremes in mean temperatures (between -4.2 and 39.5°C, average 18.32°C), low precipitation

(average 150.5mm), a high evaporation potential (average 2862mm). These values lead to a relatively high soil moisture stress, with an average of 86% of the time that the evaporative demand is more than double that of the soil moisture supply (Table 4). These aspects, in turn, lead to a high specialisation of faunal and floral species that have adapted to occur within these arid regions. This means that these species potentially suffer significant losses from relatively small habitat impacts. The aridity of the region also means that floral species are relatively slow-growing and therefore natural veld succession and recuperation processes are relatively slow following a habitat transformation or disturbance.

4.3 Site descriptions & floral species community structures.

The proposed alignment route runs through four different vegetation types. The survey sites were chosen to be representative of typical areas within these vegetation units, excepting for the northern extreme, where the pipeline route has too limited an association with the vegetation unit (Kalahari Karroid Shrubland) to be relevant (see [Figure 3](#)[Figure 3](#)[Figure 3](#)).

4.3.1 Site 1 – *Gordonia Duneveld*.

This site fell within a transitional zone between the Nama-Karoo vegetation unit of Kalahari-Karroid Shrubland and the Savanna vegetation unit of *Gordonia Duneveld* and therefore components of both vegetation units were present. The transitional zone also meant that the well-established parallel vegetated dune features of *Gordonia Duneveld* were not yet prominent. This area had been utilised for grazing purposes by cattle, sheep and goats and was therefore suffering transformation through this grazing pressure. The general aridity of the survey area meant that grazing pressure has a considerable impact on vegetation features, species structures and vegetation cover.



Figure 4: Various views of Survey Site 1 within the *Gordonia Duneveld* vegetation unit.

The dominant floral species encountered at the site are presented in Table 5. It should be noted that two tree species that are protected under the National Forests Act (Act No 84 of 1998) occur within the area and were readily observed within the site. These were *Acacia haematoxylon* (Grey camelthorn) and *Acacia erioloba* (Camelthorn).

Table 5: Dominant floral species observed at Site 1.

Trees/shrubs	Forbs	Grasses/sedges/reeds
<i>Rhus lancea</i> <i>Acacia haematoxylon</i> <i>Acacia erioloba</i> <i>Acacia mellifera</i> <i>Ziziphus mucronata</i> <i>Boscia foetida</i> subsp. <i>foetida</i> <i>Grewia flava</i> <i>Rhigozum trichotomum</i> <i>Tapinanthus oleifolius</i> <i>Monechma genistifolium</i> <i>Crotalaria orientalis</i>	<i>Lycium pumilum</i> <i>Tribulus terrestris</i> <i>Lycium hirsutum</i> <i>Hirpicium alienatum</i> <i>Oxalis semiloba</i> <i>Hirpicium echinus</i> <i>Geigeria ornativa</i> <i>Platycarpha</i> sp (cf)	<i>Schmidtia kalahariensis</i> <i>Cynodon dactylon</i> <i>Urochloa oligotricha</i> <i>Aristida congesta</i> <i>Aristida adscensionis</i> <i>Eragrostis lehmanniana</i> <i>Stipagrostis uniplumis</i> <i>Stipagrostis ciliata</i> <i>Brachiaria glomerata</i> <i>Tragus racemosus</i> <i>Enneapogon desvauxii</i> <i>Brachiaria glomerata</i> <i>Chloris virgata</i> <i>Eragrostis annulata</i> <i>Eragrostis truncate</i> <i>Setaria verticillata</i>

Grazing pressure has increase the occurrence of certain encroaching woody elements such as *Acacia mellifera* and *Rhigozum trichotomum* (especially). Deep sandy soils also meant that disturbance features (trampling from livestock) readily lead to soil mobility, which inhibits vegetation establishment. Besides the two protected tree species occurring within this survey area, no further floral species of conservational concern were noted to occur. The high degree of regular disturbance features emanating from cattle activity also means that it is highly unlikely for RDL or otherwise sensitive species to occur.

4.3.2 Site 2 – Gordonia Duneveld.

Site 2 was located further southwards along the proposed pipeline route where the parallel vegetated dune features of Gordonia Duneveld became more prominent. The proposed pipeline alignment route cuts perpendicular to the orientation of the dune series. Much of this area was utilised for game farming and therefore the vegetation structures were less transformed. The species community structures were largely similar to those observed at Site 1, with only differences in species that dominated being observed. At this site grass species such as *Stipagrostis obtusa* and *Stipagrostis ciliata* (both indicators of intact community structures with good grazing value) dominated the undergrowth, together with *Enneapogon desvauxii*, *Aristida adscensionis* and *Schmidtia kalahariensis*. *Boscia foetida*, *Parkinsonia africana*, *Acacia haematoxylon*, *Acacia erioloba* and *Acacia mellifera* dominated the tree components.



Figure 5: Various views of Survey Site 2 within the *Gordonia Duneveld* vegetation unit.

4.3.3 Site 3 – Bushmanland Arid Grassland.

Site 3 was located still further southwards along the proposed pipeline route where the dune features gave way to open plains. Open arid shrubby grassland with sparse cover became the prominent landscape feature. The grassy layer was largely absent due to grazing pressure. The increased aridity of this vegetation unit saw the increase in succulent floral species and those spinous species that are adapted to safeguard against grazing pressure, such as *Euphorbia damarana*, *Aloe claviflora*, *Monechma genistifolium*, *Ruschia intricata* and *Barleria lichtensteiniana*. The tree component still included those species observed throughout the pipeline route, but species such as *Acacia mellifera*, *Acacia haematoxylon*, *Boscia foetida* and *Rhigozum trichotomum* dominated. A species observed within this area that was not observed within other areas of the proposed pipeline route was *Rhigozum obovatum*.

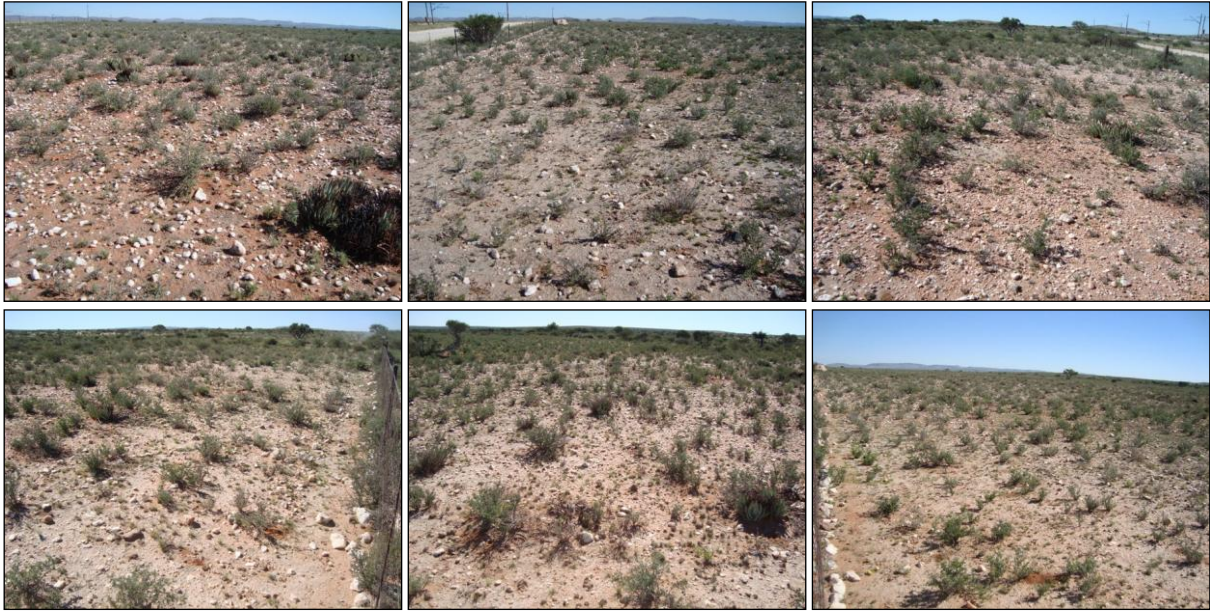


Figure 6: Various views of Survey Site 3 within the *Bushmanland Arid Grassland* vegetation unit.

Grazing pressure within this area, once again, excludes the potential for any floral species of conservational significance from being supported.

4.3.4 Site 4 – Lower Gariep Alluvial Vegetation.

This site was located further south within the riparian zones and floodplains of the Orange River. Much of the vegetation within this zonal area has been transformed to accommodate agricultural crops and the vast majority of the farm homesteads and infrastructure is located within this area. This means that the natural vegetation features have largely been lost. This was the only area where exotic species encroachment was observed to be potentially problematic, with *Prosopis glandulosa*, *Nicotiniana glauca* and *Eucalyptus* spp being the species of greatest concern. The banks of the river were largely dominated by reedbeds made up of *Phragmites australis*. The high association that this area has with agricultural activities and infrastructure, together with the high incidence of exotic vegetation means that the potential for floral species of conservational concern being supported is regarded as low.



Figure 7: Various views of Survey Site 4 within the Lower Gariep Alluvial Vegetation unit.

Two site alternatives have been proposed to accommodate the pump station. . Alternative 1 lies approximately 500m to the east of Alternative 1 and falls within an area that has retained some natural features. Establishment of infrastructure within this area will therefore have a greater ecological impact. Alternative 2 is located within the established agricultural field, where complete transformation of the floral community structures has already taken place and is routinely uprooted and re-established. This is therefore the preferred site that will have the least overall ecological impact. If Alternative 1 is found to be the preferred site, it is perceived that there will be no significant losses to biodiversity within the region as no RDL or conservationally significant biodiversity was observed at this site,

4.4 Protected species.

As mentioned above, there are tree species that are nationally protected under the National Forests Act (Act No 84 of 1998) that have been recorded from the QDS that incorporates the survey area and that were observed within the area earmarked for development. These 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. As mentioned above, these tree 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 this sector, regardless of their national protection status. The SANBI (Plants of southern Africa: A checklist) database was utilised in order to see if any protected tree species have been recorded from the area. None have been recorded from the area. There were two tree species observed, however, namely *Acacia erioloba* (SA Tree no 168) and *Acacia haematoxylon* (SA Tree no 169) that were relatively common within the survey area.

It should be noted that a permit to remove or destroy protected species has to be sought from the national authority, namely the Department of Agriculture, Forestry and Fisheries (DAFF) prior to the removal or destruction of these species.



Figure 8: Protected tree species observed within the survey area: *Acacia erioloba* (top) and *Acacia haematoxylon* (bottom).

4.5 Faunal Assessments.

The faunal assessment was undertaken largely as a desktop study as time limitations for field assessments restricted the ability to conduct adequate species counts. In addition, the often secretive and nocturnal nature of many species reduces the likelihood of encountering them during a diurnal field assessment.

4.5.1 Mammals.

Mammals with historical distributions that include the survey area amount to 54 species (Friedmann & Daly, 2004), which includes one RDL species, namely the critically endangered Black rhino (Arid ecotype) *Diceros bicornis bicornis*. It is, however, not viable to consider this species when assessing the impact of the pipeline construction activities. There are a further six species that are classified as near threatened, which include various bat species recorded from the region. These species are particularly dependent on cave structures for roosting and breeding purposes – a habitat unit not associated with the proposed development area. Only one species, the Honey badger (*Mellivora capensis*) that also occurs within the area could be at risk. This species is a highly opportunistic and tenacious species that readily raid cultivated bee hives, chicken coops, and has been known to prey on small livestock. It is therefore a species that is actively persecuted and has, as a consequence, suffered a decline in numbers. Further than this, three species are classified as data deficient. These include small mammalian species (shrews and rodents) that are known to have a tolerance to a broad habitat range and condition. The remainder of the species are classified as least concern. The full list of species is presented in Appendix A, [Table 11](#)~~Table 11~~~~Table 11~~.

Mammalian species observed during the field survey were limited to one Cape fox (*Vulpes chama*) which had been killed by a vehicle on the servitude roadway, and the spoor of both Water mongoose (*Atilax paludinosus*) and Cape clawless otter (*Aonyx capensis*) that were observed in the mud along the edge of the river. Species that had been confined to fenced areas included Springbok (*Antidorcas marsupialis*) and Impala (*Aepyceros melampus*). These species are therefore also of limited relevance to the survey.

4.5.2 Avifauna.

As birds are highly mobile, they can move away from unfavourable areas and habitats. They are therefore not directly affected by small, localised developments unless they are directly dependent on the habitat that will be subject to the development. It must, however, be noted that habitat destruction is the leading cause of species decline, and the cumulative effects of localised habitat destruction needs to be taken into consideration. The openness of the proposed development area and the relatively localised extent of the proposed development activities mean that there is limited cumulative impact. This is reiterated by proposed alignment route being closely associated with an existing servitude roadway, railway line and a substation, together with powerlines, making for the concentration of impacting features within an open landscape. It should be noted, however, that the increased capacity for electricity generation will increase the density of powerline infrastructure, which will eventually pose a threat to avifauna within area.

The avifaunal species recorded from the region (a combined list including the QDS grids of 2821DB and 2821DD) amounts to 240 species. This is a relatively low number and is due to the general aridity of the region leading to limited food supplies and limited cover. This species list is presented in Appendix A, [Table 12](#)~~Table 12~~~~Table 12~~, with the species observed during the field survey being indicated as bold text.

Of the 240 species recorded from the region, there are seven species classified as vulnerable. These include larger raptors, scavengers (vultures) and species that require large ranges for hunting or territory establishment. Many of the larger raptor species have historically been actively persecuted by farmers due to them preying on livestock and have therefore suffered decline through poisonings. Further decline has been suffered through collision impacts with powerlines and habitat transformation. A further ten species are classified as near threatened. These species also include smaller species that are regarded as habitat specialists and are suffering from habitat transformation and decline. None of the species of conservational concern were observed during the field survey and no habitat of suitable quality was noted that could support any sensitive species in viable numbers. The proposed development activities are to take place in

association with a railway and a roadway, both of which impose disturbance features that would displace sensitive species from the immediate vicinity.

4.5.3 Reptiles.

The survey area is regarded as being relatively rich in reptilian diversity, with 69 species having been recorded. None of these species are regarded as being of conservational concern. This list is presented in Appendix A, [Table 14](#)~~Table 14~~~~Table 14~~.

Only one commonly-occurring reptile species, namely *Trachylepis punctatissima* (Striped Skink) was observed on the site during the field assessment. This is by no means an indication of the potential reptile diversity list for the area. Exhaustive and long-term trapping and sampling would have to be employed to accurately ascertain a potential reptile diversity list for the proposed development. This is not practical for a survey of this nature.

4.5.4 Amphibians.

There are eight amphibian species recorded from the area, none of which are of conservational concern. No amphibian species were observed during field assessment. The riparian and aquatic habitat located along the banks of the Orange River is the most likely area to support the greatest diversity and density of amphibian species. The potential species list from known historical records is presented in Appendix A, [Table 15](#)~~Table 15~~~~Table 15~~. The isolated nature of the proposed development activities means that amphibian populations within the general area will not be significantly impacted in the long term.

4.5.5 Invertebrates.

Protected invertebrate taxa include Mygalomorph spiders (baboon and trapdoor spiders), scorpion, certain butterfly and, more recently, certain dragonfly species. These are taxa that are either under pressure from collectors for the pet trade, or from habitat transformation and destruction. The aridity of the area makes for a high degree of habitat specialist species. Displacement of these species due to habitat destruction therefore has a negative impact on populations as their degree of adaptability is low. The area is well-known for scorpion diversity.

A desktop review of available literature and previous field experience within the area by the field ecologists allowed for the identification of potential and previously-recorded invertebrates and potential habitat to support various RDL invertebrate species to be reviewed that were relevant to the proposed development area. Methodical searching within the set survey sites, where rock turning and burrow excavations were techniques employed to locate invertebrates. No invertebrate species of conservational significance were collected. It should be noted, however, that the survey was undertaken during the winter and that invertebrate observations were expectedly low. Previous survey undertaken during the summer months revealed healthy populations of various scorpion species and baboon spiders (*Harpactira* and *Harpactirella* species). The species diversity that was observed therefore is by no means an indication of the complete invertebrate diversity potential of the proposed development site and surrounding area. Butterfly species observed throughout the survey area were all commonly-occurring species, with widespread distributions.

Table 667: 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	Project activity or issue	Environmental significance <i>before</i> mitigation					Environmental significance <i>after</i> mitigation as per EMP				
		E	D	I	P	SR	E	D	I	P	SR
PRECONSTRUCTION & CONSTRUCTION PHASES											
Habitat destruction	Vegetation removal through soil stripping; Smothering of vegetation during soil stockpiling.	2	3	3	4	12	1	2	2	4	9
Impacts on RDL floral and faunal species	Direct impacts due to inclusion of RDL species in vegetation removal.	2	3	2	2	9	1	1	1	1	4
Soil erosion	Soil disturbances aggravating soil erosion; Erosion of unprotected stockpiles of soil.	2	3	3	4	12	1	2	2	2	7
Impacts on floral communities	Vegetation removal and site disturbances leading to shifts in floral community and habitat unit structures.	2	3	3	4	12	1	2	2	4	9
	Depletion of biodiversity through indiscriminate collecting and harvesting of floral species by construction teams (firewood, etc).	2	1	2	3	8	1	1	1	1	4
	Disturbances through construction activities that will destroy various floral species.	2	3	3	4	12	1	2	2	4	9
Impacts on faunal communities	Habitat destruction leading to loss of faunal diversity.	2	3	3	4	12	1	2	2	4	9
	Impacts on faunal communities by indiscriminate collecting and hunting by construction teams.	2	1	2	3	8	1	1	1	1	4
	Increased disturbance factors that will displace sensitive faunal species.	2	3	3	4	12	1	2	2	4	9
	Increased vehicular movement on servitude roadway increasing the risk of faunal road deaths.	2	2	2	3	9	2	1	1	2	6
Soil contamination	Pollution of soils due to oil/fuel leaks & wastes that will affect biodiversity.	2	2	2	3	9	1	1	1	1	4
MANAGEMENT PHASE											
Soil disturbances	Excavations of sections of the pipeline during planned or unplanned maintenance	2	3	3	4	12	1	2	2	4	9
Soil contamination	Contamination of soils from fluid leaks of construction vehicles during maintenance procedures.	2	2	2	3	9	1	1	1	1	4
Soil erosion	Formation of soil erosion following disturbances and incorrect reinstatement.	2	3	2	3	10	1	1	1	2	5
Biodiversity impacts	Vegetation disturbances to gain access to areas in need of maintenance.	2	3	3	4	12	1	2	2	4	9
	Exotic vegetation encroachment following soil disturbances.	2	4	2	3	11	1	1	1	2	5
DECOMMISSIONING PHASE											
Soil disturbances	Excavations to remove pipeline will disturb soils that had settled.	2	3	3	4	12	1	2	2	4	9

Potential environmental impact	Project activity or issue	Environmental significance <i>before</i> mitigation					Environmental significance <i>after</i> mitigation as per EMP				
		E	D	I	P	SR	E	D	I	P	SR
Soil contamination	Contamination of soils from fluid leaks of construction vehicles during excavation and removal procedures.	2	2	2	3	9	1	1	1	1	4
Soil erosion	Formation of soil erosion following disturbances and incorrect reinstatement.	2	3	3	4	12	1	2	2	2	7
Biodiversity impacts	Vegetation destruction of naturalised and established vegetation.	2	3	3	4	12	1	2	2	4	9
	Exotic vegetation encroachment following soil disturbances.	2	4	2	3	11	1	1	1	2	5

SP ratings: 4-6 (Low), 7-9 (Medium), 10-12 (High); 13-16 (Very high).

E=Extent; D=Duration; I=Intensity; P=Probability of Occurrence; SR=Significance rating.

NOTE: All impacts are rated as a *negative impact* (deleterious or adverse impact).

Table 778: Mitigation measures proposed for the *Construction phase* of the proposed development activities.

Environmental Consideration	Environmental Impacts	Mitigation Measures	Time Frames	Responsible Party
Flora	<ul style="list-style-type: none"> Destruction of RDL and sensitive floral species; Damage to habitat that could potentially support RDL or sensitive floral species; Transformation of vegetation community structures; Soil disturbances that allow for the establishment of exotic vegetation; Damage to plant life outside of the footprint area. 	<ul style="list-style-type: none"> Movement of personnel and machinery to be limited to the areas designated for the established access roadways and construction footprint area; Any recruitment of exotic vegetation to be managed on an ongoing basis until indigenous pioneering vegetation has dominated the disturbed areas. These species should be limited to naturally-occurring species representative of the vegetation type for the locality. Ongoing monitoring of exotic vegetation recruitment should be undertaken and any recruitment controlled; Dumping or storage of topsoil must not be done on established vegetation, but should remain within designated areas; Workers and machinery to remain inside construction footprint. All labourers to be informed of disciplinary actions for the wilful damage to plants; Indiscriminant damage of vegetation to be avoided. 	Continuous throughout the construction phase.	Contractor
Fauna	<ul style="list-style-type: none"> Habitat destruction; Destruction of RDL and displacement of sensitive species; Impacts on faunal biodiversity. 	<ul style="list-style-type: none"> Movement of personnel and machinery to be limited to the areas designated for the established servitude area; Riparian zones of the Orange River are designated as ecologically sensitive areas. No unnecessary movement of heavy machinery should be allowed within this habitat unit to retain its features; Dumping or storage of topsoil must not be done on established vegetation, but should remain within the construction footprint. Workers and machinery to remain inside construction footprint. All labourers to 	Continuous throughout the construction phase.	Contractor

Environmental Consideration	Environmental Impacts	Mitigation Measures	Time Frames	Responsible Party
		<ul style="list-style-type: none"> be informed of disciplinary actions for the wilful damage to habitat. Indiscriminate damage of the environment to be avoided. 		
Soil	<ul style="list-style-type: none"> Excavations required for the pipeline will disturb soils that have settled and make them vulnerable to erosion; Pollution of soil will adversely affect vegetation and habitat integrity. 	<ul style="list-style-type: none"> Excavated soils should be reinstated and adequately landscaped; The source of the pollution must immediately be identified and rectified; Polluted soils should be immediately cleaned and transferred to an appropriate registered landfill site; Subsequentially removed soils should be replaced with unpolluted soils of similar geological, chemical and pedological characteristics. 	Following the construction phase.	Contractor
	<ul style="list-style-type: none"> Compaction of soils leading to lowered potential for re-vegetation 	<ul style="list-style-type: none"> Soil should be shallow-ripped and scoured prior to replanting and placing of a geotextile layer (on steep topographies) to avoid soil erosion. Heavy machinery should be limited to designated roadways. 	Following the construction phase	Contractor

Table 889: Mitigation measures proposed for the *Operations* phase of the proposed development activities.

Environmental Consideration	Environmental Impacts	Mitigation Measures
Flora	<ul style="list-style-type: none"> Damage to plant life outside of the footprint area; Encroachment of alien vegetation following site disturbances. 	<ul style="list-style-type: none"> Ecologically sensitive areas should be retained as prohibited areas to workers; Workers and machinery to remain inside construction footprint. All labourers to be informed of disciplinary actions for the wilful damage to plants; Encroachment of alien vegetation to be monitored for regularly and controlled.
Fauna	<ul style="list-style-type: none"> Ongoing impacts that will affect avifaunal biodiversity; Collisions of avifauna with antennae and anchor cabling. 	<ul style="list-style-type: none"> Ecologically sensitive areas should be retained as prohibited areas to workers; Workers and machinery to remain inside construction footprint. All labourers to be informed of disciplinary actions for the wilful damage to plants and animals; Maintenance crews to monitor for bird collisions and to mitigate for this impact if found to be necessary.
General	<ul style="list-style-type: none"> Excavations of soils to gain access to the pipeline during planned and unplanned maintenance procedures will disturb settled soils, potentially leading to formation of erosion; Smothering of habitat through storage of excavated soils. 	<ul style="list-style-type: none"> The relevant mitigation measures proposed for the construction phase should be carried forward to operations, where potential environmental impacts may still occur. Special conditions relating to operations, as stipulated in the RoD, need to be adhered to. The contractor must perform appropriate maintenance functions, as required. Responsible parties must be competent in the necessary maintenance tasks. Feedback must be provided to the ECO and project proponent on a frequent basis.

Table 9910: Mitigation measures proposed for the *Decommissioning* phase of the proposed development activities.

Environmental Consideration	Environmental Impacts	Mitigation Measures
Flora	<ul style="list-style-type: none"> • Damage to established and naturalised plant life during excavations, unearthing and removal of the pipeline; • Heavy machinery required will impact on vegetation features within adjacent areas; • Soil disturbances will increase opportunism for exotic species encroachment. 	<ul style="list-style-type: none"> • Excavations should be filled and adequately landscaped in order to abate potential erosion; • Heavy machinery should be limited to single access roadways; • Workers and machinery to remain inside construction footprint. All labourers to be informed of disciplinary actions for the wilful damage to plants; • Encroachment of alien vegetation to be monitored for regularly and controlled; • All mitigation measures applicable to the construction phase will be applicable to the decommissioning phase.
Fauna	<ul style="list-style-type: none"> • Ongoing impacts that will affect avifaunal biodiversity; • Collisions of avifauna with antennae and anchor cabling. 	<ul style="list-style-type: none"> • Ecologically sensitive areas should be retained as prohibited areas to workers; • Workers and machinery to remain inside construction footprint. All labourers to be informed of disciplinary actions for the wilful damage to plants and animals; • Maintenance crews to monitor for bird collisions and to mitigate for this impact if found to be necessary.
General	<ul style="list-style-type: none"> • Excavations of soils to gain access to the pipeline during planned and unplanned maintenance procedures will disturb settled soils, potentially leading to formation of erosion; • Smothering of habitat through storage of excavated soils. 	<ul style="list-style-type: none"> • The relevant mitigation measures proposed for the construction phase should be carried forward to operations, where potential environmental impacts may still occur. • Special conditions relating to operations, as stipulated in the RoD, need to be adhered to. • The contractor must perform appropriate maintenance functions, as required. Responsible parties must be competent in the necessary maintenance tasks. • Feedback must be provided to the ECO and project proponent on a frequent basis.

5 IMPACT SIGNIFICANCE & RATINGS.

The perceived impacts that will negatively impact on the overall ecological functionality and integrity of the proposed development site and immediate surrounding area are presented in [Table 6](#) according to the impact scores outlined in [Error! Reference source not found.](#)

Table 10496: Rating scores for the various factors used for calculating the significance rating of a particular impact.

Spatial extent		Duration		Intensity		Probability	
Rating	Score	Rating	Score	Rating	Score	Rating	Score
Site specific	1	Short term(0-15yrs)	1	Low	1	Improbable	1
Local	2	Medium (2-15yrs)	2	Moderate	2	Possible	2
Regional	3	Long (16-30yrs)	3	High	3	Highly probable	3
National	4	Permanent	4	Very high	4	Definite	4
International	5						

The impacts identified that could be deleterious to the overall long term ecological functionality and integrity of the proposed development area have been shown to be readily managed to within acceptable limits by the implementation of realistic and achievable mitigation measures ([Table 7](#), [Table 8](#), [Table 9](#) and [Table 10](#)). No impacts of high to very high are assumed to therefore take place ([Table 6](#)). It should be noted, however, 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 sincere efforts of the management and construction teams associated with the project.

6 CONCLUSIONS & RECOMMENDATIONS.

A faunal and floral ecological assessment was undertaken for the area pertaining to the proposed SolAfrica (Pty) Ltd pipeline running from the Orange River through to the Eskom Garona substation. The field survey was undertaken during May 2012.

The following salient conclusions were drawn and recommendations made on completion of the survey:

- The area earmarked for development does not incorporate any areas of particular ecological sensitivity through the association with existing infrastructure (Transnet servitude, railway, existing pipeline) and the transformation of the land and vegetation structures through farming activities (livestock and agriculture). The riparian zones of the Orange River, regardless of present ecological state, is considered an inherently sensitive habitat unit and therefore the impact footprint within this area should be limited as far as possible;
- Two alternative localities have been proposed for the associated pump station. Alternative 1 falls within an area that has retained some natural features. Alternative 2 falls within an existing agricultural field. The ecological impact would be greatest at Alternative 1 and therefore Alternative 2 is the preferred option;
- No Red Data Listed faunal or floral species were noted during the field survey and the habitat quality and present land use is presumed to largely exclude the possibility of these species occurring where they would be impacted by the development activities;

- An impact significance assessment was undertaken, which is presented in [Table 6](#)~~Table 6~~~~Table 7~~, wherein the impacts have been shown to be readily mitigated to reduce the impacts to within acceptable limits;
- Mitigation measures have been proposed in [Table 7](#)~~Table 7~~~~Table 8~~, [Table 8](#)~~Table 8~~~~Table 9~~ and [Table 9](#)~~Table 9~~~~Table 10~~ for the construction, operations and decommissioning phases of the proposed development, respectively.
- It is felt that the implementation of the proposed mitigation measures will allow for the retention of the long term and overall ecological integrity and functionality of the proposed development site and immediate surrounding area.

7. REFERENCES.

- 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.
- Animal Demographic Unit (ADU) is thanked for the use of species data and species lists taken from SARCA (South African Reptile Conservation Assessment) and SAFAP (South African Frog Atlas Project), Department of Zoology, University of Cape Town, Cape Town.
- 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.
- Branch, B. (1998). *Field guide to snakes and other reptiles of southern Africa*. Struik Publishers, Cape Town.
- Bromilow, C. (2001). *Problem plants of South Africa*. Briza Publications, Pretoria.
- Carruthers, V. (2001). *Frogs and frogging in southern Africa*. Struik Publishers, Cape Town.
- Coates-Palgrave, K. (2000). *Trees of southern Africa (2nd edition)*. Struik Publishers, Cape Town.
- Channing, A. (2001). *Amphibians of central and southern Africa*. Cornell University, London.
- 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.
- Court, D. (2010). *Succulent flora of southern Africa (Revised edition)*. Struik Nature, Cape Town.
- Fey, M. (2010). *Soils of South Africa*. Cambridge University Press, Cape Town, South Africa.
- 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.
- Dippenaar-Schoeman, A.S. (2002). *Baboon and trapdoor spiders of southern Africa*. ARC Handbook, No. 13. Agricultural Research Council, Pretoria.
- Du P. Bothma, J. (Editor) (2002). *Game ranch management (4th edition)*. Van Schaik Publishers, Pretoria.
- Department of Water Affairs and Forestry. (2005). *A practical field procedure for identification and delineation of wetlands and riparian areas (1st edition)*. DWAF, Pretoria.
- 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.
- Gildenhuys, P. (2009). *A pictorial guide to the baboon spiders of southern Africa*. Cadiz Street Publishing, Durbanville, Cape Town.
- Harrison J. A., Burger M., Minter L. R., De Villiers A.L., Baard E. H. W., Scott E., Bishop & Ellis S. (2001). *Conservation assessment and management plan for southern African frogs. Final Report*. IUCN/SSC Conservation Breeding Specialist Group: Apple Valley, MN.
- 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. pp 39.
- Manning, L. (2009). *Field guide to wild flowers of South Africa*. Struik Nature, Cape Town.
- Marais, J. (2004). *A complete guide to the snakes of southern Africa*. Struik Publishers, Cape Town.
- Newman, K. (1998). *SAPPI Newman's birds of southern Africa*. Southern Book Publishers, Halfway House (Midrand).
- 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 (2012). The South African National Biodiversity Institute is thanked for the use of data from the National Herbarium, Pretoria (PRE) Computerised Information System (PRECIS) from www.posa.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.
- Shearing, D. and van Heerden, K. (2008). *Karoo: South African wild flower guide 6 (Third impression)*. Botanical Society of South Africa, Claremont.
- Skinner, J.D. and Smithers, R.H.N. (1990). *The mammals of the southern African sub region*. University of Pretoria, Pretoria.
- Skinner, J.D. and Chimimba, C.T. (2005). *The mammals of the southern African subregion – third edition*. Cambridge University Press, Cape Town.
- Smit, N. (1999). *Guide to the acacias of South Africa*. Briza Publications, Pretoria.
- 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 (2012). *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, N. (2001). *Flowering plants of the Kalahari Dunes*. Published by Ekotrust CC.
- 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 Oudtshoorn, B. and Gericke, N. (1997). *Medicinal plants 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.
- Woodhall, S. (2005). *Field guide to butterflies of South Africa*. Struik Publishers, Cape Town.

APPENDIX A - EXPECTED FAUNAL BIODIVERSITY SPECIES LISTS.

Table 11: Expected mammal list (based on known historical distribution lists) for the proposed development site. The RDL status for each species is also given.

Species	Name	Status
<i>Antidorcas marsupialis</i>	Springbok	
<i>Ceratotherium simum</i>	White Rhinoceros	
<i>Diceros bicornis bicornis</i>	Black Rhinoceros - arid ecotype	CE
<i>Giraffa camelopardalis</i>	Giraffe	
<i>Oreotragus oreotragus</i>	Klipspringer	
<i>Oryx gazella</i>	Gemsbok	
<i>Raphicerus campestris</i>	Steenbok	
<i>Sylvicapra grimmia</i>	Common Duiker	
<i>Procavia capensis</i>	Rock Hyrax	
<i>Aonyx capensis</i>	Cape Clawless Otter	
<i>Atilax paludinosus</i>	Water Mongoose	
<i>Canis mesomelas</i>	Black-backed Jackal	
<i>Caracal caracal</i>	Caracal	
<i>Cynictis penicillata</i>	Yellow Mongoose	
<i>Felis silvestris</i>	African Wild Cat	
<i>Galerella pulverulenta</i>	Small Grey Mongoose	
<i>Galerella sanguinea</i>	Slender Mongoose	
<i>Genetta genetta</i>	Small-spotted Genet	
<i>Ictonyx striatus</i>	Striped Polecat	
<i>Mellivora capensis</i>	Honey Badger	NT
<i>Otocyon megalotis</i>	Bat-eared Fox	
<i>Panthera pardus</i>	Leopard	
<i>Proteles cristatus</i>	Aardwolf	
<i>Suricata suricatta</i>	Suricate	
<i>Vulpes chama</i>	Cape Fox	
<i>Cistugo lesueuri</i>	Lesueur's Wing-gland Bat	NT
<i>Neoromicia capensis</i>	Cape Serotine Bat	
<i>Nycteris thebaica</i>	Egyptian Slit-faced Bat	
<i>Nycteris woodi</i>	Wood's Slit-faced Bat	NT
<i>Rhinolophus darlingi</i>	Darling's Horseshoe Bat	NT
<i>Rhinolophus denti</i>	Dent's Horseshoe Bat	NT
<i>Tadarida aegyptiaca</i>	Egyptian Free-tailed Bat	
<i>Crocidura cyanea</i>	Reddish-grey Musk Shrew	DD
<i>Crocidura hirta</i>	Lesser Red Musk Shrew	DD
<i>Lepus capensis</i>	Cape Hare / Desert Hare	
<i>Lepus saxatilis</i>	Scrub / Savannah Hare	
<i>Cercopithecus aethiops pygerythrus</i>	Vervet Monkey	
<i>Papio ursinus</i>	Chacma Baboon	
<i>Aethomys namaquensis</i>	Namaqua Rock Mouse	
<i>Desmodillus auricularis</i>	Short-tailed Gerbil	
<i>Gerbillurus paeba</i>	Hairy-footed Gerbil	
<i>Graphiurus ocellatus</i>	Spectacled Dormouse	
<i>Hystrix africaeaustralis</i>	Porcupine	
<i>Malacothrix typica</i>	Large-eared Mouse	
<i>Mastomys coucha</i>	Multimammate Mouse	
<i>Parotomys brantsii</i>	Brants' Whistling Rat	
<i>Parotomys littledalei</i>	Littledale's Whistling Rat	NT
<i>Pedetes capensis</i>	Springhare	
<i>Rhabdomys pumilio</i>	Striped Mouse	
<i>Saccostomus campestris</i>	Pouched Mouse	
<i>Tatera leucogaster</i>	Bushveld Gerbil	DD
<i>Xerus inauris</i>	Cape Ground Squirrel	
<i>Macroscelides proboscideus</i>	Round-eared Elephant-shrew	

Species	Name	Status
<i>Orycteropus afer</i>	Aardvark	

Table 12: Expected bird list (based on known historical distribution lists) for the proposed development site. General status and habitat preferences are also given (Gibbon, 2002). The observed species during the field assessment are indicated as bold text. Abbreviation explanations are given in [Table 13](#).

Rob	English Name	Species	Status	Endemic Status	General Status	Habitats
1	Ostrich	<i>Struthio camelus</i>			R-C	BW, Ki, Gr, Ko, Ds, Fy, Fa
7	Blacknecked Grebe	<i>Podiceps nigricollis</i>			R (n)-U	Wa, Ms
8	Dabchick	<i>Tachybaptus ruficollis</i>			R-C	Wa
55	Whitebreasted Cormorant	<i>Phalacrocorax lucidus</i>			R-C	Wa, Ms
58	Reed Cormorant	<i>Phalacrocorax africanus</i>			R-C	Wa
60	Darter	<i>Anhinga rufa</i>			R-C	Wa
62	Grey Heron	<i>Ardea cinerea</i>			R-C	Wa
63	Blackheaded Heron	<i>Ardea melanocephala</i>			R-C	Gr, Fa, Wa
64	Goliath Heron	<i>Ardea goliath</i>			R-U	Wa
65	Purple Heron	<i>Ardea purpurea</i>			R-U	Wa
67	Little Egret	<i>Egretta garzetta</i>			R-C	Wa
68	Yellowbilled Egret	<i>Egretta intermedia</i>			R-U	Wa
71	Cattle Egret	<i>Bubulcus ibis</i>			R-C	BW, Gr, Fa, Wa
76	Blackcrowned Night Heron	<i>Nycticorax nycticorax</i>			R-C	Wa
78	Little Bittern	<i>Ixobrychus minutus</i>			R/NBM-U	Wa
81	Hamerkop	<i>Scopus umbretta</i>			R-C	Wa
83	White Stork	<i>Ciconia ciconia</i>			NBM-C	BW, Ki, Gr, Ko, Mo, Fa
84	Black Stork	<i>Ciconia nigra</i>	NT		R-U/R	RC, Fa, Wa
85	Abdim's Stork	<i>Ciconia abdimii</i>			NBM-C	Ki, Gr, Ko, Fa, Wa
89	Marabou Stork	<i>Leptoptilos crumeniferus</i>	NT		R-R/LC	BW, Wa
91	Sacred Ibis	<i>Threskiornis aethiopicus</i>			R-C	Gr, Fa, Wa
94	Hadeda Ibis	<i>Bostrychia hagedash</i>			R-A	Fo, BW, Gr, To, Fa, Wa
95	African Spoonbill	<i>Platalea alba</i>			R (n)-C	Wa
96	Greater Flamingo	<i>Phoenicopterus ruber</i>	NT		R (n)-LA	Wa, Ms
97	Lesser Flamingo	<i>Phoenicopterus minor</i>	NT		R (n)-LA	Wa, Ms
102	Egyptian Goose	<i>Alopochen aegyptiacus</i>			R-A	Fa, Wa
103	South African Shelduck	<i>Tadorna cana</i>		Endemic	E-C	Wa
104	Yellowbilled Duck	<i>Anas undulata</i>			R-A	Wa
105	African Black Duck	<i>Anas sparsa</i>			R-U	RC, Wa
106	Cape Teal	<i>Anas capensis</i>			R-C	Wa
108	Redbilled Teal	<i>Anas erythrorhyncha</i>			R-C	Wa
112	Cape Shoveller	<i>Anas smithii</i>		Near-endemic	Er-C	Wa
113	Southern Pochard	<i>Netta erythrophthalma</i>			R-C	Wa
116	Spurwinged Goose	<i>Plectropterus gambensis</i>			R-VC	Fa, Wa
117	Maccoa Duck	<i>Oxyura maccoa</i>			R-U	Wa
118	Secretarybird	<i>Sagittarius serpentarius</i>	NT		R-U	BW, Ki, Gr, Ko, Ds, Fy, Mo, Fa
123	White-backed Vulture	<i>Gyps africanus</i>	VU		R-C	BW, Ki, Ko, Ds
124	Lappet-faced Vulture	<i>Torgos tracheliotus</i>	VU		R-U	BW, Ki, Ko, Ds
126	Black Kite	<i>Milvus migrans</i>			NBM-LC	BW, Ko, Ds, Fa
126.1	Yellowbilled Kite	<i>Milvus aegyptius</i>			BM-C	Fo, BW, Gr, To, Fa
127	Blackshouldered Kite	<i>Elanus caeruleus</i>			R (n)-C	BW, Gr, Ko, Ds, Fa
131	Black Eagle	<i>Aquila verreauxii</i>			R-U	Mo, RC
132	Tawny Eagle	<i>Aquila rapax</i>	VU		R-LC	BW, Ki
136	Booted Eagle	<i>Hieraaetus pennatus</i>			R/NBM-C	BW, Ki, Gr, Ko, Fy, Mo, Fa

Rob	English Name	Species	Status	Endemic Status	General Status	Habitats
140	Martial Eagle	<i>Polemaetus bellicosus</i>	VU		R-U	BW, Ki, Gr, Ko, Ds
143	Blackbreasted Snake Eagle	<i>Circaetus pectoralis</i>			R-U	BW, Ki, Ko, Ds, Fa
148	African Fish Eagle	<i>Haliaeetus vocifer</i>			R-C	Wa, Ms
149	Steppe Buzzard	<i>Buteo vulpinus</i>			NBM-C	BW, Gr, Ko, Fa
152	Jackal Buzzard	<i>Buteo rufofuscus</i>		Endemic	E-C	Gr, Ko, Ds, Mo, RC, Fa
162	Southern Pale Chanting Goshawk	<i>Melierax canorus</i>		Near-endemic	Er-C	BW, Ki, Ko, Ds
166	Montagu's Harrier	<i>Circus pygargus</i>			NBM-R	Ki, Gr
168	Black Harrier	<i>Circus maurus</i>	NT	Endemic	E-U	Ki, Gr, Ko, Ds, Fy, Mo, Fa
169	Gymnogene	<i>Polyboroides typus</i>			R-C	Fo, BW, Ko, RC
171	Peregrine Falcon	<i>Falco peregrinus</i>	NT		R/NBM-R	Fo, Gr, Ko, Ds, Mo, RC, To
172	Lanner Falcon	<i>Falco biarmicus</i>	NT		R-C	BW, Ki, Ko, Ds, Fy, Mo, RC, To, Fa
178	Rednecked Falcon	<i>Falco chicquera</i>			R-R	BW, Ki, Ko, Ds
181	Rock Kestrel	<i>Falco rupicolis</i>			R-C	Ki, Gr, Ko, Ds, Fy, Mo, RC, Fa
182	Greater Kestrel	<i>Falco rupicoloides</i>			R-C	BW, Ki, Gr, Ko, Ds, Fa
183	Lesser Kestrel	<i>Falco naumanni</i>	VU		NBM-VC	Gr, Ko, To, Fa
186	Pygmy Falcon	<i>Polihierax semitorquatus</i>			R-C	Ki
200	Common Quail	<i>Coturnix coturnix</i>			R/BM/NBM-C	Ki, Gr, Ko, Mo, Fa
203	Helmeted Guineafowl	<i>Numida meleagris</i>			R-VC	BW, Ki, Gr, Ko, Fa
205	Kurriichane Buttonquail	<i>Turnix sylvatica</i>			R (n)-U/LC	BW, Gr, Fa
210	African Rail	<i>Rallus caerulescens</i>			R/BM-C	Wa
213	Black Crake	<i>Amaurornis flavirostris</i>			R-C	Wa
223	Purple Gallinule	<i>Porphyrio madagascariensis</i>			R-C	Wa
226	Common Moorhen	<i>Gallinula chloropus</i>			R-C	Wa
228	Redknobbed Coot	<i>Fulica cristata</i>			R-A	Wa
230	Kori Bustard	<i>Ardeotis kori</i>	VU		R-R	BW, Ki, Gr, Ko, Ds
232	Ludwig's Bustard	<i>Neotis ludwigii</i>	VU	Near-endemic	Er-U	Gr, Ko, Ds
235	Karoo Korhaan	<i>Eupodotis vigorsii</i>		Endemic	E-C	Ko
237	Redcrested Korhaan	<i>Eupodotis ruficrista</i>			Es-C	BW, Ki
239.1	Whitewinged Korhaan	<i>Eupodotis afroaoides</i>			E-VC	Ki, Ko, Ds
247	Chestnutbanded Plover	<i>Charadrius pallidus</i>	NT		R-U	Wa, Ms
248	Kittlitz's Plover	<i>Charadrius pecuarius</i>			R-C	Gr, Wa, Ms
249	Threebanded Plover	<i>Charadrius tricollaris</i>			R-C	Wa, Ms
252	Caspian Plover	<i>Charadrius asiaticus</i>			NBM-U	BW, Ki, Gr
255	Crowned Plover	<i>Vanellus coronatus</i>			R-C	BW, Ki, Gr, Ko, Fy, To, Fa
258	Blacksmith Plover	<i>Vanellus armatus</i>			R-VC	Gr, Wa
264	Common Sandpiper	<i>Actitis hypoleucos</i>			NBM-C	Gr, Wa, Ms
266	Wood Sandpiper	<i>Tringa glareola</i>			NBM-C	Wa
269	Marsh Sandpiper	<i>Tringa stagnatilis</i>			NBM-C	Wa, Ms
270	Greenshank	<i>Tringa nebularia</i>			NBM-C	Wa, Ms
272	Curlew Sandpiper	<i>Calidris ferruginea</i>			NBM-VC	Wa, Ms
274	Little Stint	<i>Calidris minuta</i>			NBM-C	Wa, Ms
281	Sanderling	<i>Calidris alba</i>			NBM-C	Wa, Ms
284	Ruff	<i>Philomachus pugnax</i>			NBM-C	Gr, Wa
290	Whimbrel	<i>Numenius phaeopus</i>			NBM-C	Wa, Ms
294	Pied Avocet	<i>Recurvirostra avosetta</i>			R-LC	Wa, Ms
295	Blackwinged Stilt	<i>Himantopus himantopus</i>			R-C	Wa, Ms
297	Spotted Dikkop	<i>Burhinus capensis</i>			R-C	BW, Ki, Gr, Ko, Ds, Fy, To, Fa, Ms

Rob	English Name	Species	Status	Endemic Status	General Status	Habitats
299	Burchell's Courser	<i>Cursorius rufus</i>		Near-endemic	Er-U	Ki, Gr, Ko, Ds, Fy, Fa
300	Temminck's Courser	<i>Cursorius temminckii</i>			R-U	BW, Ki, Gr, Fa
301	Doublebanded Courser	<i>Rhinoptilus africanus</i>			R-LC	Ki, Gr, Ko, Ds
315	Greyheaded Gull	<i>Larus cirrocephalus</i>			R-VC	Wa, Ms
338	Whiskered Tern	<i>Chlidonias hybridus</i>			R (n)-LC	Wa
339	Whitewinged Tern	<i>Chlidonias leucopterus</i>			NBM-A	Wa
344	Namaqua Sandgrouse	<i>Pterocles namaqua</i>		Near-endemic	Er-C	Ki, Ko, Ds
345	Burchell's Sandgrouse	<i>Pterocles burchelli</i>		Near-endemic	E-C	Ki
347	Double-banded Sandgrouse	<i>Pterocles bicinctus</i>		Near-endemic	Er-C	BW, Ki, Ko, Ds
348	Feral Pigeon	<i>Columba livia</i>			R-A	To, Fa
349	Rock Pigeon	<i>Columba guinea</i>			R-C	Mo, RC, To, Fa
352	Redeyed Dove	<i>Streptopelia semitorquata</i>			R-C	Fo, BW, To, Fa
354	Cape Turtle Dove	<i>Streptopelia capicola</i>			R-VC	BW, Ki, Gr, Ko, Ds, Fy, To, Fa
355	Laughing Dove	<i>Streptopelia senegalensis</i>			R-VC	BW, Ki, Gr, Ko, Ds, Fy, To, Fa
356	Namaqua Dove	<i>Oena capensis</i>			R-VC	BW, Ki, Gr, Ko, Ds, To, Fa
382	Jacobin Cuckoo	<i>Clamator jacobinus</i>			BM-C	BW, Ki
386	Diederik Cuckoo	<i>Chrysococcyx caprius</i>			BM-VC	BW, Ki, Gr, Ko, Fy, To, Fa
392	Barn Owl	<i>Tyto alba</i>			R-C	BW, Ki, Gr, Ko, Ds, Fy, RC, To, Fa
397	Whitefaced Owl	<i>Ptilopus granti</i>			R-C	BW, Ki
398	Pearlspotted Owl	<i>Glaucidium perlatum</i>			R-C	BW, Ki
401	Spotted Eagle Owl	<i>Bubo africanus</i>			R-C	Fo, BW, Ki, Gr, Ko, Ds, Fy, RC, To, Fa
402	Giant Eagle Owl	<i>Bubo lacteus</i>			R-U	BW, Ki
404	Eurasian Nightjar	<i>Caprimulgus europaeus</i>			R-U	BW, Ki, To, Fa
406	Rufouscheeked Nightjar	<i>Caprimulgus rufigena</i>			BM-C	BW, Ki, Ko, Ds, Fa
408	Freckled Nightjar	<i>Caprimulgus tristigma</i>			R-C	RC
411	Eurasian Swift	<i>Apus apus</i>			NBM-C	BW, Ki, Gr, Ko, Ds, Fy, Mo, RC, To, Fa
413	Bradfield's Swift	<i>Apus bradfieldi</i>		Near-endemic	Er-C	Ko, Ds, Mo, RC, To
415	Whiterumped Swift	<i>Apus caffer</i>			BM-VC	Ko, Ds, Mo, RC, To, Fa
416	Horus Swift	<i>Apus horus</i>			BM-LC	Gr, Mo, RC, Fa, Wa
417	Little Swift	<i>Apus affinis</i>			R/BM-VC	BW, Gr, Ko, Ds, Fy, Mo, RC, To, Fa
418	Alpine Swift	<i>Tachymarptis melba</i>			BM-C	BW, Ki, Gr, Ko, Ds, Fy, Mo, RC, Fa
421	Palm Swift	<i>Cypsiurus parvus</i>			R-C	BW, To
425	White-backed Mousebird	<i>Colius colius</i>		Endemic	E-C	Ko, Ds, To
426	Redfaced Mousebird	<i>Urocolius indicus</i>			R-C	BW, Ko, Fy, To, Fa
428	Pied Kingfisher	<i>Ceryle rudis</i>			R-C	Wa, Ms
429	Giant Kingfisher	<i>Megaceryle maxima</i>			R-U	Wa, Ms
431	Malachite Kingfisher	<i>Alcedo cristata</i>			R-C	Wa
437	Striped Kingfisher	<i>Halcyon chelicuti</i>			R-C	BW
438	Eurasian Bee-eater	<i>Merops apiaster</i>			NBM/BM-C	BW, Ki, Gr, Ko, Ds, Fa
445	Swallowtailed Bee-eater	<i>Merops hirundineus</i>			R-LC	BW, Ki, Ko, Ds
446	Eurasian Roller	<i>Coracias garrulus</i>			NBM-C	BW, Ki, Gr, Fa
451	African Hoopoe	<i>Upupa africana</i>			R (n)-C	BW, Ki, Ko, Ds, To, Fa

Rob	English Name	Species	Status	Endemic Status	General Status	Habitats
454	Scimitar-billed Woodhoopoe	<i>Rhinopomastus cyanomelas</i>			R-C	BW, Ki
465	Acacia Pied Barbet	<i>Tricholaema leucomelas</i>		Near-endemic	Er-C	BW, Ki, Gr, Ko, Ds, To, Fa
476	Lesser Honeyguide	<i>Indicator minor</i>			R-LC	BW, To, Fa, Wa
483	Goldentailed Woodpecker	<i>Campethera abingoni</i>			R-C	Fo, BW, Ki, RC, To
486	Cardinal Woodpecker	<i>Dendropicos fuscescens</i>			R-C	Fo, BW, Ki, Ko, Ds, Fy, RC, To, Fa
493	Monotonous Lark	<i>Mirafra passerina</i>		Near-endemic	Er-C	BW, Ki
495.2	Eastern Clapper Lark	<i>Mirafra fasciolata</i>		Near-endemic	Er-C	Ki, Gr, Ko, Fa
497	Fawn-coloured Lark	<i>Calendulauda africanoides</i>			R-C	BW, Ki
498.1	Bradfield's Lark	<i>Calendulauda bradfieldi</i>				Ki, Gr, Ko, Ds
506	Spikeheeled Lark	<i>Chersomanes albofasciata</i>		Near-endemic	Er-C	Ki, Gr, Ko, Ds
507	Redcapped Lark	<i>Calandrella cinerea</i>			R (n)-C	BW, Ki, Gr, Ko, Ds, Fy, Mo, Fa
508	Pink-billed Lark	<i>Spizocorys conirostris</i>		Near-endemic	Er-C	Ki, Gr, Ko, Fa
510	Sclater's Lark	<i>Spizocorys sclateri</i>	NT	Endemic	E-U	Ko
511	Stark's Lark	<i>Spizocorys starki</i>		Near-endemic	Er-C	Ko, Ds
516	Greybacked Sparrowlark	<i>Eremopterix verticalis</i>		Near-endemic	Er-VC	Ki, Gr, Ko, Ds, Fa
517	Black-eared Finchlark	<i>Eremopterix australis</i>		Endemic	E-C	Ki, Ko
518	Eurasian Swallow	<i>Hirundo rustica</i>			NBM-A	BW, Ki, Gr, Ko, Ds, Fy, Mo, To, Fa, Wa
520	Whitethroated Swallow	<i>Hirundo albigularis</i>			BM-C	Gr, RC, To, Fa
523	Pearlbreasted Swallow	<i>Hirundo dimidiata</i>			R/BM-C	BW, Fa
526	Greater Striped Swallow	<i>Hirundo cucullata</i>			BM-C	Ki, Gr, Ko, Fy, Mo, RC, To, Fa
528	South African Cliff Swallow	<i>Hirundo spilodera</i>		Breeding-endemic	Ebm-LC	BW, Gr, Fa
529	Rock Martin	<i>Hirundo fuligula</i>			R-C	Ki, Mo, RC, To, Fa
532	Sand Martin	<i>Riparia riparia</i>			NBM-C	Gr, Fa, Wa
533	Brownthroated Martin	<i>Riparia paludicola</i>			R-C	Gr, Wa
541	Forktailed Drongo	<i>Dicrurus adsimilis</i>			R-C	BW, Ki, RC, To, Fa
543	Eurasian Golden Oriole	<i>Oriolus oriolus</i>			NBM-U	BW, Ki, Fa
547	Black Crow	<i>Corvus capensis</i>			R-C	BW, Gr, Ko, Ds, Mo, Fa
548	Pied Crow	<i>Corvus albus</i>			R-A	BW, Gr, Ko, Ds, To, Fa
552	Ashy Tit	<i>Parus cinerascens</i>		Near-endemic	Er-U	BW, Ki
557	Cape Penduline Tit	<i>Anthoscopus minutus</i>		Near-endemic	Er-C	BW, Ki, Ko, Ds, Fy, Fa
567	African Red-eyed Bulbul	<i>Pycnonotus nigricans</i>		Near-endemic	Er-VC	BW, Gr, Ko, Ds, To, Fa
577.1	Karoo Thrush	<i>Turdus smithi</i>		Endemic	E-C	Fo, To, Fa
580	Groundscraper Thrush	<i>Psophocichla litsipsirupa</i>			R-C	BW, Ki, To, Fa
583	Short-toed Rock-thrush	<i>Monticola brevipes</i>		Near-endemic	Er-U	RC, To
586	Mountain Chat	<i>Oenanthe monticola</i>		Near-endemic	Er-C	Ko, Ds, Mo, RC, To, Fa
587	Capped Wheatear	<i>Oenanthe pileata</i>			R/BM-C	BW, Ki, Gr, Ko, Fa

Rob	English Name	Species	Status	Endemic Status	General Status	Habitats
589	Familiar Chat	<i>Cercomela familiaris</i>			R-C	BW, Ki, Gr, Ko, Ds, Fy, Mo, RC, To, Fa
590	Tractrac Chat	<i>Cercomela tractrac</i>		Near-endemic	Er-C	Ko, Ds
591	Sicklewinged Chat	<i>Cercomela sinuata</i>		Endemic	E-C	Gr, Ko, Fy, Mo, Fa
592	Karoo Chat	<i>Cercomela schlegelii</i>		Near-endemic	Er-C	Ko, Ds, Fa
595	Anteating Chat	<i>Myrmecocichla formicivora</i>		Endemic	E-C	Ki, Gr, Ko, Fa
601	Cape Robin	<i>Cossypha caffra</i>			R-C	Fo, Fy, RC, To
614	Karoo Robin	<i>Cercotrichas coryphoeus</i>		Endemic	E-C	Ko, Fy
615	Kalahari Robin	<i>Cercotrichas paena</i>		Near-endemic	Er-C	BW, Ki
619	Garden Warbler	<i>Sylvia borin</i>			NBM-C	Fo, BW, To
621	Chestnut-vented Tit-Babbler	<i>Parisoma subcaeruleum</i>		Near-endemic	Er-C	BW, Ki, Ko, Ds
622	Layard's Tit-babbler	<i>Parisoma layardi</i>		Endemic	E-U	Ko, Ds, Mo, RC
625	Icterine Warbler	<i>Hippolais icterina</i>			NBM-C	BW, Ki
631	African Marsh Warbler	<i>Acrocephalus baeticatus</i>			BM-C	Wa
635	Cape Reed Warbler	<i>Acrocephalus gracilirostris</i>			R-C	Wa
643	Willow Warbler	<i>Phylloscopus trochilus</i>			NBM-VC	Fo, BW, Ki, To, Fa
651	Longbilled Crombec	<i>Sylvietta rufescens</i>			R-C	BW, Ki, Ko
653	Yellowbellied Eremomela	<i>Eremomela icteropygialis</i>			R-U	BW, Ki, Ko, Ds
664	Fantailed Cisticola	<i>Cisticola juncidis</i>			R-VC	Gr, Fa
665	Desert Cisticola	<i>Cisticola aridulus</i>			R-C	Gr, Fa
669	Grey-backed Cisticola	<i>Cisticola subruficapilla</i>		Near-endemic	Er-C	Gr, Ko, Ds, Fy, Mo
677	Levaillant's Cisticola	<i>Cisticola tinniens</i>			R-C	Gr, Fa, Wa
685	Blackchedsted Prinia	<i>Prinia flavicans</i>		Near-endemic	Er-C	BW, Ki, Gr, Ds, To, Fa
687	Namaqua Warbler	<i>Phragmacia substriata</i>		Endemic	E-LC	Ko
688	Rufous-eared Warbler	<i>Malcorus pectoralis</i>		Endemic	E-C	Ki, Ko, Ds
689	Spotted Flycatcher	<i>Muscicapa striata</i>			NBM-C	BW, Ki, Ko, To, Fa
697	Chat Flycatcher	<i>Bradornis infuscatus</i>		Near-endemic	Er-C	Ki, Ko, Ds
698	Fiscal Flycatcher	<i>Sigelus silens</i>		Endemic	E-C	BW, Ko, To
703	Pirit Batis	<i>Batis pririt</i>		Near-endemic	Er-C	Ki, Ko, Ds
706	Fairy Flycatcher	<i>Stenostira scita</i>		Endemic	E-C	BW, Ko, Fy, Mo, To, Fa
711	African Pied Wagtail	<i>Motacilla aguimp</i>			R-C	RC, To, Fa, Wa, Ms
713	Cape Wagtail	<i>Motacilla capensis</i>			R-C	Gr, Fy, To, Fa, Wa
716	Grassveld Pipit	<i>Anthus cinnamomeus</i>			R-C	BW, Gr, Fa
721	Rock Pipit	<i>Anthus crenatus</i>		Endemic	E-LC	Ko, Mo, RC
731	Lesser Grey Shrike	<i>Lanius minor</i>			NBM-C	BW, Ki, Gr
732	Fiscal Shrike	<i>Lanius collaris</i>			R-C	BW, Ki, Gr, Ko, Ds, Fy, Mo, To, Fa
733	Redbacked Shrike	<i>Lanius collurio</i>			NBM-C	BW, Ki, Gr, Fa
739	Crimson-breasted Shrike	<i>Laniarius atrococcineus</i>		Near-endemic	Er-C	BW, Ki, Ko, Ds
741	Brubru	<i>Nilaus afer</i>			R-C	BW
746	Bokmakierie	<i>Telophorus zeylonus</i>		Near-endemic	Er-C	Gr, Ko, Ds, Fy, RC, To, Fa
759	Pied Starling	<i>Spreo bicolor</i>		Endemic	E-C	Gr, Ko, Fy, Mo, To, Fa
760	Wattled Starling	<i>Creatophora cinerea</i>			R (n)-LA	BW, Ki, Gr, Ko, Ds, To, Fa
764	Glossy Starling	<i>Lamprotornis nitens</i>			Er-C	BW, Ki, Ko, Ds, To, Fa

Rob	English Name	Species	Status	Endemic Status	General Status	Habitats
770	Pale-winged Starling	<i>Onychognathus nabouroup</i>		Near-endemic	Er-C	Ko, Ds, RC
779	Marico Sunbird	<i>Cinnyris mariquensis</i>			R-C	BW, To
783	Southern Doublecollared Sunbird	<i>Cinnyris chalybeus</i>		Endemic	E-C	Fo, Fy, Mo, To
788	Dusky Sunbird	<i>Cinnyris fuscus</i>		Near-endemic	Er-C	Ko, Ds
796.1	Orange River White-eye	<i>Zosterops pallidus</i>		Endemic	E-VC	Fo, BW, Ko, Fy, To, Fa
799	Whitebrowed Sparrowweaver	<i>Plocepasser mahali</i>			R-VC	BW, Ki, Fa
800	Sociable Weaver	<i>Philetairus socius</i>		Endemic	E-C	BW, Ki
801	House Sparrow	<i>Passer domesticus</i>			R-VC	To, Fa
803	Cape Sparrow	<i>Passer melanurus</i>		Near-endemic	Er-VC	BW, Ki, Ko, Ds, Fy, To, Fa
804	Southern Greyheaded Sparrow	<i>Passer diffusus</i>			Er-C	BW, Ki, Ko, To, Fa
806	Scalyfeathered Finch	<i>Sporopipes squamifrons</i>		Near-endemic	Er-C	BW, Ki, Ko, Ds, Fa
814	Masked Weaver	<i>Ploceus velatus</i>			R-C	BW, Ki, Gr, Ko, Ds, Mo, To, Fa, Wa
821	Redbilled Quelea	<i>Quelea quelea</i>			R (n)-LA	BW, Ki, Gr, Fa
824	Red Bishop	<i>Euplectes orix</i>			R-C	Gr, To, Fa, Wa
834	Melba Finch	<i>Pytilia melba</i>			R-C	BW, Ki, Ko, Ds
842	Redbilled Firefinch	<i>Lagonosticta senegala</i>			R-C	BW, Gr, Ko, To, Fa
845	Violeteared Waxbill	<i>Granatina granatina</i>			Er-LC	BW, Ki, Fa
846	Common Waxbill	<i>Estrilda astrild</i>			R-C	Gr, To, Fa, Wa
847	Blackcheeked Waxbill	<i>Estrilda erythronotos</i>			R-LC	BW, Ki
852	Quail Finch	<i>Ortygospiza atricollis</i>			R-C	Gr
856	Redheaded Finch	<i>Amadina erythrocephala</i>		Near-endemic	Er-VC	Gr, Fa
860	Pintailed Whydah	<i>Vidua macroura</i>			R (n)-C	BW, Gr, To, Fa
870	Blackthroated Canary	<i>Serinus atrogularis</i>			R-C	BW, Ki, Gr, Ko, Ds, Fy, To, Fa
876	Blackheaded Canary	<i>Alario alario</i>			E-U	Ko, Ds, To, Fa
876.1	Damara Canary	<i>Alario leucolaema</i>			E-U	Ko, Ds
878	Yellow Canary	<i>Serinus flaviventris</i>			Er-C	Ki, Gr, Ko, Ds, Fy, Mo, To, Fa
879	Whitethroated Canary	<i>Serinus albogularis</i>			Er-C	Ko, Ds
885	Cape Bunting	<i>Emberiza capensis</i>		Near-endemic	R-C	Ko, Ds, Fy, Mo, RC
887	Lark-like Bunting	<i>Emberiza impetuani</i>		Near-endemic	Er-VC	Ko, Ds, Fy

Table 13: Abbreviation explanations for [Table 12](#) [Table 12](#) [Table 12](#).

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 species Ebr = species with breeding range wholly confined to southern	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 Mo = Mountains RC = Rocks and Cliffs To = Towns and Gardens Fa = Farmland

Status	Occurrence	Endemic Status	Red Data Species	Habitats
		Africa.		Wa = Wetland (Inland Water) Mp = Marine pelagic Ms = Marine Shoreline

Table 14: Expected reptile list (based on known historical distribution lists) for the proposed development site. RDL status is also given.

Species	Common name	Red list category	Atlas region endemic
<i>Acontias kgalagadi kgalagadi</i>	Striped Blind Legless Skink		0
<i>Acontias lineatus</i>	Striped Dwarf Legless Skink		0
<i>Agama aculeata aculeata</i>	Common Ground Agama		0
<i>Agama anchietae</i>	Anchieta's Agama		0
<i>Agama atra</i>	Southern Rock Agama		0
<i>Aspidelaps lubricus lubricus</i>	Coral Shield Cobra		0
<i>Bitis arietans arietans</i>	Puff Adder		0
<i>Bitis caudalis</i>	Horned Adder		0
<i>Boaedon capensis</i>	Brown House Snake		0
<i>Chamaeleo dilepis</i>	Flap-neck chameleon		
<i>Chondrodactylus angulifer angulifer</i>	Common Giant Ground Gecko		0
<i>Chondrodactylus bibronii</i>	Bibron's Gecko		0
<i>Chondrodactylus turneri</i>	Turner's Gecko		0
<i>Colopus wahlbergi wahlbergi</i>	Kalahari ground gecko		1
<i>Colopus wahlbergii furcifer</i>	Striped Ground Gecko		0
<i>Cordylus polyzonus</i>	Karoo girdled lizard		1
<i>Dasypeltis scabra</i>	Rhombic Egg-eater		0
<i>Dipsina multimaclata</i>	Dwarf Beaked Snake		0
<i>Geochelone pardalis</i>	Leopard tortoise		
<i>Gerrhosaurus flavigularis</i>	Yellow-throated plated lizard		
<i>Heliobolus lugubris</i>	Bushveld Lizard		0
<i>Ichnotropis squamulosa</i>	Common rough-scaled lizard		
<i>Karusasaurus polyzonus</i>	Karoo Girdled Lizard		0
<i>Leptotyphlops scutifrons scutifrons</i>	Peter's thread snake		1
<i>Lycophidion capense capense</i>	Cape Wolf Snake		0
<i>Lygodactylus bradfieldi</i>	Bradfield's Dwarf Gecko		0
<i>Trachylepis capensis</i>	Cape skink		
<i>Trachylepis punctatissima</i>	Striped skink		
<i>Meroles suborbitalis</i>	Spotted Desert Lizard		0
<i>Monopeltis infuscata</i>	Dusky spade-snouted worm lizard		
<i>Naja nigricincta woodi</i>	Black Spitting Cobra		0
<i>Naja nivea</i>	Cape Cobra		0
<i>Nucras tessellata</i>	Western Sandveld Lizard		0
<i>Pachydactylus bibronii</i>	Bibron's thick-toed gecko		1
<i>Pachydactylus capensis</i>	Cape thick-toed gecko		1
<i>Pachydactylus capensis</i>	Cape Gecko		0
<i>Pachydactylus latirostris</i>	Quartz Gecko		0
<i>Pachydactylus purcelli</i>	Purcell's Gecko		0
<i>Pachydactylus rugosus</i>	Common Rough Gecko		0
<i>Pedioplanis inornata</i>	Plain Sand Lizard		0
<i>Pedioplanis laticeps</i>	Karoo Sand Lizard		1
<i>Pedioplanis lineocellata</i>	Spotted Sand Lizard		0
<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard		0
<i>Prosymna bivittata</i>	Two-striped Shovel-snout		0
<i>Prosymna sundevallii</i>	Sundevall's Shovel-snout		0
<i>Psammobates oculifer</i>	Serrated Tent Tortoise		0
<i>Psammobates tentorius subsp. ?</i>	Tent Tortoise (subsp. ?)		0
<i>Psammobates tentorius tentorius</i>	Karoo Tent Tortoise		0
<i>Psammobates tentorius verroxii</i>	Verrox's Tent Tortoise		0

Species	Common name	Red list category	Atlas region endemic
<i>Psammophis leightoni trinasalis</i>	Fork-marked sand snake		1
<i>Psammophis notostictus</i>	Karoo Sand Snake		0
<i>Psammophis trinasalis</i>	Fork-marked Sand Snake		0
<i>Pseudaspis cana</i>	Mole Snake		0
<i>Ptenopus garrulus garrulus</i>	Common Barking Gecko		0
<i>Ptenopus garrulus maculatus</i>	Spotted Barking Gecko		0
<i>Rhinotyphlops lalandei</i>	Delalande's Beaked Blind Snake		0
<i>Rhinotyphlops schinzi</i>	Schinz's Beaked Blind Snake		0
<i>Stigmochelys pardalis</i>	Leopard Tortoise		0
<i>Telescopus beetzii</i>	Beetz's Tiger Snake		0
<i>Trachylepis occidentalis</i>	Western Three-striped Skink		0
<i>Trachylepis sparsa</i>	Karasburg Tree Skink		0
<i>Trachylepis spilogaster</i>	Kalahari Tree Skink		0
<i>Trachylepis sulcata sulcata</i>	Western Rock Skink		0
<i>Trachylepis variegata</i>	Variiegated Skink		0
<i>Varanus albigularis albigularis</i>	Rock Monitor		0
<i>Varanus niloticus</i>	Water Monitor		0
<i>Xenocalamus bicolor bicolor</i>	Bicoloured Quill-snouted Snake		0
<i>Zygaspis quadrifrons</i>	Kalahari round-headed worm lizard		

(* Endemic status – 1=Endemic to southern African sub-region; 2=Endemic to SA.)

Table 15: Expected amphibian list (based on known historical distribution lists) for the proposed development site. RDL and endemic status* are also given.

Family	Species	Conservational Status
Pipidae	<i>Xenopus laevis</i>	Least Concern
Ranidae	<i>Tomopterna cryptotis</i>	Least Concern
Hyperoliidae	<i>Kassina senegalensis</i>	Least Concern
Bufo	<i>Bufo poweri</i>	Least Concern
Bufo	<i>Bufo gutturalis</i>	Least Concern
Ranidae	<i>Afrana fuscigula</i>	Least Concern
Hyperoliidae	<i>Kassina senegalensis</i>	Least Concern
Bufo	<i>Bufo gutturalis</i>	Least Concern

APPENDIX B – DETAILS OF THE VEGETATION TYPES ASSOCIATED WITH THE PROPOSED PIPELINE ALIGNMENT ROUTE.

Details of the vegetation units are taken from Mucina & Rutherford (2006).

B1. KALAHARI KARROID SHRUBLAND.

(Synonyms: VT 16 Kalahari Thornveld and Shrub Bushveld (60%) (Acocks, 1953). LR 29 Karroid Kalahari Bushveld (61 %) (Low & Rebelo, 1996)).

Kalahari Karroid Shrubland is characterised by low karroid shrubland on flat, gravel plains. Karoo-related elements (shrubs) meet here with northern floristic elements, indicating a transition to the Kalahari region and sandy soils. It is distributed within the Northern Cape Province where it typically forms belts alternating with belts of *Gordonia* Duneveld on plains northwest of Upington through Lutzputs and Noenieput to the Rietfontein/Mier area in the north. Other patches occur around Kakamas and north of Groblershoop. The unit is also found in the neighbouring Namibia.

The vegetation unit is formed on Cenozoic Kalahari Group sands. Small patches of Kalahari Karroid Shrubland also occur on calcrete outcrops and screes on scarps of intermittent rivers (mekgacha). In places Dwyka Group tillites form outcroppings. The soils are deep (greater than 300 mm), red-yellow, apedal, freely drained, and with a high base status.

Kalahari Karroid Shrubland is considered least threatened, with a target conservation total of 21 %. Very little of the unit is statutorily conserved, mostly within the Augrabies Falls National Park. Although only a small area has been transformed many of the belts of this type were preferred routes for early roads, thus promoting the introduction of alien plants (about a quarter of the unit has scattered *Prosopis* species). Erosion within the unit is very low.

Table 16: Dominant and diagnostic floristic species of Kalahari Karroid Shrubland.

Trees & Shrubs	Forbs	Grasses
<i>Acacia mellifera</i> subsp. <i>detinens</i> , <i>Parkinsonia africana</i> , <i>Boscia foetida</i> subsp. <i>foetida</i> , <i>Rhigozum trichotomum</i> , <i>Tapinanthus oleifolius</i> , <i>Hermannia spinosa</i> , <i>Limeum aethiopicum</i> , <i>Phaeoptilum spinosum</i> , <i>Aizoon schellenbergii</i> , <i>Aptosimum albomarginatum</i> , <i>Aptosimum lineare</i> , <i>Aptosimum marlothii</i> , <i>Aptosimum spinescens</i> , <i>Barleria rigida</i> , <i>Hermannia modesta</i> , <i>Indigofera heterotricha</i> , <i>Leucosphaera bainsii</i> , <i>Monechma genistifolium</i> subsp. <i>genistifolium</i> , <i>Phyllanthus maderaspatensis</i> , <i>Polygala seminuda</i> , <i>Ptycholobium biflorum</i> subsp. <i>biflorum</i> ,	<i>Dicoma capensis</i> , <i>Chamaesyce inaequilatera</i> , <i>Amaranthus praetermissus</i> , <i>Barleria lichtensteiniana</i> , <i>Chamaesyce glanduligera</i> , <i>Chascanum garipense</i> , <i>Cleome angustifolia</i> subsp. <i>diandra</i> , <i>Cucumis africanus</i> , <i>Geigeria ornativa</i> , <i>Hermannia abrotanoides</i> , <i>Indigastrum argyraeum</i> , <i>Indigofera alternana</i> , <i>Indigofera auricoma</i> , <i>Kohautia cynanchica</i> , <i>Limeum argute-carinatum</i> , <i>Mollugo cerviana</i> , <i>Monsonia umbellata</i> , <i>Sesamum capense</i> , <i>Tribulus cristatus</i> , <i>Tribulus pterophorus</i> , <i>Tribulus terrestris</i> , <i>Gisekia africana</i> ,	<i>Aristida adscensionis</i> , <i>Enneapogon desvauxii</i> , <i>Enneapogon scaber</i> , <i>Stipagrostis obtusa</i> , <i>Aristida congesta</i> , <i>Enneapogon cenchroides</i> , <i>Eragrostis annulata</i> , <i>Eragrostis homomalla</i> , <i>Eragrostis porosa</i> , <i>Schmidtia kalahariensis</i> , <i>Stipagrostis anomala</i> , <i>Stipagrostis ciliate</i> , <i>Stipagrostis</i> <i>hochstetteriana</i> , <i>Stipagrostis uniplumis</i> , <i>Tragus berteronianus</i> , <i>Tragus racemosus</i>

Trees & Shrubs	Forbs	Grasses
<i>Sericocoma avolans</i> , <i>Solanum capense</i> , <i>Tephrosia dregeana</i>	<i>Gisekia pharnacioides</i> , <i>Trianthera parvifolia</i>	

Climate.

The area falls within a strongly-seasonal region, with most rain falling in late summer and early autumn. Winters are particularly dry, with the lowest relative humidity when compared to other Nama-Karoo units. Solar radiation is high and in winter is higher than in any other vegetation type of the Nama-Karoo.

B2. 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 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.

Table 17: Dominant and diagnostic floristic species of Gordonia Duneveld.

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

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

Gordonia Duneveld falls within a summer and autumn rainfall region with very dry winters. Frost occurs fairly frequently to frequently in winter.

B3. BUSHMANLAND ARID GRASSLAND.

Bushmanland Arid Grassland

(Synonyms: VT29 Arid Karoo and Desert False Grassveld (36%), VT 32 Orange River Broken Veld (36%) (Acocks 1953) LR 51 Orange River Nama Karoo (51%) (Low & Rebelo 1996)).

Bushmanland Arid Grassland is characterised by extensive to irregular plains on a slightly sloping plateau, which is sparsely vegetated by grasslands dominated by white grasses (*Stipagrostis* species) giving this vegetation type the character of semidesert 'steppe'. In places low *Salsola* shrubs change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected. It is distributed within the Northern Cape Province where it spans about one degree of latitude from around Aggeneys in the west to Prieska in the east. The southern border of the unit is formed by edges of the Bushmanland Basin, while in the northwest this vegetation unit borders on desert vegetation (northwest of Aggeneys and Pofadder). The northern border (in the vicinity of Upington) and the eastern border (between Upington and Prieska) are formed with often intermingling units of Lower Gariiep Broken Veld, Kalahari Karroid Shrubland and Gordonia Duneveld. Most of the western border is formed by the edge of the Namaqualand hills.

Bushmanland Arid Grassland is considered least threatened, with a target conservation value of 21%. Only small patches statutorily conserved, being in Augrabies Falls National Park and Goegab Nature Reserve. Very little of the area has been transformed. Erosion is considered very low to low.

Table 18: Dominant and diagnostic floristic species of Bushmanland Arid Grassland.

Trees/Shrubs	Forbs/Herbs	Grasses/Sedges/Reeds
Small Trees: <i>Acacia mellifera</i> subsp. <i>detinens</i> <i>Boscia foetida</i> subsp. <i>foetida</i>	<i>Acanthopsis hoffmannseggiana</i> <i>Aizoon canariense</i> <i>Amaranthus praetermissus</i> <i>Barleria lichtensteiniana</i> <i>Chamaesyce inaequilatera</i> <i>Dicoma capensis</i> <i>Indigastrum argyraeum</i> <i>Lotononis platycarpa</i> <i>Sesamum capense</i> <i>Tribulus pterophorus</i> <i>T terrestris</i> <i>Vahlia capensis</i>	<i>Aristida adscensionis</i> (d) <i>Aristida congesta</i> (d) <i>Enneapogon desvauxii</i> (d) <i>Eragrostis nindensis</i> (d) <i>Schmidtia kalahariensis</i> (d) <i>Stipagrostis ciliata</i> (d) <i>Stipagrostis obtusa</i> (d) <i>Cenchrus ciliaris</i> <i>Enneapogon scaber</i> <i>Eragrostis annulata</i> <i>Eragrostis porosa</i> <i>Eragrostis procumbens</i> <i>Panicum lenipes</i> <i>Setaria verticillata</i> <i>Sporobolus nervosus</i> <i>Stipagrostis brevifolia</i> <i>Stipagrostis uniplumia</i> <i>Tragus berteronianus</i> <i>Tragus racemosus</i>
Tall Shrubs: <i>Lycium cinereum</i> (d) <i>Rhigozum trichotomum</i> (d) <i>Cadaba aphylla</i> <i>Parkinsonia africana</i>	Succulent Herbs: <i>Gisekia pharnacioides</i> <i>Psilocaulon coriarium</i> <i>Trianthena parvifolia</i>	
Low Shrubs: <i>Aptosimum spinescens</i> (d) <i>Hermannia spinosa</i> (d) <i>Pentzia spinescens</i> (d) <i>Aizoon asbestinum</i> <i>Aizoon schellenbergii</i> <i>Aptosimum elongatum</i> <i>Aizoon lineare</i> <i>Aizoon marlothii</i> <i>Barleria rigida</i> <i>Berkheya annectens</i> <i>Blepharis mitrata</i> <i>Eriocephalus ambiguous</i> <i>Eriocephalus spinescens</i>	Geophytic Herb: <i>Moraea venenata</i>	

Trees/Shrubs	Forbs/Herbs	Grasses/Sedges/Reeds
<i>Limeum aethiopicum</i> <i>Lophiocarpus polystachyus</i> <i>Monechma incanum</i> <i>M. spartioides</i> <i>Pentzia pinnatisecta</i> <i>Phaeoptilum spinosum</i> <i>Polygala seminuda</i> <i>Pteronia leucoclada</i> <i>Pteronia mucronata</i> <i>Pteronia sordid</i> <i>Rosenia humilis</i> <i>Senecio niveus</i> <i>Sericocoma avolans</i> <i>Solanum capense</i> <i>Talinum arnotii</i> <i>Tetragonia arbuscula</i> <i>Zygophyllum microphyllum</i> Succulent Shrubs: <i>Kleinia longiflora</i> <i>Lycium bosciifolium</i> <i>Salsola tuberculata</i> <i>Salsola glabrescens</i>		

Geology & Soils

A third of the unit is covered by recent (Quaternary) alluvium and calcrete. Superficial deposits of the Kalahari Group are also present in the east. The extensive Palaeozoic diamictites of the Dwyka Group also outcrop in the area as do gneisses and metasediments of Mokolian age. The soils of most of the area are red-yellow apedal soils, freely drained, with a high base status and less than 300 mm deep. Only about one fifth of the area has soils deeper than 300 mm.

Climate

The majority of rain falls in late summer to early autumn and is very variable from year to year. Frost incidence ranges from around 10 frost days per year in the northwest to about 35 days in the east.

B4. LOWER GARIEP ALLUVIAL VEGETATION.

Lower Gariep Alluvial Vegetation is characterised by flat alluvial terraces and riverine islands supporting a complex of riparian thickets (dominated by *Ziziphus mucronata*, *Euclea pseudebenus* and *Tamarix usneoides*), reed beds with *Phragmites australis* as well as flooded grasslands and herblands populating sand banks and terraces within and along the river. It is distributed in the Northern Cape Province where it occurs along broad alluvium (floodplains 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).

Lower Gariep Alluvial Vegetation is considered endangered. It has a target conservation value of 31%, but only about 6% is statutorily conserved in the Richtersveld and Augrabies Falls National Parks. Approximately 50% is transformed for agricultural purposes (vegetables and grapes) or alluvial diamond mining. *Prosopis* species, *Nicotiana glauca* and *Argemone ochroleuca* can invade the alluvia in places.

Table 19: Dominant and diagnostic floristic species of Lower Gariep Alluvial Vegetation.

Trees/Shrubs	Forbs/Herbs	Grasses/Sedges/Reeds
<p>Small Trees:</p> <p><i>Acacia karroo</i> (d)</p> <p><i>Euclea pseudebenus</i> (d)</p> <p><i>Salix mucronata</i> subsp. <i>mucronata</i> (d)</p> <p><i>Schotia afra</i> var. <i>angustifolia</i> (d)</p> <p><i>Ziziphus mucronata</i> (d)</p> <p><i>Acacia erioloba</i></p> <p><i>Combretum erythrophyllum</i></p> <p><i>Ficus cordata</i></p> <p><i>Maerua gilgai</i></p> <p><i>Prosopis glandulosa</i> var. <i>glandulosa</i></p> <p><i>Rhus lancea</i></p> <p>Tall Shrubs:</p> <p><i>Gymnosporia linearis</i> (d)</p> <p><i>Tamarix usneoides</i> (d)</p> <p><i>Ehretia rigida</i></p> <p><i>Euclea undulata</i></p> <p><i>Sisyndite spartea</i></p> <p>Low Shrub:</p> <p><i>Asparagus laricinus</i></p> <p>Woody Climber:</p> <p><i>Asparagus retrofractus</i></p> <p>Succulent Shrub:</p> <p><i>Lycium bosciifolium</i></p> <p>Low Shrubs:</p> <p><i>Tetragonia schenckii</i> (d)</p> <p><i>Litogyne gariepina</i></p>	<p><i>Chenopodium olukondae</i></p> <p><i>Amaranthus praetermissus</i></p> <p><i>Coronopus integrifolius</i></p> <p><i>Frankenia pulverulenta</i></p> <p><i>Gnaphalium confine</i></p> <p><i>Pseudognaphalium luteo-album</i></p>	<p><i>Phragmites australis</i> (d)</p> <p><i>Cynodon dactylon</i> (d)</p> <p><i>Setaria verticillata</i> (d)</p> <p><i>Cenchrus ciliaris</i></p> <p><i>Cyperus laevigatus</i></p> <p><i>Eragrostis echinochloidea</i></p> <p><i>Leucophrys mesocoma</i></p> <p><i>Polypogon monspeliensis</i></p> <p><i>Stipagrostis namaquensis</i></p>

Geology, Soil & Hydrology

The unit is formed on recent alluvial deposits of the Orange River supporting soil forms such as Dundee and Oakleaf. The river cuts through a great variety of Precambrian metamorphic rocks. It is subject to floods, especially in summer, caused by high precipitation on the Highveld.

Climate

The region has a very arid (desert) to subarid (semidesert) climate and erratic, unimodal (winter-rainfall) regime in the extreme west (near the Orange River mouth) to bimodal, equinoctial with the major peak in March and less pronounced peak in November in the extreme east (near Upington).