ENVIRONMENTAL IMPACT REPORT:

Specialist ecological study on the potential impacts of the proposed Aggeneis Oranjemond 400 kV Project, Northern Cape

Prepared by

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on behalf of
Eskom

DRAFT REPORT: 2nd draft

David Hoare Consulting cc
Biodiversity Assessments, Vegetation Description / Mapping, Species Surveys

REGULATIONS GOVERNING THIS REPORT

This report has been prepared in terms the EIA Regulations promulgated under the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 545 Section 32 - Specialist reports and reports on specialized processes under the Act. Relevant clauses of the above regulation are quoted below and reflect the required information in the "Control sheet for specialist report" given above.

Regulation 32. (1): An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialized process.

Regulation 32. (2): A specialist report or a report on a specialized process prepared in terms of these Regulations must contain:

(a) details of (i) the person who prepared the report, and
(ii) the expertise of that person to carry out the specialist study or specialized process;

(b) declaration that the person is independent in a form as may be specified by the competent authority;

(c) indication of the scope of, and the purpose for which, the report was prepared;

(d) description of the methodology adopted in preparing the report or carrying out the specialized process;

(e) description of any assumptions made and any uncertainties or gaps in knowledge;

(f) description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;

(g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;

(h) description of any consultation process that was undertaken during the course of carrying out the study;

(i) summary and copies of any comments that were received during any consultation process;

(j) any other information requested by the competent authority.

Appointment of specialist

Dr David Hoare of David Hoare Consulting cc was commissioned by Savannah Environmental (Pty) Ltd to provide specialist consulting services for the Environmental Impact Assessment for the proposed Aggeneis-Oranjemond 400 kV power line in the Northern Cape province. The consulting services comprise an assessment of potential impacts on the flora, fauna, vegetation and ecology in the study area by the proposed project.

Details of specialist

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Summary of expertise

David Hoare:

- PhD in ecology
- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science, Botanical Science), registration number 400221/05.
- Founded David Hoare Consulting cc, an independent consultancy, in 2001.
- Ecological consultant since 1995.
- Conducted, or co-conducted, over 300 specialist ecological surveys as an ecological consultant.
- Published six technical scientific reports, 15 scientific conference presentations, seven book chapters and eight refereed scientific papers.
- Attended 15 national and international congresses & 5 expert workshops, lectured vegetation science / ecology at 2 universities and referee for 2 international journals.

Independence

David Hoare Consulting cc and its Directors have no connection with Eskom. David Hoare Consulting cc is not a subsidiary, legally or financially, of the proponent. Remuneration for services by the proponent in relation to this project is not linked to approval by decision-making authorities responsible for authorising this proposed project and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. David Hoare is an independent consultant to Savannah Environmental (Pty) Ltd and has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of this specialist performing such work. The percentage work received directly or indirectly from the proponent in the last twelve months is approximately 3% of turnover.

Scope and purpose of report

The scope and purpose of the report are reflected in the “Terms of reference” section of this report

Conditions relating to this report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. David Hoare Consulting cc and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from on-going research or further work in this field, or pertaining to this investigation.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

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INTRODUCTION

Terms of reference and approach

Savannah Environmental (Pty) Ltd. was appointed by Eskom to undertake an application for environmental authorisation through an Environmental Impact Assessment (EIA) for the proposed "Aggeneis-Oranjemond 400 kV Transmission Line Project." The project involves the establishment of a new 400 kV transmission line which will connect the Aggeneis and Oranjemond substations in the Northern Cape Province over an approximate distance of 240km. The envisaged project includes the upgrade of both substations to accommodate the new transmission line. The purpose of the EIA is to identify environmental impacts associated with the project.

In September 2010 David Hoare Consulting cc was appointed by Savannah Environmental (Pty) Ltd to undertake an ecological assessment of the study area. The specific terms of reference for the ecological EIA study are as follows:

- An indication of the methodology used in determining the significance of potential environmental impacts;
- A description of the environmental issues that were identified during the environmental impact assessment process;
- An assessment of the significance of direct, indirect and cumulative impacts in terms of standard criteria;
- A description and comparative assessment of all alternatives identified during the environmental impact assessment process;
- Recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Plan;
- An indication of the extent to which the issue could be addressed by the adoption of achievable mitigation measures;
- A description of any assumptions, uncertainties and gaps in knowledge;
- An environmental impact statement which contains
- A summary of the key findings of the environmental impact assessment,
- An assessment of the positive and negative implications of the proposed activity,
- A comparative assessment of the positive and negative implications of the distribution line alternatives,
- A comparative assessment of the positive and negative implications of the access road alternatives.

This report provides details of the results of the EIA phase. The findings of the study are based on a combination of a desktop assessment of the study area, detailed interpretation of aerial photography and fieldwork undertaken on site.

Study area

At a regional level the study area falls within the Northern Cape Province between the town of Aggeneis to the west of the town of Upington and the mouth of the Orange River. A more detailed description of the study area is provided in a section below.

METHODOLOGY

The environmental study was undertaken in two phases, a Scoping phase and an Environmental Impact Assessment phase. The objective of the EIA phase study was to assess the significance of potential impacts on flora, fauna and ecology within the study area. This report contains all the descriptive information on flora and fauna that were presented in the Scoping report as well as a comprehensive assessment of potential impacts. The results of the EIA phase study are provided in this report.

Assessment philosophy

Many parts of South Africa contain high levels of biodiversity at species and ecosystem level. At any single site there may be large numbers of species or high ecological complexity. Sites also vary in their natural character and uniqueness and the level to which they have been previously disturbed. Assessing the potential impacts of a proposed development often requires evaluating the conservation value of a site relative to other natural areas and relative to the national importance of the site in terms of biodiversity conservation. A simple approach to evaluating the relative importance of a site includes assessing the following:

- Is the site unique in terms of natural or biodiversity features?
- Is the protection of biodiversity features on the site of national/provincial importance?
- Would development of the site lead to contravention of any international, national or provincial legislation, policy, convention or regulation?

Thus, the general approach adopted for this type of study is to identify any critical biodiversity issues that may lead to the decision that the proposed project cannot take place, i.e. to specifically focus on red flags and/or potential fatal flaws. Biodiversity issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. These can be organised in a hierarchical fashion, as follows:

Species

1. threatened plant species
2. protected trees
3. threatened animal species

Ecosystems

1. threatened ecosystems
2. protected ecosystems
3. critical biodiversity areas
4. areas of high biodiversity
5. centres of endemism

Processes

1. corridors
2. mega-conservancy networks
3. rivers and wetlands
4. important topographical features

It is not the intention to provide comprehensive lists of all species that occur on site, since most of the species on these lists are usually common or widespread species. Rare, threatened, protected and conservation-worthy species and habitats are considered to be the highest priority, the presence of which are most likely to result in significant negative impacts

on the ecological environment. The focus on national and provincial priorities and critical biodiversity issues is in line with National legislation protecting environmental and biodiversity resources, including, but not limited to the following which ensure protection of ecological processes, natural systems and natural beauty as well as the preservation of biotic diversity in the natural environment:

1. Environment Conservation Act (Act 73 of 1989)
2. National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998)
3. National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004)

Plant and animal species of concern

The purpose of listing Red List plant and animal species is to provide information on the potential occurrence of species of special concern in the study area that may be affected by the proposed infrastructure. Species appearing on these lists can then be assessed in terms of their habitat requirements in order to determine whether any of them have a likelihood of occurring in habitats that may be affected by the proposed infrastructure.

Lists were compiled specifically for any species of conservation concern previously recorded in the area and any other species with potential conservation value. Historical occurrences of threatened plant species were obtained from the South African National Biodiversity Institute for the quarter degree squares within which the study area is situated.

Regulations published for the National Forests Act provide a list of protected tree species for South Africa. The species on this list were assessed in order to determine which protected tree species have a geographical distribution that coincides with the study area and habitat requirements that may be met by available habitat in the study area.

Provincial and National legislation was evaluated in order to provide lists of any plant or animal species that have protected status. The most important legislation is the following: *National Environmental Management: Biodiversity Act (Act No 10 of 2004)*.

Lists of threatened animal species that have a geographical range that includes the study area were obtained from literature sources (for example, Alexander & Marais 2007, Branch 1988, 2001, du Preez & Carruthers 2009, Friedmann & Daly 2004, Mills & Hes 1997). The likelihood of any of them occurring was evaluated on the basis of habitat preference and habitats available at each of the proposed sites. The three parameters used to assess the probability of occurrence for each species were as follows:

- *Habitat requirements*: most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics within the study area were assessed;
- *Habitat status*: in the event that available habitat is considered suitable for these species, the status or ecological condition was assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water-quality plays a major role); and
- *Habitat linkage*: movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red Data species within the study area.

For all threatened or protected organisms (flora and fauna) that occur in the general geographical area of the site, a rating of the likelihood of it occurring on site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- MEDIUM: habitats on site match general habitat description for species (e.g. fynbos), but detailed microhabitat requirements (e.g. mountain fynbos on shallow soils overlying Table Mountain sandstone) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. mountain fynbos on shallow soils overlying Table Mountain sandstone);
- DEFINITE: species found in habitats on site.

Habitats of concern

The purpose of producing a habitat sensitivity map is to provide information on the location of potentially sensitive features in the study area. This was compiled by taking the following into consideration:

1. The general status of the vegetation of the study area was derived by compiling a landcover data layer for the study area (*sensu* Fairbanks et al. 2000) using available satellite imagery and aerial photography. From this it can be seen which areas are transformed versus those that are still in a natural status.
2. Various provincial, regional or national level conservation planning studies have been undertaken in the area, e.g. the National Spatial Biodiversity Assessment (NSBA), Succulent Karoo Ecosystem Rogramme (SKEP), draft Namakwa District Biodiversity Sector Plan. The mapped results from these were taken into consideration in compiling the habitat sensitivity map.
3. Habitats in which various species of plants or animals occur that may be protected or are considered to have high conservation status are considered to be sensitive.

Assessment of impacts

Direct, indirect, and cumulative impacts of the issues identified through the scoping study, as well as all other issues identified in the EIA phase were assessed in terms of the following criteria:

» The **nature**, which includes a description of what causes the effect, what will be affected and how it will be affected.
» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 was assigned as appropriate (with 1 being low and 5 being high):
» The **duration**, wherein it was indicated whether:
  * the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  * the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  * medium-term (5–15 years) – assigned a score of 3;
  * long term (> 15 years) - assigned a score of 4; or
  * permanent - assigned a score of 5;
» The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes

continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

» The **probability** *of occurrence*, which describes the likelihood of the impact actually occurring. Probability was estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
» the **significance**, was determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
» the **status**, which was described as either positive, negative or neutral.
» the degree to which the impact can be reversed.
» the degree to which the impact may cause irreplaceable loss of resources.
» the degree to which the impact can be mitigated.

The **significance** was calculated by combining the criteria in the following formula:

S=(E+D+M)P

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

» < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
» 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
» > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Limitations and exclusions

- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be located in an area where it was not previously known to exist.
- There are a large number of listed plant species for the grids in which the proposed project is located. For many of these species, there is limited information on habitats in which they occur or their total geographical distribution. A detailed floristic field survey during different seasons is required to locate these populations in order to increase the confidence in the location of these species populations - this is beyond the budget and time-frames for this project.

The avifaunal assessment is excluded from this study and will be undertaken in a separate specialist study.

DESCRIPTION OF STUDY AREA

Location

The study site is situated in the Northern Cape between Aggeneys and Alexander Bay (Figure 1). The site falls within the 1:250 000 mapsheets 2816, 2916 and 2918 and includes the quarter degree grids 2816DA, 2816DB, 2816DC, 2816DD, 2916BB, 2917AA, 2917AB, 291AC, 2917AD, 2917BA, 2917BB, 2917BC, 2917BD, 2917CA, 2917CB, 2917DA, 2917DB, 2918AA, 2918AB, 2918AC, 2918AD, 2918BC, 2918BD, 2918CA and 2918CB.

Four technically feasible corridor alternatives are being considered for the EIA (Figure 1). **Corridor 1** is the southern-most route. It starts just west of the town of Aggeneys, goes just past Springbok to the coast near Kleinsee then north to just inland of Alexander Bay. Corridor 2 is north of Corridor 1. It starts just west of Aggeneys, goes just past Steinkopf towards the coast near Port Nolloth then north to just inland of Alexander Bay. **Corridor 3** is the northernmost route. It starts just west of Aggeneys, goes just past Steinkopf towards the coast to the north of Port Nolloth then north to just inland of Alexander Bay. Corridor 4 is a slight variation on corridor 2 and has an alternative section to the west of Steinkopf.

The study area is relatively isolated. There are some main roads along the alignments, especially Corridor 1. However, some parts of Corridors 2 and 3 are not accessible by road. The northward-running parts of all three alignments are inland of the main road from Port Nolloth to Alexander Bay.

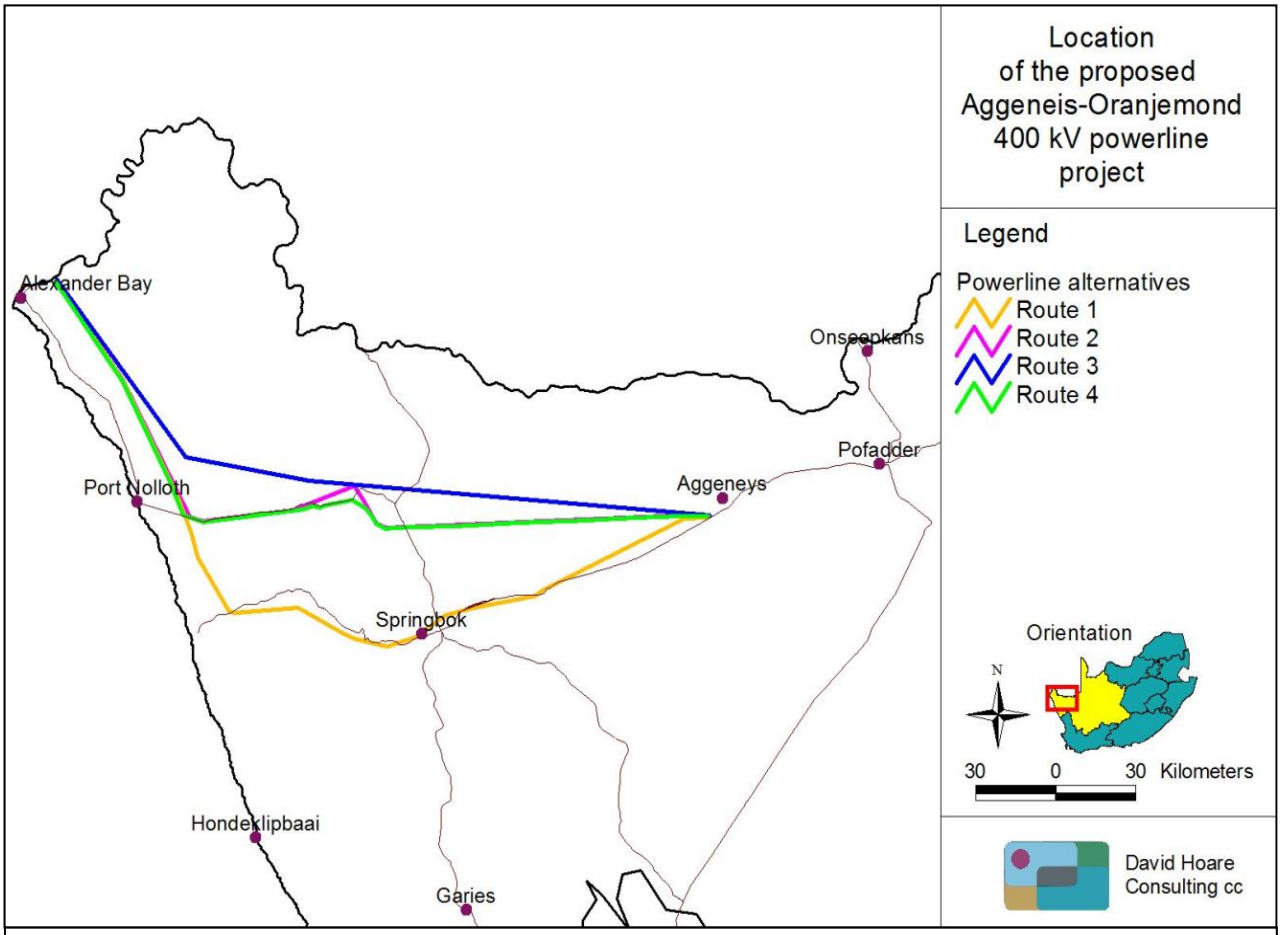

Figure 1: Location of the proposed Aggeneis Oranjemond 400 kV power line.

Topography

A general view of the topography of the study area is given in Figure 2. The alternative corridors begin on the high ground near Aggeneys. Between Aggeneys and Springbok the topography is relatively flat, except for widely spaced inselbergs and hills. The elevation in this region varies between approximately 800 and 1000 m above sea level. Between Springbok and Steinkopf, the topography is rugged and mountainous, associated with the escarpment along the west coast of South Africa. The elevation in this escarpment zone varies between 500 and 1000 m. From this escarpment westwards, the elevation drops onto the coastal plains. These plains are gently undulating to hilly in places. They vary in elevation from 100 to 400 m above sea level.

Despite the aridity of the study area, there are various non-perennial streams and drainage lines in the study area, other than the perennial Orange River. These include, from the north-western side, the Holgat, Kamma, Soutwaterleegte, Doring, Brak, Gari and Sabie.

Major soil patterns

Detailed soil information is not available for broad areas of the country. As a surrogate, landtype data was used to provide a general description of soils in the study area (landtypes are areas with largely uniform soils, topography and climate). There are a variety of landtypes in the study area (Figure 3). The most common landtypes in the study area affected by the proposed alignment alternatives are Ae, Af, Ag, Ah, Ai, Fb, Fc and Ib (Land Type Survey Staff, 1987).

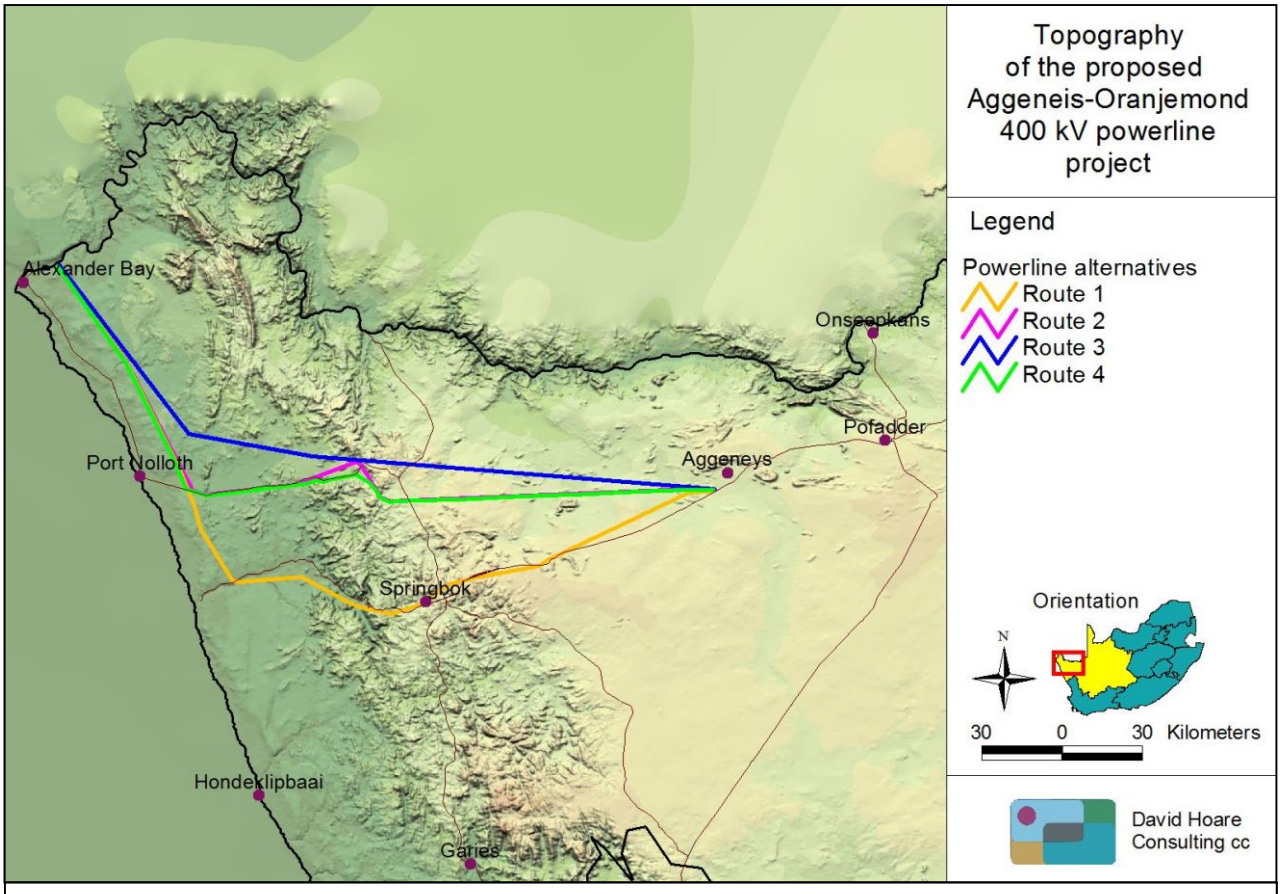

Figure 2: Topography of the study area (background image MetroGIS).

The Fc landtype consists of pedologically young landscapes in which the dominant soil-forming processes have been rock weathering. Soils are mostly shallow and/or rocky (MacVicar et al. 1974). These occur primarily on the moderately undulating parts of the study area in the north and in the bottomlands in the south.

The Ib landtype consists of 60-80% exposed rock with shallow and/or rocky soils (MacVicar et al. 1974). There is therefore very little soil. These are the soils on the steeper slopes connected to the escarpment.

Landuse and landcover of the study area

A landcover map of the study area (Fairbanks *et al*. 2000) indicates that the entire study area consists of natural vegetation. It is, however, possible that livestock farming has affected the vegetation to some degree. This area of the country consists primarily of farms used as rangeland for commercial livestock production. Commercial farming systems are characterised by land stocked at economically sustainable levels. These regions have been commercially farmed as stock ranches for close to 100 years. Degradation of vegetation has been blamed on high stocking rates of domestic livestock in commercial farming areas. The study area is no exception and degradation due to overgrazing is likely.

The coastal areas just outside the corridors under investigation have been extensively mined for diamonds and the natural vegetation has been degraded due to these activities.

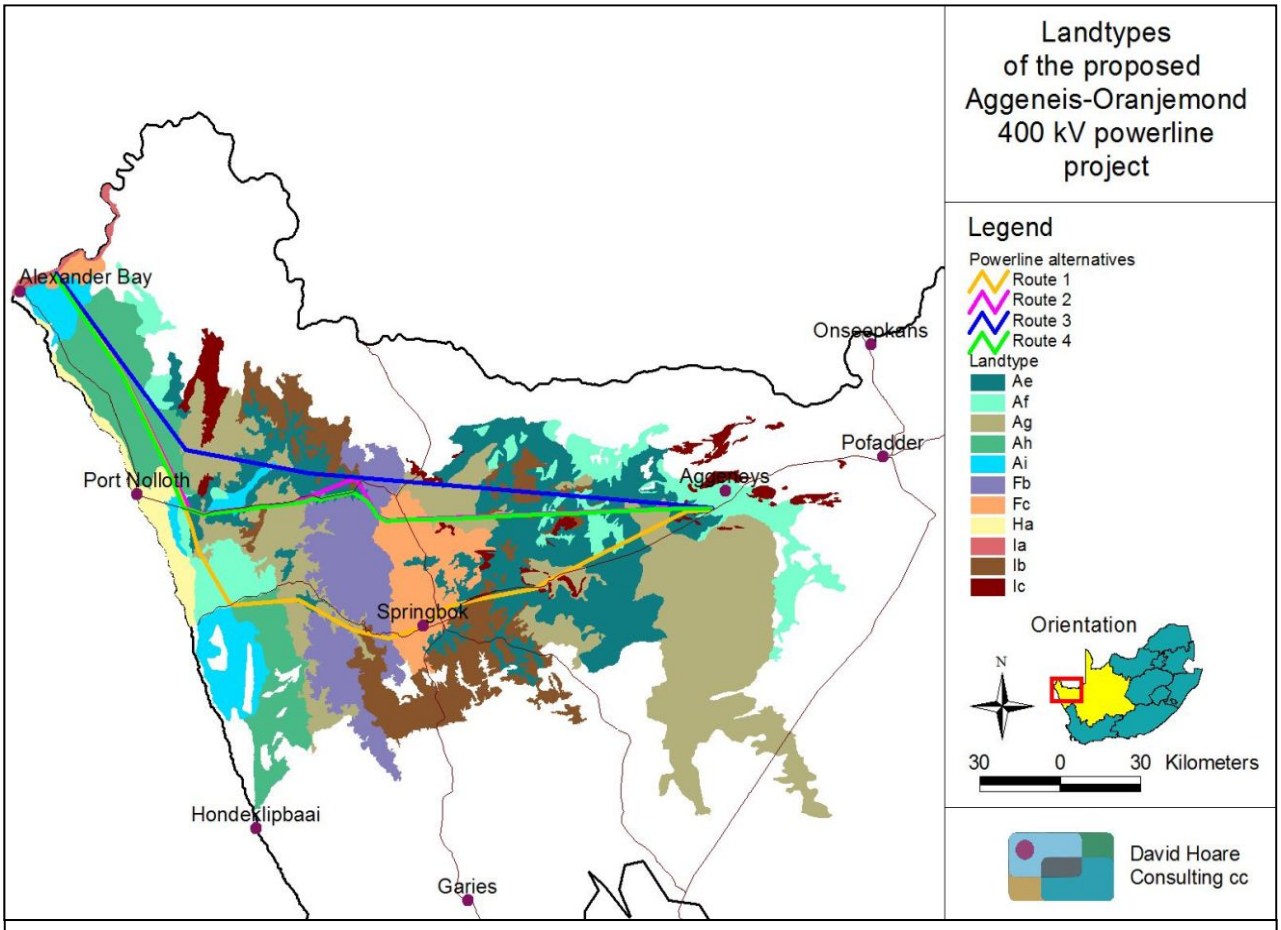

Figure 3: Landtypes found within the proposed study areaA.

Broad vegetation types of the region

The study area traverses the Nama Karoo, Succulent Karoo and Desert Biomes (Mucina & Rutherford 2006). The most recent and detailed description of the vegetation of this region is part of a national map (Mucina, Rutherford & Powrie, 2005; Mucina *et al*. 2006). This map shows 26 different vegetation types across which the proposed alternative alignments traverse. The vegetation types are shown in Figure 4 and are as follows:

- Aggeneys Gravel Vygieveld (Succulent Karoo Biome),
- Anenous Plateau Shrubland (Succulent Karoo Biome),
- Arid Estuarione Salt Marshes (Azonal Vegetation),
- Bushmanland Arid Grassland (Nama Karoo Biome),
- Bushmanland Inselberg Shrubland (Succulent Karoo Biome),
- Bushmanland Sandy Grassland (Nama Karoo Grassland),
- Bushmanland Vloere (Azonal Vegetation),
- Kosiesberg Succulent Shrubland (Succulent Karoo Biome),
- Lekkersing Succulent Shrubland (Succulent Karoo Biome),
- Lower Gariep Alluvial Vegetation (Azonal Vegetation),
- Namaqualand Blomveld (Succulent Karoo Biome),
- Namaqualand Heuweltjieveld (Succulent Karoo Biome),
- Namaqualand Klipkoppe Shrubland (Succulent Karoo Biome),
- Namaqualand Riviere (Succulent Karoo Biome),

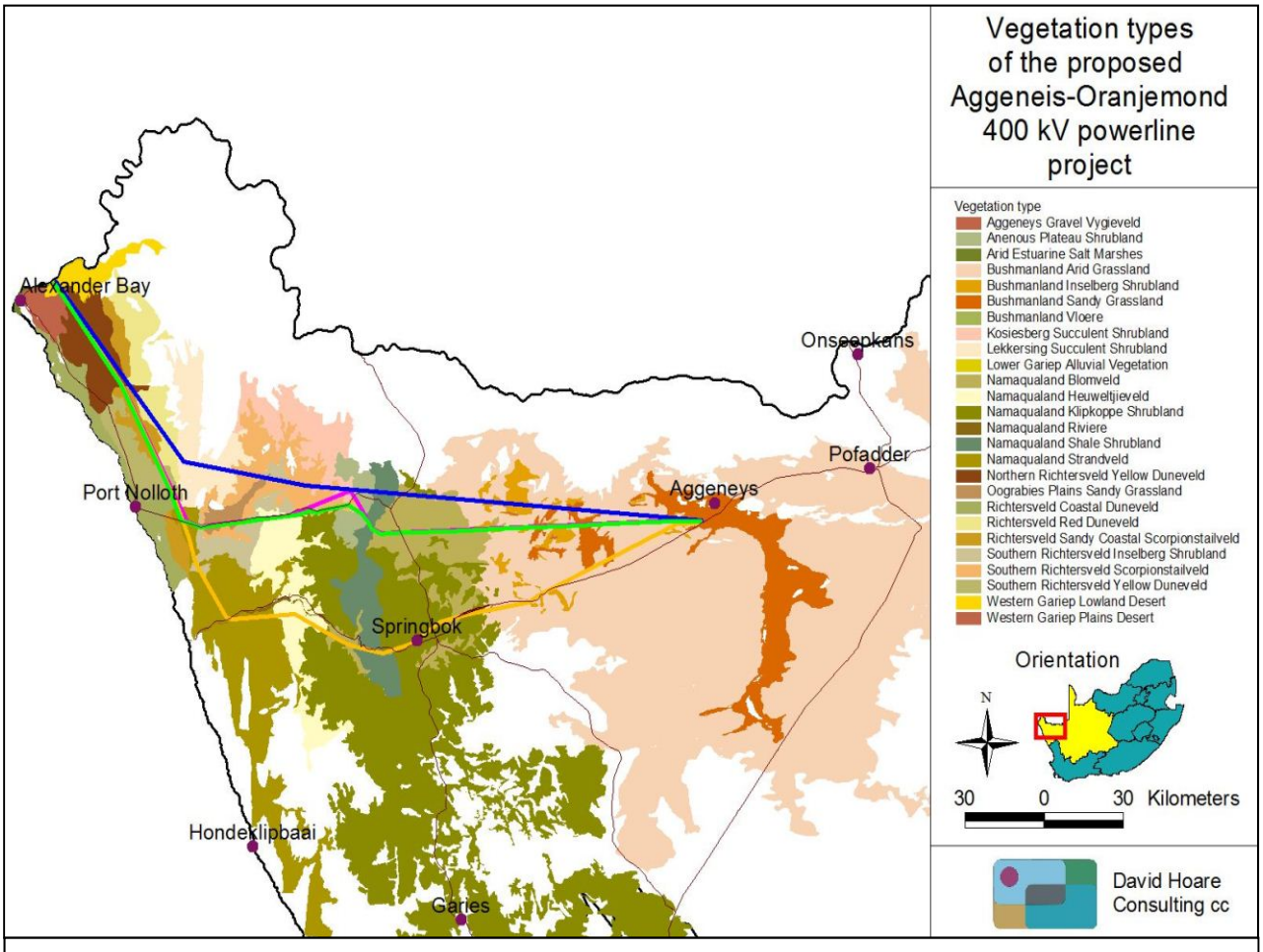

Figure 4: Vegetation types of the study area.

- Namaqualand Shale Shrubland (Succulent Karoo Biome),
- Namaqualand Strandveld (Succulent Karoo Biome),
- Northern Richtersveld Yellow Duneveld (Succulent Karoo Biome),
- Oograbies Plains Sandy Grassland (Succulent Karoo Biome),
- Richtersveld Coastal Duneveld (Succulent Karoo Biome),
- Richtersveld Red Duneveld (Succulent Karoo Biome),
- Richtersveld Sandy Coastal Scorpionstailveld (Succulent Karoo Biome),
- Southern Richtersveld Inselberg Shrubland (Succulent Karoo Biome),
- Southern Richtersveld Scorpionstailveld (Succulent Karoo Biome),
- Southern Richtersveld Yellow Duneveld (Succulent Karoo Biome),
- Western Gariep Lowland Desert (Desert Biome),
- Western Gariep Plains Desert (Desert Biome).

Conservation status of broad vegetation types

On the basis of a recently established approach used at national level by SANBI (Driver et al. 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 1, as determined by best available scientific approaches (Driver et al. 2005).

Table 1: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)		
80–100	least threatened	LT
60–80	vulnerable	VU
*BT–60	endangered	EN
0–*BT	critically endangered	CR

The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

Of the 26 vegetation types occurring in the study area (Table 2), all but one are classified as Least Threatened (Driver *et al*. 2005; Mucina *et al*., 2006). The Lower Gariep Alluvial Vegetation is considered to be endangered.

Table 2: Conservation status of different vegetation types occurring in the study area, according to Driver et al. 2005 / Mucina et al. 2005 and the Draft Ecosystems List of the National Environmental Management: Biodiversity Act.

Vegetation Type	Conservation status (Mucina et al. 2005)	Status (NEMBA)
Aggeneys Gravel Vygieveld	Least Threatened	Not listed
Anenous Plateau Shrubland	Least Threatened	Not listed
Arid Estuarione Salt Marshes	Least Threatened	Not listed
Bushmanland Arid Grassland	Least Threatened	Not listed
Bushmanland Inselberg Shrubland	Least Threatened	Not listed
Bushmanland Sandy Grassland	Least Threatened	Not listed
Bushmanland Vloere	Least Threatened	Not listed
Kosiesberg Succulent Shrubland	Least Threatened	Not listed

Vegetation Type	Conservation status (Mucina et al. 2005)	Status (NEMBA)
Lekkersing Succulent Shrubland	Least Threatened	Not listed
Lower Gariep Alluvial Vegetation	Endangered	Endangered
Namaqualand Blomveld	Least Threatened	Not listed
Namaqualand Heuweltjieveld	Least Threatened	Not listed
Namaqualand Klipkoppe Shrubland	Least Threatened	Not listed
Namaqualand Riviere	Least Threatened	Not listed
Namaqualand Shale Shrubland	Least Threatened	Not listed
Namaqualand Strandveld	Least Threatened	Not listed
Northern Richtersveld Yellow Duneveld	Least Threatened	Not listed
Oograbies Plains Sandy Grassland	Least Threatened	Not listed
Richtersveld Coastal Duneveld	Least Threatened	Not listed
Richtersveld Red Duneveld	Least Threatened	Not listed
Richtersveld Sandy Coastal Scorpionstailveld	Least Threatened	Not listed
Southern Richtersveld Inselberg Shrubland	Least Threatened	Not listed
Southern Richtersveld Scorpionstailveld	Least Threatened	Not listed
Southern Richtersveld Yellow Duneveld	Least Threatened	Not listed
Western Gariep Lowland Desert	Least Threatened	Not listed
Western Gariep Plains Desert	Least Threatened	Not listed

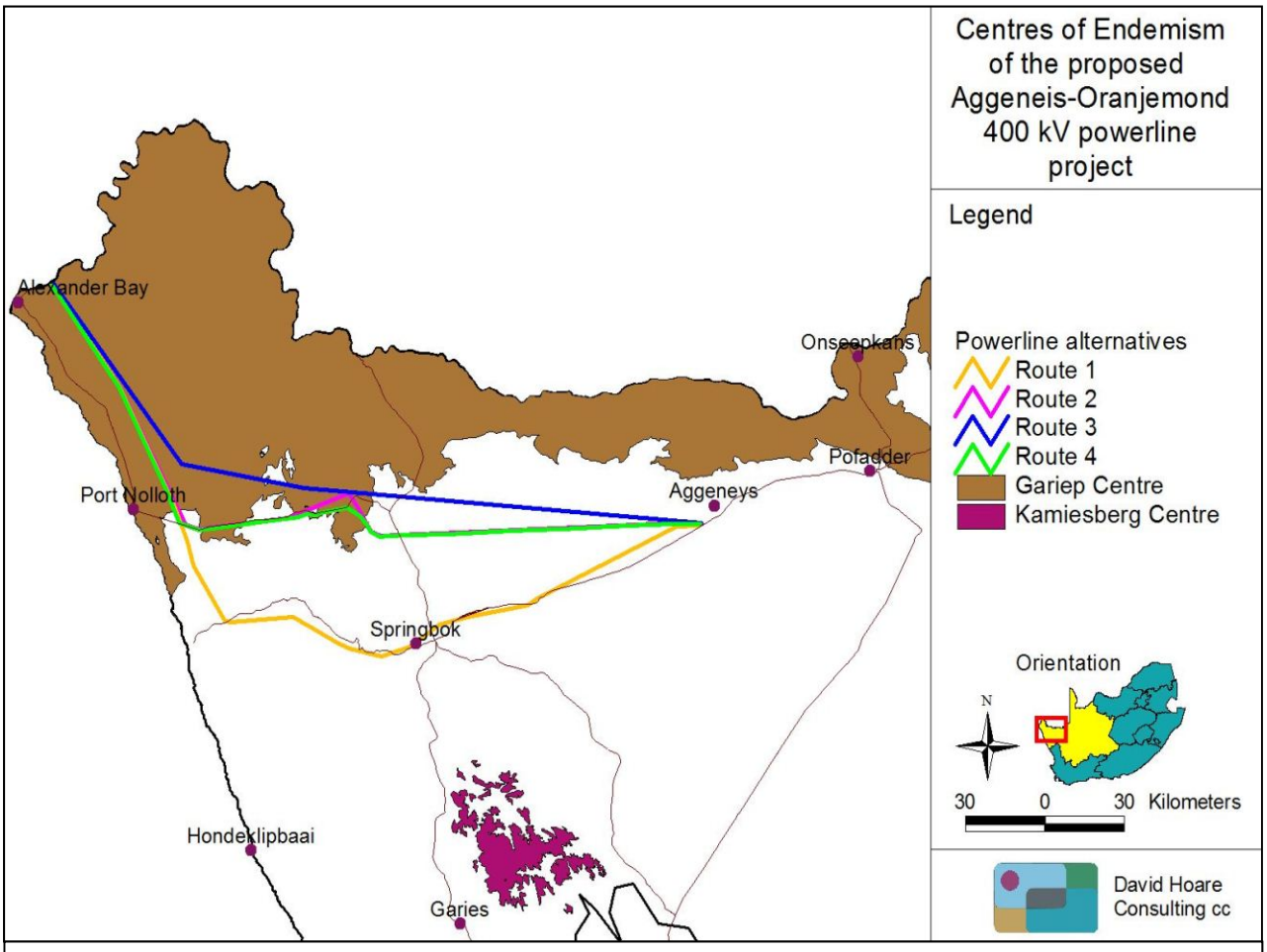

Figure 5: Centres of Plant Endemism of the study area.

Succulent Karoo Region and Gariep Centre of Endemism

Most of the study area falls within the Succulent Karoo Region, a floristic region containing a number of areas with concentrations of endemic species (van Wyk & Smith 2001). It is recognised as an important centre of plant diversity and endemism in Africa (Davis et al. 1994). The hallmark of the Succulent Karoo is its exceptionally diverse and endemic-rich flora, especially succulents and bulbs (Driver et al. 2003). In addition to its floral diversity, the biome is a centre of diversity for reptiles and many groups of invertebrates (Driver et al. 2003). The Succulent Karoo Region is also considered one of the Earth's 25 hotspots, which are geographical areas that contain the world's greatest plant and animal diversity while also being subjected to high levels of pressure from development and/or degradation (Mittermeier et al. 2000, Steenkamp et al. 2004, 2005). The biome is home to 6 356 plant species, 40% of which are endemic and 936 (17%) of which are Red Data Listed (Driver et al. 2003). This region is the world's only entirely arid hotspot (van Wyk & Smith 2001). The Succulent Karoo Region comprises roughly those karroid areas along and below the Great Escarpment in the western to south-western parts of South Africa and a small part of southern Namibia receiving mainly winter rainfall (van Wyk & Smith 2001).

There are a number of areas within the Succulent Karoo Region that are foci of high local endemism, including the Gariep Centre of Endemism, the Knersvlakte Centre, the Little Karoo Centre, the Worcester-Robertson Karoo Centre and the Hantam-Roggeveld Centre. The study area falls partly within the Gariep Centre of Plant Endemism (GC) (van Wyk & Smith 2001) (Figure 5). This area occupies the lower reaches of the Orange River valley and surrounding areas, extending from Augrabies to Alexander Bay and including the Richtersveld (van Wyk & Smith 2001). The topography of the GC includes sandy plains and dunes, rugged inselbergs, gravel plains, dry river beds, steep rock-strewn mountains and deep gorges (van Wyk & Smith 2001).

The GC is exceptionally rich in succulents and is considered to have the richest variety of succulents on earth (van Wyk & Smith 2001). The GC is thought to have approximately 2700 species / infraspecific taxa of which 21% are endemics. Approximately 80% of the endemics are succulents (van Wyk & Smith 2001). The area is a centre of diversity and endemism for a number of plant groups, including Mesembryanthemaceae, Zygophyllaceae, Asclepiadaceae, Asteraceae, Crassulaceae, Euphorbiaceae, Liliaceae, Geraniaceae and Portulacaceae.

Threats to the flora of the GC include strip mining for diamonds and other minerals along the coast, extensive overgrazing by sheep and goats in many of the inland mountainous areas, invasion by alien plants, especially species of *Prosopis*, and illegal removal of succulents by collectors and traders (van Wyk & Smith 2001). Conservation areas in the GC include the Richtersveld National Park, Ais-Ais/Hunsberg Reserve Complex and the Augrabies Falls National Park and adjacent Riemvasmaak region. Other areas which are considered to be worthy of conservation include the Sperrgebiet, the mountains around and south-west of Steinkopf and the Lower Orange River Valley upstream of Vioolsdrif, including inland mountains such as Groot Pellaberg, Skimmelberge and Dabenorisberge (van Wyk & Smith 2001).

Important Biodiversity Areas

A bioregional planning project named the Succulent Karoo Ecosystem Plan (SKEP) was undertaken in 2002 to provide an overarching framework to guide conservation efforts in the Succulent Karoo (Driver et al. 2003). The goal of the Biodiversity Component of SKEP was to identify broad-scale geographic priorities for terrestrial biodiversity conservation in the

Succulent Karoo biome, using a systematic conservation planning approach. The current study area (from approximately 18° longitude westwards) falls within a geographical priority area called the Greater Richtersveld Region.

More recently, a conservation plan of parts of the Northern Cape Province (Namakwa District) has been produced, which indicates areas critical for conserving biodiversity in the Province. This product is intended to help guide land-use planning, environmental assessments and authorisations; and, natural resource management in order to promote development which occurs in a sustainable manner. This is a more detailed map than that emanating from the SKEP project. The conservation plan includes important features, such as vegetation types with high conservation value, important biodiversity corridors, habitats critical for conserving species of high conservation importance and ecological factors, such as steep slopes and kloofs, that may be ecologically sensitive. A map of critical biodiversity areas in the study area is shown in Figure 6. According to the draft Namakwa District Biodiversity Sector Plan, the following features occur in areas that may be affected by the proposed alignments:

- corridors;
- terrestrial areas important for biodiversity of different groups, including plants, fish, invertebrates, birds, mammals, reptiles and amphibians;
- kloofs;
- SA vegetation types of high conservation value;
- SA vegetation on quartzitic substrates;
- steep slopes.

These are organised into different priority levels, including T1 areas, T2 areas and Corridors. The draft Namakwa District Biodiversity Sector Plan proposes the following restrictions to development within these different areas:

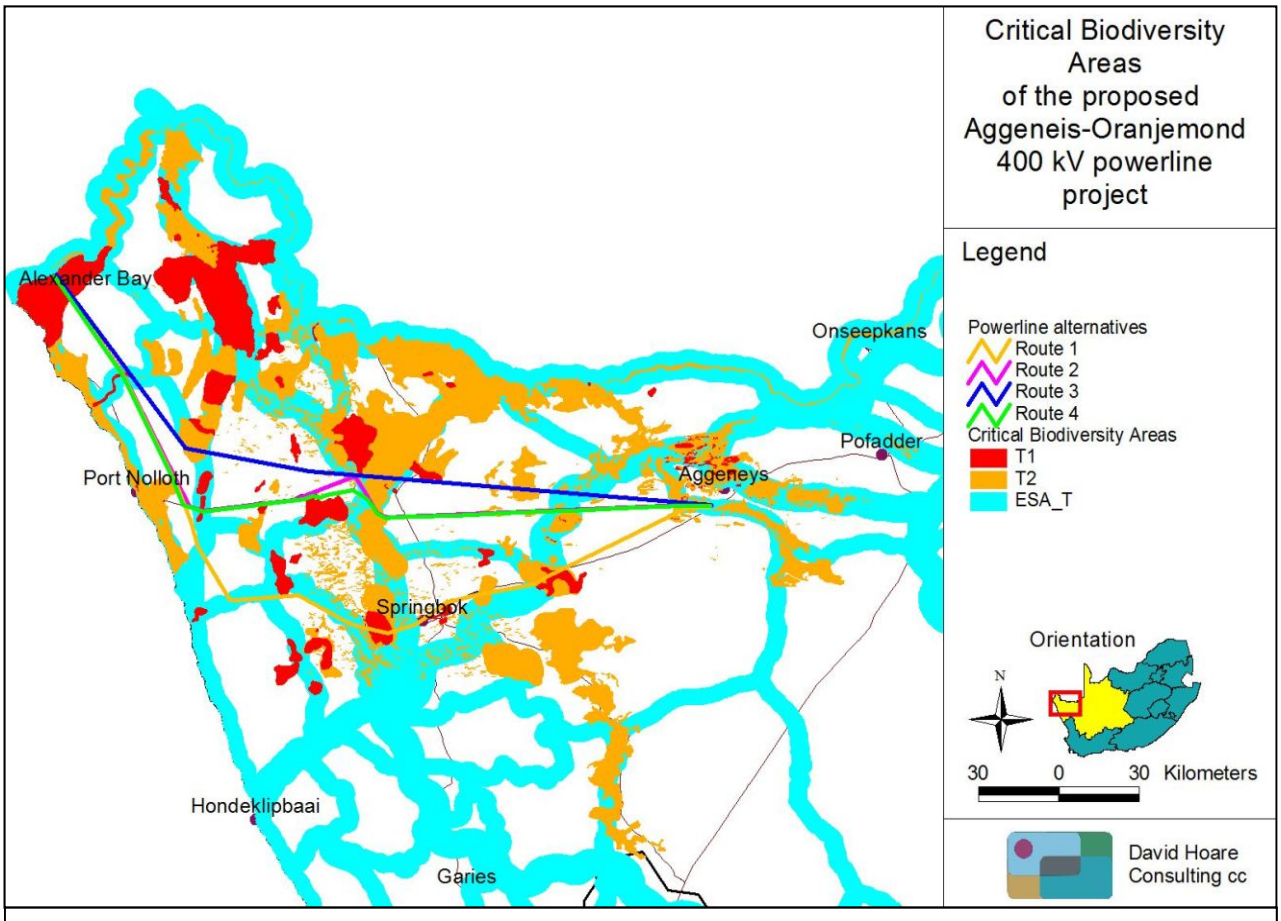

Figure 6: Important biodiversity areas of the study area.

Feature	Category	Management Objectives	Suitability for linear projects
T1 area	Irreplaceable sites: The most important areas for biodiversity conservation	Maintain in a natural state with no further biodiversity loss	Restricted
T2 area	Important areas: Other areas known to be of high biodiversity value	Maintain near-natural landscapes with no or limited loss of biodiversity pattern and limited loss of ecosystem processes	Restricted
Corridors	Ecological support areas (ESA-T): Areas that support key biodiversity resources (e.g. water) or ecological processes (e.g. movement corridors) in the landscape	Maintain near-natural landscapes with some loss of biodiversity pattern and limited loss of ecosystem processes	Restricted
Protected areas	Statutory protected and conservation areas.	Maintain in a natural state with limited or no biodiversity loss	Unsuitable

Reserves and Parks

There are various parks and reserves in the country, which serve to conserve critical areas of biodiversity. These are categorised according to the level of protection they are afforded. Statutory reserves, including National Parks, have the highest level of protection. Private Reserves also provide for conservation of natural areas, but do not have the same level of legal protection. In all conservation planning products, existing protected areas are considered to be "no go" areas in terms of future development.

There are three protected areas along the path of proposed alternative corridors:

1. The first is the Goegap Nature Reserve to the east of Springbok, which incorporates the Hester Malan Wild Flower Garden. The Goegap Nature Reserve is approximately 15 000 ha in size. Hartmann's Mountain Zebra (see below) occurs in this reserve. Route Alternative 1 crosses the northern boundary of this reserve.
2. The second is a small outlier of the Richtersveld National Park, situated just inland of Port Nolloth. The history of this part of the park is unknown. Corridor Alternatives 1,2 and 4 pass through the middle of this protected area.
3. A third protected area is indicated in the draft Namakwa District Biodiversity Sector Plan as occurring around Aggeneys. It is called the Black Mountain Mine Reserve. No information is available on this reserve, but it is probably a private reserve owned by the mining company at Aggeneys. The town of Aggeneys is entirely within the reserve. All four corridors pass through this reserve, because the substation at Aggeneys is within the reserve.

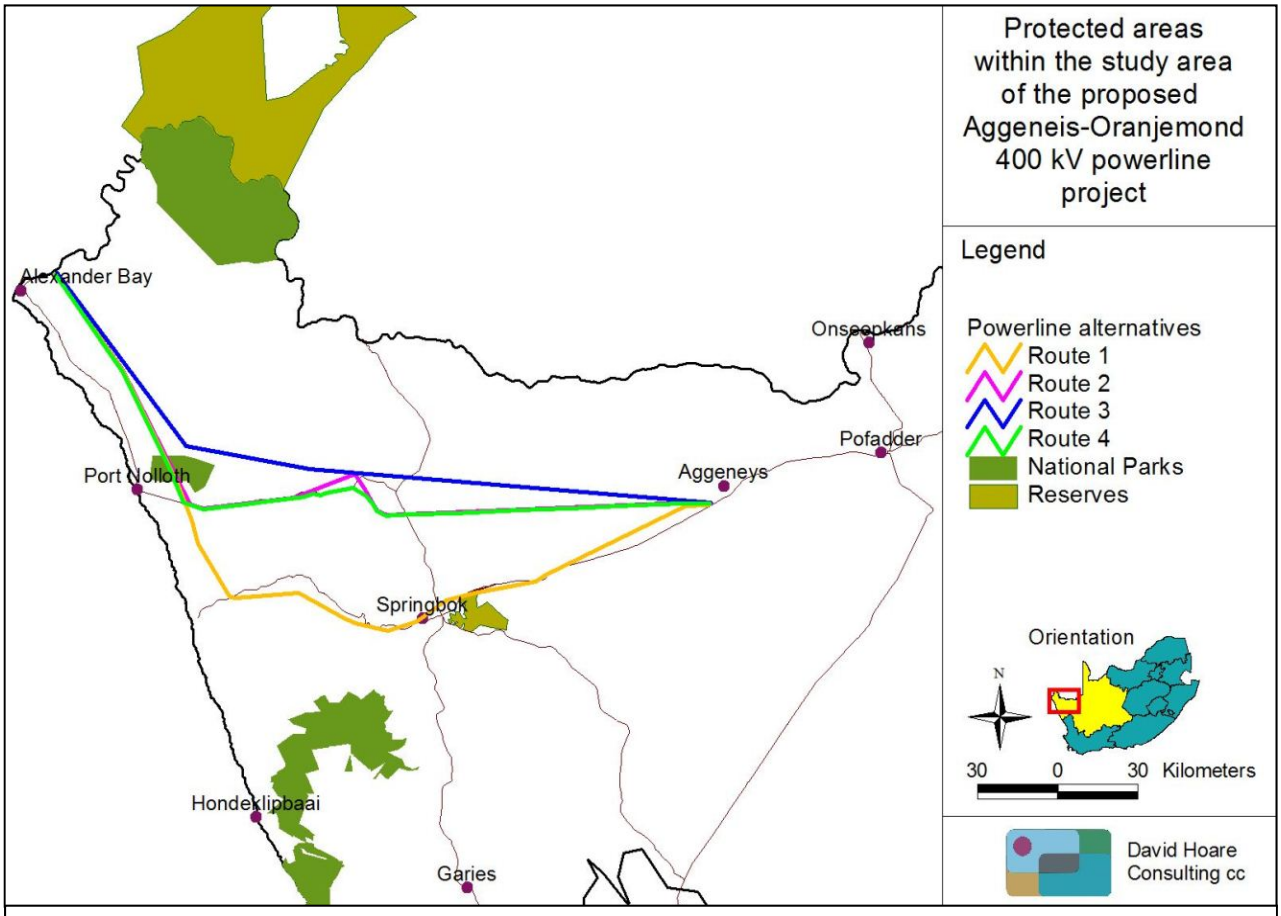

Figure 7: Existing protected areas within the study area.

Red List plant species of the study area

Lists of plant species previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute. These are listed in Appendix 1 per quarter degree grid. Each grid has a different number of threatened, near threatened and rare species (see Table 3 for explanation of categories). Note that species that are listed on the SANBI website as "*Thr" (i.e. suspected to be threatened but not assessed) are listed here as Data Deficient (suspected to be threatened but unable to assess due to lack of data).

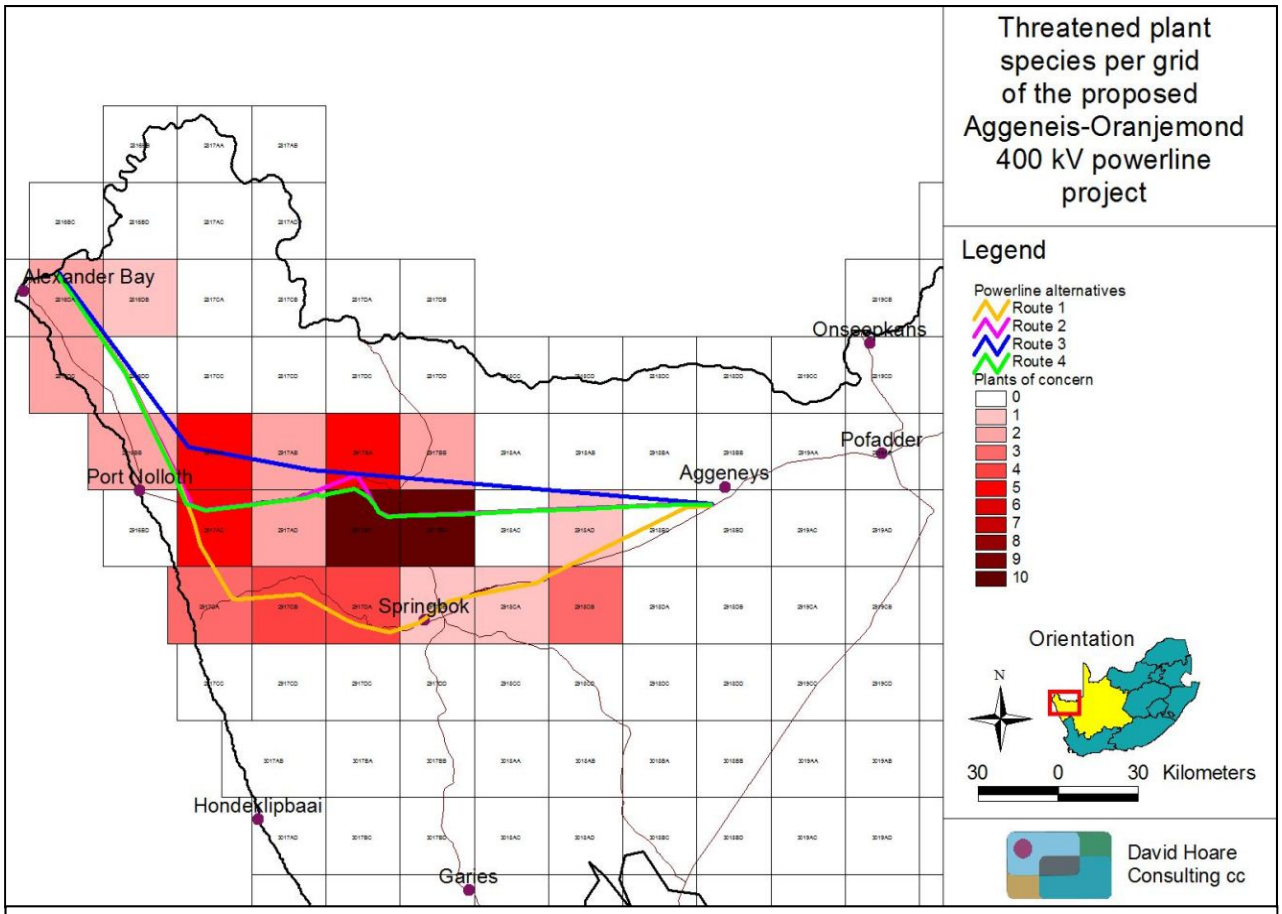

Figure 8: Number of threatened plant species recorded per quarter degree grid in the study area.

Table 3: Explanation of IUCN Ver. 3.1 categories (IUCN, 2001), and Orange List categories (Victor & Keith, 2004).

IUCN / Orange List category	Definition	Class
EX	Extinct	Extinct
CR	Critically Endangered	Red List
EN	Endangered	Red List
VU	Vulnerable	Red List
NT	Near Threatened	Orange List
Critically Rare	Rare: only one subpopulation	Orange List
Declining	Declining taxa	Orange List
Rare	Rare	Orange List
Rare-Sparse	Rare: widely distributed but rare	Orange List
DDD	Data Deficient: well known but not enough information for assessment	Data Deficient
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient

An indication of the number of threatened plant species (CR, EN, VU & DD) per quarter degree grid is provided in Figure 8. This provides an assessment of which parts of the study area are most likely to contain threatened plant species. The escarpment area, especially around Steinkopf, appears to have the highest concentrations of threatened plant species. This is followed by concentrations in the hilly areas to the north-east to south-east of Port Nolloth. Note that this Figure EXCLUDES all other plant species of conservation concern, i.e. those listed as near threatened or rare. The distribution of all other plant species of conservation concern, i.e. those listed as near threatened or rare, is shown in Figure 9. The same general pattern emerges - the escarpment zone is the most likely to harbour plant species of conservation concern, followed by the hilly areas inland of Port Nolloth.

Red List animal species of the study area

All Red List vertebrates (mammals, birds, reptiles, amphibians) that could occur in the study area are listed in Appendix 2. Those vertebrate species with a geographical distribution that includes the study area and habitat preference that includes habitats available in the study area are discussed further.

There are three mammal species of conservation concern that could occur in available habitats in the study area. This includes one species classified as Critically Endangered (CR), De Winton's Golden Mole, one species classified as Endangered, Hartmann's Mountain Zebra and one classified as Vulnerable in the South African part of its range, although globally, it is listed as Least Concern, the Angolan Wing-gland Bat.

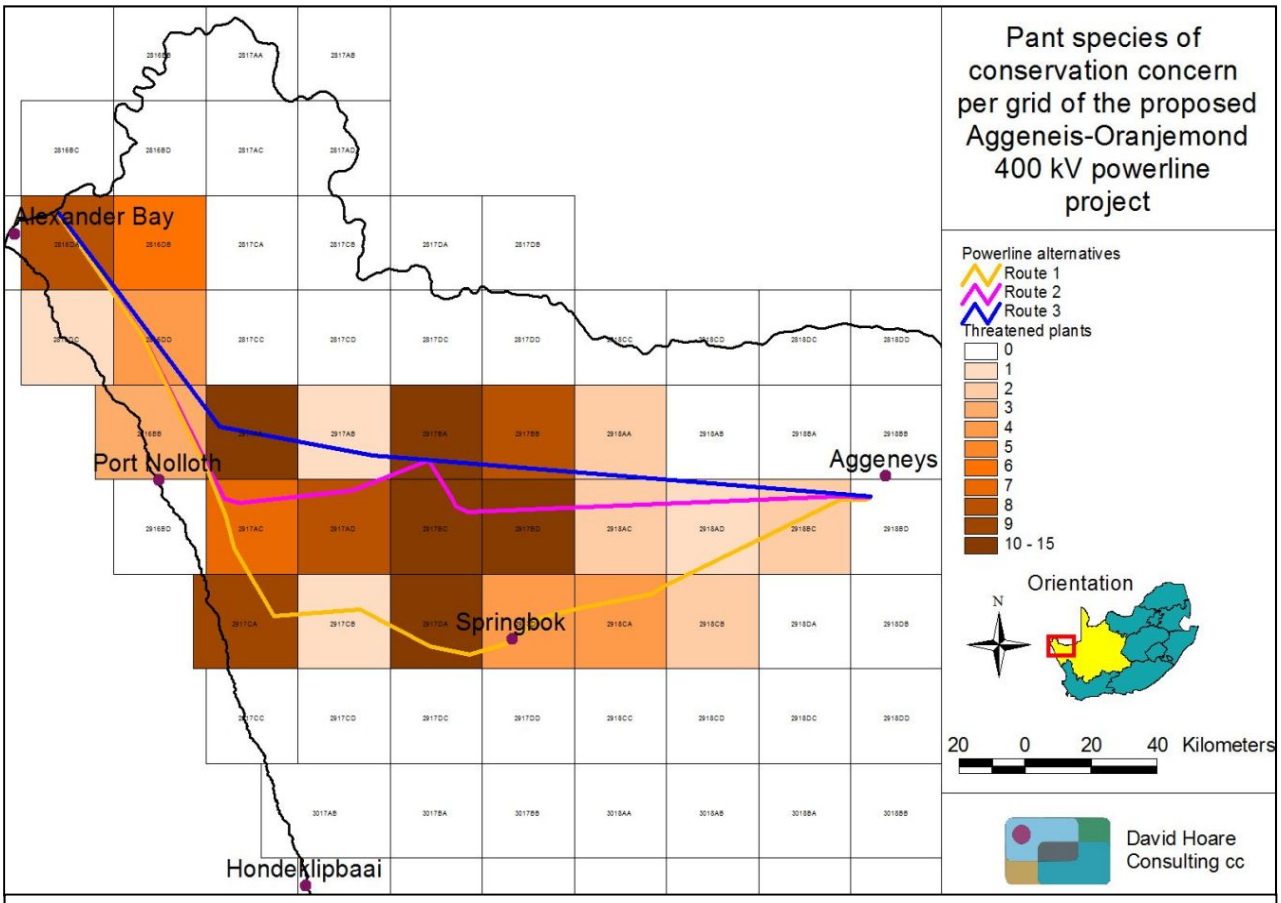

Figure 9: Number of plant species of conservation concern (not listed as threatened) recorded per quarter degree grid in the study area.

There is one frog species of conservation concern previously recorded in the grids in which the study area is located and which could occur on site. This is the Namaqua Stream Frog, listed as Vulnerable (VU). Within the study area, it is restricted to mountainous areas along the Great Escarpment, where it is found in seeps and springs.

There are three reptile species of conservation concern that occur in the study area, one, the Armadillo Girdled Lizard, listed as Vulnerable, and two, the Namaqua Plated Lizard and the Speckled Padloper, listed as Near Threatened.

Protected trees

Tree species protected under the National Forest Act are listed in Appendix 3. Those that have a geographical distribution that includes the study area are *Acacia erioloba* (Camel Thorn, Kameeldoring), *Acacia haematoxylon* (Grey Camel Thorn, Vaalkameeldoring), *Boscia albitrunca* (Shepard's Tree / Witgatboom / !Xhi) and *Euclea pseudebenus* (Ebony Tree, Ebbeboom).

The tree *Acacia erioloba* occurs in dry woodland along watercourses in arid areas where underground water is present as well as on deep Kalahari sands (mostly Bushmanland Arid Grassland). *Acacia haematoxylon* occurs on deep Kalahari sand between dunes or along dry watercourses (Bushmanland Arid Grassland). *Boscia albitrunca* occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils (mostly Bushmanland Arid Grassland). *Euclea pseudobenus* occurs in semi-desert and desert areas, usually along watercourses and in depressions. It could occur in the hills or on the flats. *Acacia erioloba* is relatively common in the study area, whereas *Acacia haematoxylon*, *Euclea pseudobenus* and *Boscia albitrunca* occur more sparsely.

Any of these species could occur in any part of the study area, depending on local conditions. It is, however, most likely that they would occur in drainage areas or at the base of mobile dunes.

Sensitivity assessment

The sensitivity assessment identifies those parts of the study area that could (a) possibly have high conservation value or that (b) may be sensitive to disturbance. Areas of potentially high sensitivity are shown in Figure 10. An explanation of the different sensitivity classes is given in Table 4. Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity.

Table 4: Explanation of sensitivity ratings.

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
VERY HIGH	Indigenous natural areas that are highly positive for any of the following: • presence of threatened species (Critically Endangered, Endangered, Vulnerable) and/or habitat critical for the survival of populations of threatened species. • High conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk). • Protected habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act) And may also be positive for the following: • High intrinsic biodiversity value (high species richness and/or turnover, unique ecosystems) • High value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value) • Low ability to respond to disturbance (low resilience, dominant species very old).	• T1 areas. • Reserves and National Parks • Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered or Vulnerable. • Protected forest patches. • Confirmed presence of populations of threatened species.
HIGH	Indigenous natural areas that are positive for any of the following: • High intrinsic biodiversity value (moderate/high species richness and/or turnover). • presence of habitat highly suitable for threatened species (Critically Endangered, Endangered, Vulnerable species). • Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age). • Moderate conservation status (moderate proportion remaining intact, moderately	• T2 areas. • Habitat where a threatened species could potentially occur (habitat is suitable, but no confirmed records). • Confirmed habitat for species of lower threat status (near threatened, rare). • Habitat containing individuals of

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
	fragmented, habitat for species that are at risk). • Moderate to high value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). And may also be positive for the following: • Protected habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act)	extreme age. • Habitat with low ability to recover from disturbance. • Habitat with exceptionally high diversity (richness or turnover). • Habitat with unique species composition and narrow distribution. • Ecosystem providing high value ecosystem goods and services.
MEDIUM-HIGH	Indigenous natural areas that are positive for one or two of the factors listed above, but not a combination of factors.	• ESA (corridor) areas. • Habitat with high diversity (richness or turnover). • Habitat where a species of lower threat status (e.g. (near threatened, rare) could potentially occur (habitat is suitable, but no confirmed records).
MEDIUM	Other indigenous natural areas in which factors listed above are of no particular concern. May also include natural buffers around ecologically sensitive areas and natural links or corridors in which natural habitat is still ecologically functional.	
MEDIUM-LOW	Degraded or disturbed indigenous natural vegetation.	
LOW	No natural habitat remaining.	

Any natural vegetation within which there are features of conservation concern will be classified into one of the high sensitivity classes (MEDIUM-HIGH, HIGH or VERY HIGH. The difference between these three high classes is based on a combination of factors and can be summarised as follows:

1. Areas classified into the VERY HIGH class are vital for the survival of species or ecosystems. They are either known sites for threatened species or are ecosystems that have been identified as being remaining areas of vegetation of critical conservation importance. CBA1 areas would qualify for inclusion into this class.
2. Areas classified into the HIGH class are of high biodiversity value, but do not necessarily contain features that would put them into the VERY HIGH class. For example, a site that is known to contain a population of a threatened species would be in the VERY HIGH class, but a site where a threatened species could potentially occur

(habitat is suitable), but it is not known whether it does occur there or not, is classified into the HIGH sensitivity class. The class also includes any areas that are not specifically identified as having high conservation status, but have high local species richness, unique species composition, low resilience or provide very important ecosystem goods and services. CBA2 areas would qualify for inclusion into this class, if there were no other factors that would put them into the highest class.

3. Areas classified into the MEDIUM-HIGH sensitivity class are natural vegetation in which there are one or two features that make them of biodiversity value, but not to the extent that they would be classified into one of the other two higher categories. ESA areas would qualify for inclusion into this class.

There are a number of features that need to be taken into account in order to evaluate sensitivity in the study area. These include the following:

1. vegetation of conservation importance: this is based primarily on the Draft Ecosystem List;
2. presence of reserves and National Parks;
3. “irreplaceable” and “important” biodiversity areas;
4. perennial and non-perennial rivers and streams: this represents a number of ecological processes including groundwater dynamics, hydrological processes, nutrient cycling and wildlife dispersal;
5. potential occurrence of populations of Red List organisms, including flora and fauna that have been evaluated as having a high chance of occurring within natural habitats in the study area.

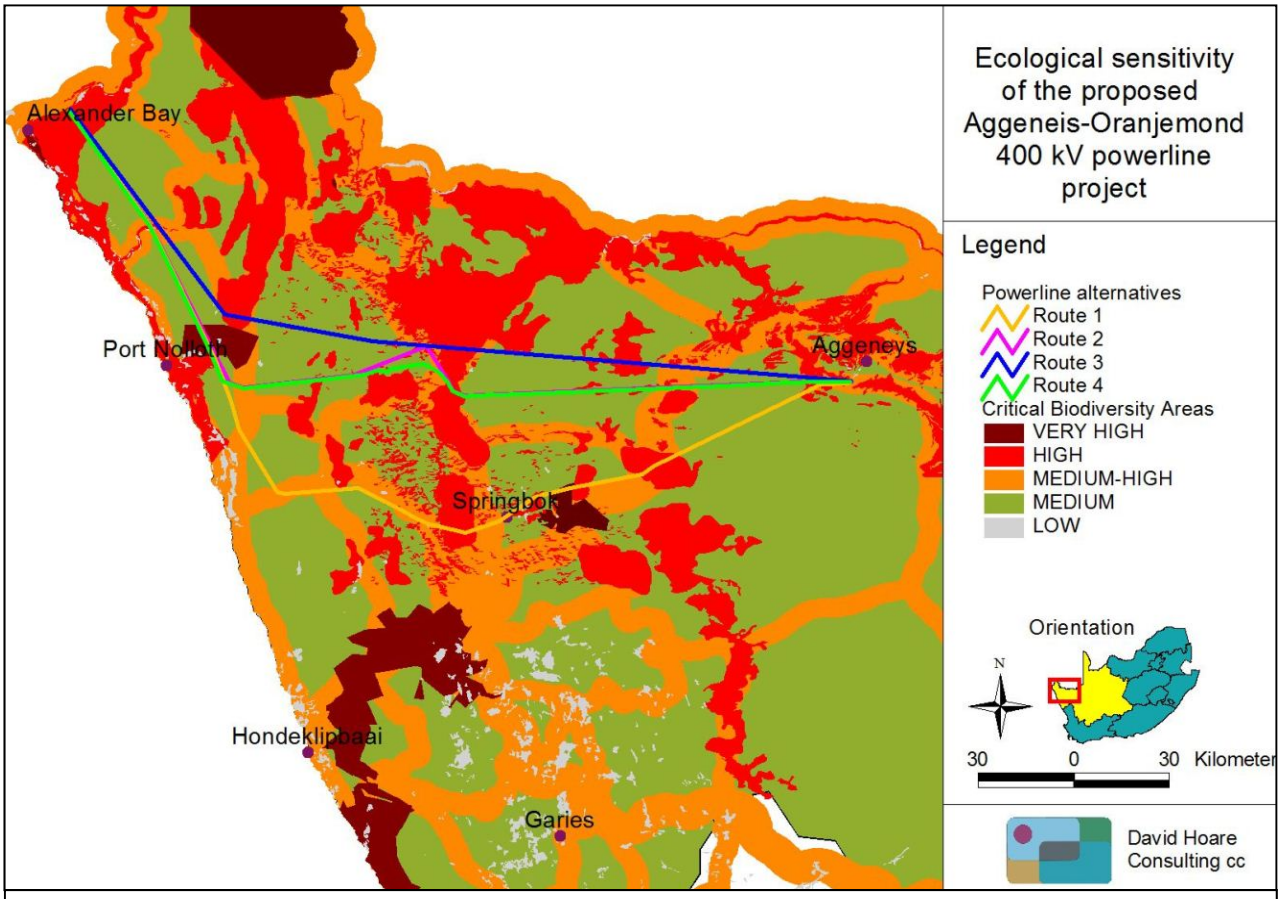

Figure 10: Potentially sensitive parts of the study area.

These factors have been taken into account in evaluating sensitivity within the study area (Figure 10). The sensitivity classification for the site is as follows:

1. VERY HIGH: (i) Areas falling within the Endangered vegetation type, Lower Gariep Alluvial Vegetation. (ii) Areas falling within National Parks and/or reserves. (iii) All T1 areas (irreplaceable sites), according to the Namakwa District Biodiversity Sector Plan.
2. HIGH: All T2 areas (important biodiversity areas), according to the Namakwa District Biodiversity Sector Plan are classified as having high sensitivity (see Table 4 and Figure 10).
3. MEDIUM-HIGH: All ESA (corridor) areas, according to the Namakwa District Biodiversity Sector Plan are classified as having medium-high sensitivity (see Table 4 and Figure 10).
4. MEDIUM: All remaining areas of natural vegetation.
5. LOW: Areas where no natural vegetation occurs is classified as having low sensitivity (see Table 4 and Figure 10). This includes cultivated lands, mined areas, urban areas, roads and bare ground.

RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS

Relevant legislation is provided in this section to provide a description of the key legal considerations of importance to the proposed project. The applicable legislation is listed below.

Legislation

National Environmental Management Act, Act No. 107 of 1998 (NEMA)

NEMA requires, inter alia, that:

- "development must be socially, environmentally, and economically sustainable",
- "disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied." ,
- "a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions",

NEMA states that "the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage."

National Forests Act (Act no 84 of 1998)

Protected trees

According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that ' no person may cut, damage, disturb, destroy or remove any *protected tree*, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.

Forests

Prohibits the destruction of indigenous trees in any natural forest without a licence.

National Environmental Management: Biodiversity Act (Act No 10 of 2004)

In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).
- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

Chapter 4 of the Act relates to threatened or protected ecosystems or species. According to Section 57 of the Act, "Restricted activities involving listed threatened or protected species":

- (1) A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7.

Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants: are prohibited and must be controlled.
- Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.

- Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands.

Northern Cape Nature Conservation Act, No. 9 of 2009

This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project:

- Boundary fences may not be altered in such a way as to prevent wild animals from freely moving onto or off of a property;
- Aquatic habitats may not be destroyed or damaged;
- The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species.

The Act provides lists of specially protected and protected species for the Province. According to the Act, no person may hunt, import, export, transport, keep, possess, breed or trade in a specimen of a specially protected or protected animal species. According to the Act, no person may pick, import, export, transport, possess, cultivate or trade in a specimen of a specially protected or protected plant species.

The Act makes no mention of control of impacts due to development or destruction *in situ* of any listed species due to construction activities or any permit requirements for these types of activities.

National Water Act, No. 36 of 1998

Provides for the protection of water resources in South Africa, including protecting aquatic and associated ecosystems and their biological diversity, reducing, and preventing pollution and degradation of water resources. According to the Act, water use includes impeding or diverting the flow of water in a watercourse and altering the bed, banks, course, or characteristics of a watercourse. Any contemplated water use requires the issuing of a permit from the Department.

IDENTIFICATION OF RISKS AND POTENTIAL IMPACTS

Potential issues relevant to potential impacts on the ecology of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern (flora and fauna), including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern.
- Impacts on sensitive habitats: this includes impacts on any sensitive or protected habitats, including indigenous forest, fynbos and wetland vegetation that leads to direct or indirect loss of such habitat.
- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:
    - disruption to nutrient-flow dynamics;
    - impedance of movement of material or water;
    - habitat fragmentation;
    - changes to abiotic environmental conditions;
    - changes to disturbance regimes, e.g. increased or decreased incidence of fire;
    - changes to successional processes;
    - effects on pollinators;
    - increased invasion by alien plants.

  Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or change in ecosystem function.
- Secondary and cumulative impacts on ecology: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic or ecological environment.
- Impacts on the economic use of vegetation: this includes any impacts that affect the productivity or function of ecosystems in such a way as to reduce the economic value to users, e.g. reduction in grazing capacity, loss of harvestable products. It is a general consideration of the impact of a project on the supply of so-called ecosystem goods and services.

A number of direct risks to ecosystems would result from construction of the proposed power line, as follows:

- Clearing of land for construction.
- Construction of access roads.
- Establishment of borrow and spoil areas.
- Chemical contamination of the soil by construction vehicles and machinery.
- Operation of construction camps.
- Storage of materials required for construction.

There are also risks associated with operation of the proposed power line, as follows:

- Maintenance of vegetation within servitude as part of management of power line.

It must be noted that impacts from the service/access road would probably be of greater significance on habitats than the tower structures. The tower footprint is relatively small relative to the access road.

Description of potential impacts

Major potential impacts are described briefly below. These are compiled from a generic list of possible impacts derived from previous projects of this nature and from a literature review of the potential impacts of power lines on the ecological environment. There are two major ways that the power line development may influence ecosystem structure and functioning—through direct impacts on individual organisms and through impacts on habitat structure and functioning.

Impact 1: Loss of habitat for threatened animals

Nature: Threatened animal species are affected primarily by the overall loss of habitat, since direct construction impacts can often be avoided due to movement of individuals from the path of construction.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localized populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species, possibly extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations or the habitat that they depend on. Consequences may include:

1. fragmentation of populations of affected species;
2. reduction in area of occupancy of affected species; and
3. loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species overall survival chances.

There are a number of mammal, reptile and/or amphibian species of conservation concern that could potentially be affected by the proposed development. This includes one species listed as Critically Endangered (CR), De Winton's Golden Mole, one species listed as Endangered (EN), Hartmann's Mountain Zebra, two species listed as Vulnerable (VU), the Namaqua Stream Frog and the Armadillo Girdled Lizard, one species listed as Vulnerable in the South African part of its range, although globally, it is listed as Least Concern, the Angolan Wing-gland Bat., and two species listed as Near Threatened (NT), the Namaqua Plated Lizard and the Speckled Padloper.

Impact 2: Loss of populations of threatened plants

Plant species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localized populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened plant species, loss of a population or individuals could lead to a direct change in the conservation status of the species, possibly extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations. Consequences may include:

1. fragmentation of populations of affected species;
2. reduction in area of occupancy of affected species; and
3. loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species overall survival chances.

There are a large number of Red List or Orange List plant species that have a geographic distribution that includes the study area (see Appendix 1) and populations of these may occur in concentrations in different parts of the study area (see Figures 8 and 9).

Impact 3: Loss of individuals of protected tree species

There are a number of tree species that are protected according to Government Notice no. 1012 under section 12(I)(d) of the National Forests Act, 1998 (Act No. 84 of 1998). In terms of section1 5(1) of the National Forests Act, 1998 "no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license granted by the Minister to an (applicant and subject to such period and conditions as may be stipulated".

A number of species have a geographic distribution that includes the study area appear on this list, including the following: *Acacia erioloba, Acacia haematoxylon, Boscia albitrunca* and *Euclea pseudebenus*. Any of these species could occur in any part of the study area, depending on local conditions. It is, however, most likely that they would occur in drainage areas or at the base of mobile dunes.

Impact 4: Loss or fragmentation of indigenous natural vegetation (terrestrial)

Construction of infrastructure may lead to direct loss of vegetation. This will lead to localised or more extensive reduction in the overall extent of grassland vegetation. Where this vegetation has already been stressed due to degradation and transformation at a regional level, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat and a change in the conservation status (current conservation situation). Consequences of the impact occurring may include:

1. negative change in conservation status of habitat (Driver et al. 2005);
2. increased vulnerability of remaining portions to future disturbance;
3. general loss of habitat for sensitive species;
4. loss in variation within sensitive habitats due to loss of portions of it;
5. general reduction in biodiversity;
6. increased fragmentation (depending on location of impact);
7. disturbance to processes maintaining biodiversity and ecosystem goods and services; and
8. loss of ecosystem goods and services.

There are 26 different vegetation types across which the proposed alternative alignments traverse (see Figure 4). All except one of these is classified as Least Threatened. However, the site falls within the Gariep Centre of Endemism (see Figure 5) and the study area is situated in the heart of the part of this Centre that is considered a high priority for conservation in order to preserve species and ecosystems typical of this Centre. The area is also within the succulent Karoo Region, which is indicated as one of the world's 25 global biodiversity hotspots.

Impact 5: Damage to wetlands

Construction may lead to some direct or indirect loss of or damage to seasonal marsh wetlands or drainage lines or impacts that affect the catchment of these wetlands. This will lead to localised loss of wetland habitat and may lead to downstream impacts that affect a greater extent of wetlands or impact on wetland function. Where these habitats are already stressed due to degradation and transformation, the loss may lead to increased vulnerability

(susceptibility to future damage) of the habitat. Physical alteration to wetlands can have an impact on the functioning of those wetlands. Consequences may include:

1. increased loss of soil;
2. loss of or disturbance to indigenous wetland vegetation;
3. loss of sensitive wetland habitats;
4. loss or disturbance to individuals of rare, endangered, endemic and/or protected species that occur in wetlands;
5. fragmentation of sensitive habitats;
6. impairment of wetland function;
7. change in channel morphology in downstream wetlands, potentially leading to further loss of wetland vegetation; and
8. reduction in water quality in wetlands downstream of road.

The study area contains a number of non-perennial streams and drainage lines. In most cases, it is likely that these can be traversed without situating infrastructure anywhere within them.

Impact 6: Establishment and spread of declared weeds and alien invader plants

Major factors contributing to invasion by alien invader plants includes high disturbance, fostering/utilisation as hedges, woodlots or fruit trees, negative grazing practices, and deforestation (Zachariades *et al*. 2005). Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins *et al*. 2003). Consequences of this may include:

1. loss of indigenous vegetation;
2. change in vegetation structure leading to change in various habitat characteristics;
3. change in plant species composition;
4. change in soil chemical properties;
5. loss of sensitive habitats;
6. loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
7. fragmentation of sensitive habitats;
8. change in flammability of vegetation, depending on alien species;
9. hydrological impacts due to increased transpiration and runoff; and
10. impairment of wetland function.

There are various alien plants that occur in the study area. Species of *Prosopis* are most likely to be problematic in this area.

Impact 7: Crossing National Parks / reserves

Construction of a power line through a National Park or nature reserve can affect the perceived or real biodiversity value of the area. These areas are protected according to legislation and are usually treated as “no-go” areas in biodiversity planning documents. The Namakwa District Biodiversity Sector Plan considers these areas to be unsuitable for development. There are three protected areas along the path of proposed alternative alignments, the Goegap Nature Reserve to the east of Springbok, a small outlier of the Richtersveld National Park, situated just inland of Port Nolloth, and the Black Mountain Mine Reserve near Aggeneys (see Figure 7).

ASSESSMENT OF IMPACTS

Impacts are assessed for each alignment alternative, as shown in all figures in this report.

Impacts

Impact 1: Loss of habitat for threatened animals

There are various threatened animal species that occur in the study area, many of which are restricted to specific localities (cannot move from the path of construction). This includes De Winton's Golden Mole (CR), which could potentially be severely affected if infrastructure is placed directly over habitat in which it occurs. It also includes various species that are relatively slow-moving and/or likely to be restricted to specific localities, including the Namaqua Stream Frog (VU), the Armadillo Girdled Lizard (VU), the Namaqua Plated Lizard (NT) and the Speckled Padloper (NT). The remaining two species of concern (Hartmann's Mountain Zebra and the Angolan Wing-gland Bat) can move from the path of construction and are, therefore, less likely to be directly affected by construction. The assessment below is for those species that are most likely to be directly affected and the assumption is made that they will be directly affected.

For corridor 1, all five species of concern, as described above, could occur within the corridor, but there are three species for which there is a higher chance of encountering them than on other corridors. These are the Namaqua Stream Frog (VU), the Armadillo Girdled Lizard (VU) and the Speckled Padloper (NT).

For corridor 2 and 4, all five species of concern, as described above, could occur along the alignment.

For corridor 3, four of the five species of concern, as described above, could occur along the alignment (De Wintons Golden Mole does not occur along this alignment). There are two species for which there is a higher chance of encountering them than on other routes. These are the Namaqua Plated Lizard (NT) and the Speckled Padloper (NT).

Duration: In localised areas, the impact will be permanent due to the fact that clearing of habitat for construction purposes cannot be reversed. However, most areas will recover, or impacts can be reversed with rehabilitation.

Extent: The impact will occur at the site of the proposed power line, specifically the site of individual tower structures and access roads that may affect areas of concern. It could potentially have an effect at a more regional level, since it could affect entire populations of affected species, but it is more likely to affect local populations, depending on the species. In all cases, the area of concern is likely to be limited in extent.

Magnitude: At a local scale, the potential magnitude of this impact could be high (population processes may be altered to the extent that they temporarily cease). This is a worst-case scenario.

Probability: Each power line tower occupies a small amount of space. Access roads potentially occupy more space, but tend to be tracks through the veld. The probability of directly striking a population of an affected species is considered to be relatively low, but possible. The probability of the impact occurring is therefore rated as improbable. However, if a population were to be found within the footprint of a tower or access road, then the probability would be

definite (worst-case scenario). The potential significance of the impact therefore depends on the absolute location of infrastructure relative to populations of affected species.

Significance: The potential significance of this impact emerges as possibly being of high significance at a local scale. This score is based purely on the assumption that a population will be affected and is a worst-case scenario. If no local populations are affected then the significance will be low. Mitigation measures are proposed to reduce the risk of any populations being affected.

Mitigation measures: A walkthrough survey must be undertaken once a final route has been selected and the position of individual towers and access roads is known. If any populations of species of concern are encountered, then, where possible, the individual tower structure must be shifted to avoid striking the specific habitat of concern.

Nature: Loss of habitat for threatened animals – corridor 1, 2 and 4		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Short-term (1)
Magnitude	High (8)	Small (1)
Probability	Definite (5)	Highly unlikely (1)
Significance	**High (70)**	**Low (3)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible to some degree	Reversible to some degree
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Undertake a walkthrough survey of the selected route, once tower positions are known. If any populations of species of concern are encountered, then the individual tower structure must be shifted to avoid striking the specific habitat of concern. Use existing access roads as far as possible.		
Cumulative impacts: Loss of habitat, damage to drainage lines, alien invasions may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: None likely		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Nature: Loss of habitat for threatened animals – corridor 3		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Short-term (1)
Magnitude	Medium (6)	Small (1)
Probability	Definite (5)	Highly unlikely (1)
Significance	**Medium (60)**	**Low (3)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Reversible
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: Undertake a walkthrough survey of the selected route, once tower positions are known.		

Cumulative impacts:
Loss of habitat, damage to drainage lines, alien invasions may all lead to additional impacts that will exacerbate this impact.
Residual Impacts:
None likely

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 2: Loss of populations of threatened plants

There are a large number of Red List or Orange List plant species that have a geographic distribution that includes the study area and populations of these may occur in concentrations in different parts of the study area. Corridors 2 and 4 go through the grids with the highest concentration of threatened species, although all 4 corridors could affect threatened species and all 4 corridors have an equal probability of affecting additional species of lower conservation concern.

Duration: The impact will be permanent due to the fact that clearing of vegetation for construction purposes cannot be reversed and any plants destroyed will be permanently lost. More importantly, loss of suitable habitat for any of these species means that the plants cannot become re-established.

Extent: The impact will occur at the site of the proposed power line, but will have an impact at a more regional level, since it potentially affects the global status of affected species. For plant populations, the location of infrastructure is critical.

Magnitude: At a local scale, the potential magnitude of this impact could be high (population processes may be altered to the extent that they temporarily cease). This is a worst-case scenario.

Probability: It is probable that this impact will occur because of the high numbers of species of concern that occur in the study area. However, if a population were to be found within the footprint of a tower or access road, then the probability would be definite (worst-case scenario). The potential significance of the impact therefore depends on the absolute location of infrastructure relative to populations of affected species.

Significance: The potential significance of this impact emerges as possibly being of high significance at a local scale. This score is based purely on the assumption that a population will be affected and is a worst-case scenario. If no local populations are affected then the significance will be low. Mitigation measures are proposed to reduce the risk of any populations being affected.

Mitigation measures: A walkthrough survey must be undertaken once a final route has been selected and the position of individual towers and access roads is known. If any populations of species of concern are encountered, then the individual tower structure must be shifted as far as possible to avoid striking the specific habitat of concern.

Nature: Destruction/permanent loss of individuals of threatened plant species		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Low (1)
Probability	Definite (5)	Highly unlikely (1)

Significance	**High (70)**	**Low (7)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible to some degree	Reversible to some degree
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Undertake a walkthrough survey of the selected route, once tower positions are known. This must take place during the correct season for determining whether the species of concern occur there or not. Use existing access roads as far as possible.		
Cumulative impacts: Loss of habitat, alien invasions may lead to additional impacts that will exacerbate this impact.		
Residual Impacts: None likely		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 3: Loss of individuals of protected tree species

There are four protected tree species that have a geographic distribution that includes the study area, *Acacia erioloba, Acacia haematoxylon, Boscia albitrunca* and *Euclea pseudebenus*. Any of these species could occur in any part of the study area, depending on local conditions. It is, however, most likely that they would occur in drainage areas or at the base of mobile dunes. Corridor 1 is the least likely to encounter protected trees, although the likelihood still exists that protected trees could occur within this corridor.

Duration: The impact will be long-term to permanent because clearing of trees for construction purposes will lead to the complete loss of those individuals. In some cleared areas, however, it is likely that juvenile recruitment will eventually replace lost trees. On an ongoing basis, Eskom will need to trim trees to maintain a vertical height restriction of 4 m within the servitude.

Extent: The impact will occur at the site of the individual tower structures of the proposed power line and access roads, although, in some cases, trees may be required to be trimmed to below 4 m height within the entire servitude. It may affect single individuals of protected species.

Magnitude: The potential magnitude of this impact will be low, due to the small number of trees that are likely to be affected.

Probability: It is highly likely that there will be protected trees affected.

Significance: The impact will be of medium significance.

Mitigation measures: Undertake a walkthrough survey of the selected route, once tower and access road positions are known, in order to determine the exact number of individuals of each species that will be affected. Although not considered a mitigation measure, a permit would need to be obtained for any protected trees that are affected, so a legal obligation remains to determine the presence of protected trees irrespective of the significance of the impact. If large numbers of trees will be affected, then additional biodiversity offsets or planting programmes may be required.

Nature: Loss of individuals of protected trees		
	Without mitigation	**With mitigation**

Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (3)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Medium (40)**	**Medium (36)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	To some degree	
Mitigation: Undertake a walkthrough survey of the selected route, once tower and access road positions are known, in order to determine the exact number of individuals of each species that will be affected. Obtain a permit for any protected trees that have to be destroyed or trimmed in order to construct or maintain the power line. If large numbers of trees will be affected then additional biodiversity offsets or planting programmes may be required. Use existing access roads as far as possible.		
Cumulative impacts: Impacts due to alien invasions and damage to watercourses may possibly cause damage to habitat where protected trees could grow that may exacerbate this impact.		
Residual Impacts: None likely		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 4: Loss or fragmentation of indigenous natural vegetation (terrestrial)

The individual tower structures of the power line occupy a relatively small area. Access roads potentially occupy more space, but tend to be tracks through the veld. In some areas where the natural vegetation is relatively tall, it may be necessary to trim all tall vegetation within the servitude to a height of less than 4 m. Due to the arid nature of the study area, very little vegetation is tall enough to warrant this action. Eskom usually clear the centre line of the servitude (usually about 8m) for stringing purposes during construction. This would need to be rehabilitated after construction is completed. Disturbed areas in this very arid region are not likely to recover very quickly.

Power lines do not form an impenetrable barrier across the vegetation and are therefore not likely to lead to any significant form of fragmentation. Access roads are generally less than 4 m wide and tend to eventually become grown over with vegetation, except where it is maintained as bare ground.

Duration: The impact will be long-term due to the fact that clearing of vegetation for construction purposes cannot be easily reversed and vegetation in disturbed areas within this arid region may take a long time to recover. Rehabilitation may assist in recovery of vegetation.

Extent: The impact will occur at the site of the proposed power line, but will have an impact at a more regional level, since it affects areas classified regionally as having high conservation value (Gariep Centre of Endemism).

Magnitude: At a local and regional scale, the potential magnitude of this impact will be small due to the small area of vegetation likely to be affected relative to the overall extent of the vegetation types concerned.

Probability: It is definite that there will be impacts on natural vegetation.

Potential significance: The potential significance of this impact could potentially be of low significance at a regional scale and medium significance at a local scale.

Mitigation measures: Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the servitude of the power line.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Small (3)	Small (2)
Probability	Definite (5)	Definite (5)
Significance	**Medium (40)**	**Medium (35)**
Status (positive or negative)	Negative	Negative
Reversibility	Not easily reversible	Not easily reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some extent	
Mitigation: Avoid unnecessary impacts on natural vegetation surrounding infrastructure. Impacts should be contained, as much as possible, within the servitude of the power line. Use existing access roads as far as possible		
Cumulative impacts: Soil erosion, alien invasions may lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of this vegetation type will occur, but this is insignificant relative to the total extent of the vegetation type.		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 5: Damage to wetlands / watercourses

There are a number of non-perennial watercourses within the proposed corridors that could potentially be affected by the proposed construction of the power line. These are primarily lower order watercourses. There are some wetlands very close to the coast, but these areas are not affected by this project. There are also some non-perennial wetlands in the drainage lines of the escarpment zone to the west of Steinkopf and around Springbok.

Duration: The impact will be long-term.

Extent: The impact will occur at the site of the individual proposed power line tower structures and access roads, but could have downstream impacts. The extent of the potential impact is therefore on the site and surroundings.

Magnitude: The potential magnitude of this impact will be moderate at a local scale.

Probability: Due to the fact that drainage lines occur within the footprint of the proposed power line and access roads, it is likely that drainage lines will be affected.

Potential significance: The significance of this impact is rated as medium at a scale of local and surroundings before mitigation.

Mitigation measures: Place tower structures a minimum of 50 m from the edge of any water course or drainage line and avoid crossing drainage lines and wetlands as far as possible with

access roads. If not, a permit from the Department of Water Affairs (DWA) is required if there are expected to be any impacts on any drainage line, wetland or water resource.

Nature: Damage to watercourses and drainage lines		
	Without mitigation	**With mitigation**
Extent	Local and surroundings (2)	Local and surroundings (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Likely (3)	Highly unlikely (1)
Significance	**Medium (36)**	**Low (10)**
Status (positive or negative)	Negative	Negative
Reversibility	Not Reversible	Reversible
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	To some degree	
Mitigation: Keep power line tower structures a minimum of 50 m outside any watercourse or drainage line, and avoid crossing drainage lines and wetlands as far as possible with access roads; OR obtain a permit from DWA.		
Cumulative impacts: Soil erosion and alien invasions may lead to additional impacts on watercourses that will exacerbate this impact.		
Residual Impacts: None.		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 6: Establishment and spread of declared weeds and alien invader plants

The presence of a diffuse disturbance over a wide area could lead to the spread of species that are present in the area. Watercourses are especially vulnerable to such impacts.

Extent: The impact will occur at the site of the proposed power line and access roads, but could potentially spread extensively into the surrounding landscape. The impact will therefore be evaluated at a scale of site and surroundings.

Duration: The impact will be long-term unless alien plants are controlled.

Extent: The impact will occur at the site of the proposed power line and associated access road, but could spread into neighbouring areas.

Magnitude: The potential magnitude of this impact is moderate for local ecosystems.

Probability: There is a moderate likelihood that alien species will spread on site in the absence of control measures.

Potential significance: The impact could potentially be of moderate to high significance. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low.

Mitigation measures: Disturbance of indigenous vegetation must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled so as to avoid the development of a soil seed bank of alien plants within the stock-piled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank that would take decades to remove. An

on-going monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (3)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (36)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	Not Reversible	Reversible
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	To some degree	
Mitigation: (1) Keep disturbance of indigenous vegetation to a minimum (2) Rehabilitate disturbed areas as quickly as possible following completion of construction activities in an area (3) Do not translocate soil stockpiles from areas with alien plants (4) Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) Establish an on-going monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands may lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 7: Crossing National Parks / reserves

Corridors 1, 2 and 4 crosses directly through the middle of the outlier of the Richtersveld National Park just inland of Port Nolloth. Corridor 1 also crosses the northern part of the Goegap Nature Reserve to the east of Springbok. All corridors cross the Black Mountain Mine Reserve near Aggeneys.

Extent: The impact will occur at the site of the proposed power line and associated access road, but affects the integrity of the entire reserve / park. The impact will therefore be evaluated at a scale of site and surroundings.

Duration: The impact will be long-term to permanent.

Magnitude: The potential magnitude of this impact is moderate.

Probability: It is definite that the impact will occur for this alignment.

Potential significance: The impact could potentially be of high significance.

Mitigation measures: Modify the alignment to keep it outside the boundaries of the affected reserve / park. If this is not possible then the agency managing the affected area must be consulted for comment and potential mitigation.

Nature: Crossing National Parks / reserves –corridor 1, 2 and 4		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Small (1)
Probability	Definite (5)	Highly improbable (1)
Significance	**High (65)**	**Low (8)**
Status (positive or negative)	Negative	Negative
Reversibility	Not Reversible	Reversible
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	To some degree	
Mitigation: (1) Modify the alignment to keep it outside the boundary of the affected reserve / parks. If this is not possible then the agency managing the affected area must be consulted for comment and potential mitigation.		
Cumulative impacts: None.		
Residual Impacts: None, if mitigation measures are applied.		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Nature: Crossing National Parks / reserves – corridor 3		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Small (1)
Probability	Definite (5)	Highly improbable (1)
Significance	**Medium (55)**	**Low (8)**
Status (positive or negative)	Negative	Negative
Reversibility	Not Reversible	Reversible
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	To some degree	
Mitigation: (1) Modify the alignment to keep it outside the boundary of the affected reserve / parks.		
Cumulative impacts: None.		
Residual Impacts: None, if mitigation measures are applied.		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Evaluation of alternatives

For all four proposed routes, there are likely to be impacts on protected trees, indigenous natural vegetation and wetlands and an equal likelihood of alien invader plants becoming established. For these impacts, the impacts are rated as being of medium significance and can be reduced with proposed mitigation measures. The selection of the route does not affect the significance of these impacts or the proposed mitigation measures. There are three impacts for

which selection of the route potentially affects the significance of impacts, namely impacts on threatened plants, threatened animals and National Parks / reserves. Each route is discussed below relative to these three potential impacts.

Corridor 1

This route crosses areas in which threatened plants and animals are both highly likely to occur. Concentrations of threatened plant species per grid are lower for this corridor than for corridors 2 and 4, but this corridor could still affect threatened plant species to a significant degree. All 4 corridors have an equal probability of affecting additional plant species of lower conservation concern.

There are five animal species of concern that could occur along the alignment and could potentially be negatively affected by the power line, including the Critically Endangered (CR) De Winton's Golden Mole. Three species have a higher chance of being encountered on this corridor than on other corridors. These are the Namaqua Stream Frog (VU), the Armadillo Girdled Lizard (VU) and the Speckled Padloper (NT).

Corridor 1 crosses directly through the middle of the outlier of the Richtersveld National Park just inland of Port Nolloth, the northern part of the Goegap Nature Reserve to the east of Springbok and the Black Mountain Mine Reserve near Aggeneys. Alternative corridors past the Richtersveld National Park and the Goegap Nature Reserve are required to make this route acceptable.

Corridor 2

This corridor crosses areas in which threatened plants and animals are both highly likely to occur. Concentrations of threatened plant species per grid are high for this corridor and special attention will have to be paid to avoiding populations of threatened plant species. All 4 corridors have an equal probability of affecting additional plant species of lower conservation concern.

There are five animal species of concern that could occur within this corridor and could potentially be negatively affected by the power line, including the Critically Endangered (CR) De Winton's Golden Mole.

Corridor 2 crosses directly through the middle of the outlier of the Richtersveld National Park just inland of Port Nolloth. It also crosses the Black Mountain Mine Reserve near Aggeneys. An alternative corridor past the Richtersveld National Park is required to make this route acceptable.

Corridor 3

This corridor crosses areas in which threatened plants and animals are both highly likely to occur. Concentrations of threatened plant species per grid are lower for this corridor than for corridors 2 and 4, but this corridor could still affect threatened plant species to a significant degree. All 4 corridors have an equal probability of affecting additional plant species of lower conservation concern.

For this corridor, four of the five species of concern could occur within the corridor (De Wintons Golden Mole does not occur along this alignment). There are two species for which there is a higher chance of encountering them than on other corridors. These are the Namaqua Plated Lizard (NT) and the Speckled Padloper (NT).

Corridor 3 crosses the Black Mountain Mine Reserve near Aggeneys. This reserve is of lesser concern than the other two potentially affected by other corridor alternatives.

Corridor 4

This corridor crosses areas in which threatened plants and animals are both highly likely to occur. Concentrations of threatened plant species per grid are high for this corridor and special attention will have to be paid to avoiding populations of threatened plant species. All 4 corridors have an equal probability of affecting additional plant species of lower conservation concern.

There are five animal species of concern that could occur along the alignment and could potentially be negatively affected by the power line, including the Critically Endangered (CR) De Winton's Golden Mole.

Corridor 4 crosses directly through the middle of the outlier of the Richtersveld National Park just inland of Port Nolloth and the Black Mountain Mine Reserve near Aggeneys. An alternative corridor past the Richtersveld National Park is required to make this route acceptable.

Comparison of alternative corridors

Corridors 2 and 4 pass through the grids with the highest concentration of threatened plant species, although all 4 corridors could affect threatened plant species and all 4 corridors have an equal probability of affecting additional species of lower conservation concern. Although the risks of encountering threatened plant species are greater on corridors 2 and 4, a walk-through survey in combination with modified micro-siting of tower structures could effectively avoid impacts on plant species of conservation concern.

All four of the proposed corridors could potentially affect populations or habitats of animal species of concern. However, corridor 1 is the one with the greatest risk to threatened animal species, including the greatest risks to the Critically Endangered (CR) De Winton's Golden Mole, the Vulnerable (VU) Armadillo Girdled Lizard and the Vulnerable (VU) Namaqua Stream Frog. The only corridor that does not affect the Critically Endangered (CR) De Winton's Golden Mole is corridor 3. Although the risks of encountering threatened animal species are greater on corridor 1, a walk-through survey in combination with modified micro-siting of tower structures could potentially avoid impacts on animal species of conservation concern.

Corridors 1, 2 and 4 cross directly through the middle of the outlier of the Richtersveld National Park just inland of Port Nolloth. An alternative alignment past this area is required to make these corridors acceptable. Corridor 1 crosses the northern part of the Goegap Nature Reserve to the east of Springbok. An alternative alignment past this area is required to make this corridor acceptable. All four corridors cross the Black Mountain Mine Reserve near Aggeneys. Due to the disturbed nature of the area around this reserve, it is potentially acceptable to cross this reserve, but it may be better to find an alternative route past this reserve.

DISCUSSION AND CONCLUSIONS

There are 26 major vegetation types that occur in the study area. On the basis of rates of transformation, all but one of these vegetation types are classified as Least Threatened. The vegetation type, Lower Gariep Alluvial Vegetation, associated with the floodplain of the Orange River, is classified as Endangered.

The study site occurs within the Gariep Centre of Floristic Endemism (van Wyk & Smith 2001). There is a high degree of endemism amongst succulent plants in this Centre of Endemism. Ensuring that no endemic elements of the Gariep Centre are negatively affected is very important. The draft Namakwa District Biodiversity Sector Plan identifies specific sites that are important for maintaining biodiversity patterns in the study area. This map provides the basis for identifying sensitive sites along the proposed corridors.

Wetlands and drainage lines are protected under national legislation (National Water Act). The study area contains a number of non-perennial streams and drainage lines. In most cases, it is likely that these can be traversed without situating any permanent infrastructure anywhere within them. However, any impacts on these areas would require a permit from the National Department.

There are four protected tree species that occur in the area and which may occur within the proposed servitude. A walk-through of the entire servitude would be required to identify the exact location of these. It is best to undertake this once an alignment has been selected and not to do so for all four alternative corridors under investigation. A permit from the National Department of Agriculture, Forestry and Fisheries is required to damage, disturb, destroy or remove any protected tree.

There are a large number of Red or Orange List plant species that have a high likelihood of occurring in available habitats in the study area or have been previously recorded there. This high number of plant species of conservation concern is a reflection of the high levels of endemism within the Gariep Centre of Endemism. Many species within this Centre have a restricted distribution and are, therefore, vulnerable to disturbance. A botanical survey of the final alignment to target possible populations of these species is required before it is well understood where they may occur relative to the proposed tower positions and access road alignments (once known). Initial analyses on the basis of existing information indicate that the escarpment zone around Steinkopf is the place with the highest likelihood of encountering threatened plant species.

There are a number of animal species of conservation concern that may occur in habitats within the study area. This includes one species listed as Critically Endangered (CR), De Winton's Golden Mole, one species listed as Endangered (EN), Hartmann's Mountain Zebra, two species listed as Vulnerable (VU), the Namaqua Stream Frog and the Armadillo Girdled Lizard, one species listed as Vulnerable in the South African part of its range, although globally, it is listed as Least Concern, the Angolan Wing-gland Bat., and two species listed as Near Threatened (NT), the Namaqua Plated Lizard and the Speckled Padloper. Two of these species of concern (Hartmann's Mountain Zebra and the Angolan Wing-gland Bat) can move from the path of construction and are, therefore, less likely to be directly affected by construction.

Most of the study area is in natural condition. The position of the alignments within the Gariep Centre of Endemism will lead to many areas in moderate to good condition being classified as having high sensitivity and conservation value. An indication of which areas are considered to have the highest sensitivity with respect to important biodiversity patterns is shown in Figure

6. Areas classified as having VERY HIGH sensitivity are National Parks and statutory nature reserves. These should be treated as “no-go” areas.

There are three reserves indicated as occurring within the currently proposed corridors. Two of these, an outlier of the Richtersveld National Park, situated just inland of Port Nolloth, and the Goegap Nature Reserve, just east of Springbok, should be avoided and the proposed alignments altered in these places or an alternative corridor selected. There is an additional private reserve near Aggeneys, the Black Mountain Mine Reserve. This is located in an area that contains a lot of mine infrastructure and disturbance. The ecological integrity of this reserve is therefore less likely to be affected by a power line and associated access road. It does not, therefore, necessarily need to be avoided.

A risk assessment was undertaken which identified seven main potential negative impacts on the ecological receiving environment associated with the construction of the proposed power line and associated access roads. The significance of these impacts was assessed within this report. The identified potential impacts are the following:

1. Impacts on threatened animals.
2. Impacts on threatened plants.
3. Impacts on protected tree species.
4. Impacts on indigenous natural vegetation.
5. Impacts on wetlands.
6. Establishment and spread of declared weeds and alien invader plants.
7. Impacts on National Parks / reserves.

Conclusion

All four proposed corridots are potentially acceptable, if proposed mitigation measures are put in place to manage potential impacts. However, in terms of the risk to the ecological receiving environment, Corrido1 1 is considered to be the least favourable and Corridor 3 the most favoured.

Recommendations

The following recommendations are made to reduce impacts or provide additional information that can lead to reduction or control of impacts:

- It is recommended that local alternative routes be found to avoid crossing National Parks / reserves or that corridor 3 is selected as the preferred option. It is especially important that the outlier of the Richtersveld National Park, situated just inland of Port Nolloth, is not crossed by the proposed power line.
- Once a route has been selected, and tower positions and access road routes have been determined, a walk-through survey of high risk portions of the route must be undertaken to determine whether populations of threatened animal and/or plant species will be affected or not. Tower structures and access roads should then be shifted to avoid local impacts. If not, a permit is required according to Chapter 7 the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).
- Corridor 3 is the preferred alternative from an ecological point of view.

Table 3: Summary of the significance of impacts for different infrastructure components before and after mitigation.

	Corridor 1		Corridor 2		Corridor 3		Corridor 4	
Impact on:	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation
1. threatened animals	high (70)	low (3)	high (70)	low (3)	medium (60)	low (3)	high (70)	low (3)
2. threatened plants	high (70)	low (7)	high (70)	low (7)	high (70)	low (7)	high (70)	low (7)
3. protected trees	medium (40)	medium (36)	medium (40)	medium (36)	medium (40)	medium (36)	medium (40)	medium (36)
4. vegetation	medium (40)	medium (35)	medium (40)	medium (35)	medium (40)	medium (35)	medium (40)	medium (35)
5. watercourses	medium (36)	low (10)	medium (36)	low (10)	medium (36)	low (10)	medium (36)	low (10)
6. alien plants	medium (36)	low (18)	medium (36)	low (18)	medium (36)	low (18)	medium (36)	low (18)
7. National Parks / reserves	high (65)	low (8)	high (65)	low (8)	medium (55)	low (8)	high (65)	low (8)

*Significance: <30 = low, 30–60 = medium, >60 = high.

MANAGEMENT PLAN

Control measures are only proposed for those impacts where mitigation measures are proposed to reduce the significance of impacts, i.e. some impacts are of low significance and thus no mitigation measures are proposed or no mitigation measures are possible or required.

OBJECTIVE: Control alien invasive plants	
Project component/s	Any infrastructure or activity that will result in disturbance to natural areas
Potential Impact	Invasion of natural vegetation surrounding the site by declared weeds or invasive alien species
Activity/risk source	Construction of power line infrastructure,
Mitigation: Target/Objective	Target: no alien plants within project control area Time period: construction, operation

Mitigation: Action/control	Responsibility	Timeframe
(1) Avoid creating conditions in which alien plants may become established: a. Keep disturbance of indigenous vegetation to a minimum b. Rehabilitate disturbed areas as quickly as possible c. Do not import soil from areas with alien plants (2) Establish an on-going monitoring programme to detect and quantify any alien species that may become established and identify the problem species (as per Conservation of Agricultural Resources Act) (3) Immediately control any alien plants that become established using registered control methods	Construction team, management (environmental officer)	Construction, Operation

Performance Indicator	For each alien species: number of plants and aerial cover of plants within project area and immediate surroundings
Monitoring	• On-going monitoring of area by environmental control officer during construction • On-going monitoring of area by environmental manager during operation • Annual audit of project area and immediate surroundings by qualified botanist. If no species are detected, then this can be stated. If any alien invasive species are detected then the distribution of these should be mapped (GPS co-ordinates of plants or concentrations of plants), number of individuals (whole site or per unit area), age and/or size classes of plants and aerial cover of plants. The results should be interpreted in terms of the risk posed to sensitive habitats within and surrounding the project area. The environmental manager should be responsible for driving this process. Reporting frequency depends on legal compliance framework

OBJECTIVE: Avoid impacts on threatened plants and/or animals	
Project component/s	Any infrastructure or activity that will result in disturbance to populations of plant and/or animal species of concern
Potential Impact	Loss of individuals/populations or habitats of high importance for populations of threatened plant and/or animal species.
Activity/risk source	Construction of power line infrastructure Construction of new access roads
Mitigation: Target/Objective	Target: no loss of individuals or important habitat of species of concern. Time period: construction

Mitigation: Action/control	Responsibility	Timeframe
(1) Undertake a walkthrough survey of the selected route, once tower positions are known. If any populations of species of concern are encountered, then the individual tower structure must be shifted to avoid striking the specific habitat of concern.	Construction team, management (environmental officer)	Construction
(2) Use existing access roads as far as possible	Eskom Construction team, management (environmental officer)	Planning Construction
(3) As far as possible, limit construction activities to within the power line servitude	Construction team, management (environmental officer)	Construction
(4) Locate construction camps outside of sensitive areas	Eskom Construction team, management (environmental officer)	Planning Construction

Performance Indicator	No loss of individuals or important habitat of species of concern
Monitoring	• None required

OBJECTIVE: Limit impacts on protected trees	
Project component/s	Any infrastructure that may affect protected trees
Potential Impact	Loss of single individuals or groups of protected trees
Activity/risk source	Construction of power line infrastructure Construction of new access roads
Mitigation: Target/Objective	Target: limit loss of individuals of protected trees Time period: construction

Mitigation: Action/control	Responsibility	Timeframe
(1) Where possible, position infrastructure so that individuals of protected trees are not affected. (2) Use existing access roads as far as possible (3) Undertake a walkthrough survey of the selected route, once tower positions are known, in order to determine the exact number of individuals of each species that will be affected. (4) If it is not possible to avoid destroying or damaging trees, a permit is required from Dept. of Forestry for removal of trees or damage to trees. The permit requires the identity, number, size and condition of each tree that will be affected. (5) If large numbers of trees will be affected then additional biodiversity offsets or planting programmes will be required.	Environmental management team, management (environmental officer)	Construction

Performance Indicator	No loss of trees OR obtain removal permit for affected trees Use of existing access roads
Monitoring	• None required

OBJECTIVE: Control loss of/disruption to indigenous vegetation	
Project component/s	Any infrastructure or activity that will result in disturbance to natural areas
Potential Impact	Loss of indigenous natural vegetation due to construction activities
Activity/risk source	Construction of power line infrastructure Construction of new access roads
Mitigation: Target/Objective	Target: minimal loss of natural vegetation Time period: construction

Mitigation: Action/control	Responsibility	Timeframe
(1) The construction impacts must be contained to the footprint of the infrastructure and/or the servitude of the power line. (2) Limit unnecessary impacts on surrounding natural vegetation, e.g. driving around in the veld, use access roads only (3) Before construction, demarcate servitude and ensure that construction impacts are contained within this area. (4) Use existing access roads as far as possible (5) Locate construction camps outside of sensitive areas	Construction team, management (environmental officer)	Construction

Performance Indicator	Minimum loss of natural vegetation outside of the exact footprint of the proposed project
Monitoring	• Ongoing monitoring of area by environmental control officer during construction

OBJECTIVE: Limit damage to watercourses

Project component/s	Any infrastructure or activity that will result in disturbance to watercourses
Potential Impact	Damage to watercourses by any means that will result in hydrological changes (includes erosion, siltation, dust, direct removal of soil of vegetation, dumping of material within wetlands). The focus should be on the functioning of the watercourse as a natural system
Activity/risk source	Construction of power line infrastructure Construction of access roads Operation and maintenance
Mitigation: Target/Objective	Target: no unnecessary damage to watercourses within project area Time period: construction, operation

Mitigation: Action/control	Responsibility	Timeframe
(1) Keep power line tower structures and access roads a minimum of 50 m outside any watercourse or drainage line (2) Where watercourse crossings cannot be avoided, obtain a permit from DWA. (3) Ensure construction camps are not located within the 1:50 year floodline of any watercourse	Planning team, construction team, management, environmental control officer	Planning, Construction, Operation

Performance Indicator	No impacts on water quality, water quantity, wetland vegetation, natural status of watercourses outside of footprint of infrastructure
Monitoring	• Habitat loss in watercourses should be monitored before and after construction

OBJECTIVE: Limit impacts on National Parks / reserves	
Project component/s	Any infrastructure or activity that will result in disturbance to National Parks / reserves
Potential Impact	Loss of integrity of National Park / reserve.
Activity/risk source	Construction of power line infrastructure Construction of access roads
Mitigation: Target/Objective	Target: no impacts on National Parks/ reserves Time period: construction

Mitigation: Action/control	Responsibility	Timeframe
(1) If Corridor 1, 2 or 4 is selected for implementation, modify the alignment to keep it outside the boundaries of the affected reserve / park.	Planning team, management.	Pre-construction / planning

Performance Indicator	No project components within National Parks/ reserves
Monitoring	• None required.

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APPENDICES

Appendix 1: Plant species of conservation importance (Threatened, Near Threatened and Declining) that have historically been recorded in the study area.

Sources: South African National Biodiversity Institute in Pretoria.

2816DA	
Strumaria bidentata Schinz	Endangered
Ectadium virgatum E.Mey.	Near Threatened
Bulbine rhopalophylla Dinter	Near Threatened
Helichrysum marmarolepis S.Moore	Near Threatened
Crassula columella Marloth & Schönland	Rare
Crassula sladenii Schönland	Near Threatened
Lachenalia buchubergensis Dinter	Rare
Lachenalia verticillata W.F.Barker	Rare
Astridia vanheerdei L.Bolus	Rare
Lithops olivacea L.Bolus	Vulnerable
2816DB	
Cyrtanthus herrei (F.M.Leight.) R.A.Dyer	Near Threatened
Crassula fusca Herre	Rare
Eriospermum parvulum P.L.Perry	Vulnerable
Acacia erioloba E.Mey.	Declining
Crotalaria pearsonii Baker f.	Rare
Lachenalia valeriae G.D.Duncan	Rare
Nemesia saccata E.Mey. ex Benth.	Rare
2816DC	
Adromischus marianiae (Marloth) A.Berger var. hallii Toelken	Rare
Crassula brevifolia Harv. subsp. psammophila Toelken	Vulnerable
Crassula plegmatoides Friedrich	Vulnerable
2816DD	
Helichrysum marmarolepis S.Moore	NT
Crassula ammophila Toelken	NT
Geissorhiza callista Goldblatt	Rare
Dischisma leptostachyum E.Mey.	NT
2916BB	
Gethyllis namaquensis (Schönland) Oberm.	Vulnerable
Capnophyllum leiocarpon (Sond.) Manning & Goldblatt	Declining
Aloe microstigma Salm-Dyck subsp. framesii	NT
Wahlenbergia asparagoides (Adamson) Lammers	Vulnerable
Nemesia saccata E.Mey. ex Benth.	Rare
2917AA	
Gethyllis namaquensis (Schönland) Oberm.	Vulnerable
Haemanthus pubescens L.f. subsp. arenicola Snijman	Rare
Stapeliopsis neronis Pillans	Rare
Bulbine rhopalophylla Dinter	Near Threatened
Senecio muirii L.Bolus	Rare
Crassula alcicornis Schönland	Vulnerable
Crassula columella Marloth & Schönland	Rare
Tylecodon boddleyi Van Jaarsv.	Rare
Tylecodon buchholzianus subsp. fasciculatus	Rare
Tylecodon torulosus Toelken	Vulnerable
Acanthosicyos horridus Welw. ex Hook.f.	Critically Endangered
Crotalaria pearsonii Baker f.	Rare
Babiana lobata G.J.Lewis	Rare
Lapeirousia tenuis (Goldblatt) Goldblatt & J.C.Manning	Rare
Tritonia marlothii M.P.de Vos	Rare
Conophytum meyeri N.E.Br.	Rare
Phyllobolus gariepensis Gerbaulet & Struck	Rare
2917AB	
Brunsvigia herrei F.M.Leight. ex W.F.Barker	Vulnerable
Trichogyne lerouxiae Beyers	Rare
Moraea flexicaulis Goldblatt	Critically Rare

2917AC

Othonna hallii B.Nord.	Vulnerable
Trichogyne lerouxiae Beyers	Rare
Wahlenbergia buseriana Schltr. & Brehmer	Rare
Tylecodon buchholzianus (Schuldt & P.Stephan) Toelken subsp. fasciculatus G.Will.	Rare
Euphorbia pentops A.C.White, R.A.Dyer & B.Sloane	Rare
Babiana horizontalis G.J.Lewis	Vulnerable
Conophytum meyeri N.E.Br.	Rare
Lampranthus amoenus (Salm-Dyck ex DC.) N.E.Br.	Endangered
Leipoldtia frutescens (L.Bolus) H.E.K.Hartmann	Vulnerable
Nelia schlechteri Schwantes	Rare
Oxalis crocea T.M.Salter	Vulnerable
Anacampseros scopata G.Will.	Rare

2917AD

Cyrtanthus herrei (F.M.Leight.) R.A.Dyer	Near Threatened
Strumaria villosa Snijman	Rare
Othonna pavelkae Lavranos	Rare
Colchicum huntleyi J.C.Manning & Vinn.	Rare
Euphorbia pentops A.C.White, R.A.Dyer & B.Sloane	Rare
Babiana lanata Goldblatt & J.C.Manning	Vulnerable
Lapeirousia tenuis (Goldblatt) Goldblatt & J.C.Manning	Rare
Namaquanthus vanheerdii L.Bolus	Vulnerable
Nelia pillansii (N.E.Br.) Schwantes	Rare
Avonia mallei G.Will.	Rare

2917BA

Brunsvigia herrei F.M.Leight. ex W.F.Barker	Vulnerable
Brunsvigia pulchra (W.F.Barker) D.& U.Müll.-Doblies	Rare
Haemanthus namaquensis R.A.Dyer	Rare
Hessea pilosula D.& U.Müll.-Doblies	Rare
Strumaria merxmuelleriana (D.& U.Müll.-Doblies) Snijman	Rare
Strumaria villosa Snijman	Rare
Hoodia gordonii (Masson) Sweet ex Decne.	Data Deficient
Aloe microstigma Salm-Dyck subsp. framesii	Near Threatened
Bulbine rhopalophylla Dinter	Near Threatened
Othonna euphorbioides Hutch.	Data Deficient
Eriospermum undulatum P.L.Perry	Vulnerable
Eriospermum viscosum P.L.Perry	Vulnerable
Euphorbia pentops A.C.White, R.A.Dyer & B.Sloane	Rare
Lotononis anthyllopsis B.-E.van Wyk	Rare
Pelargonium bubonifolium (Andrews) Pers.	Rare

2917BB

Brunsvigia radula (Jacq.) Aiton	Vulnerable
Hessea pilosula D.& U.Müll.-Doblies	Rare
Tromotriche herrei (Nel) Bruyns	Rare
Bulbine fragilis G.Will.	Rare
Crassula rupestris Thunb. subsp. commutata (Friedrich) Toelken	Rare
Eriospermum aribesense P.L.Perry	Vulnerable
Eriospermum ratelpoortianum P.L.Perry	Rare
Euphorbia pentops A.C.White, R.A.Dyer & B.Sloane	Rare
Lachenalia buchubergensis Dinter	Rare
Lachenalia polypodantha Schltr. ex W.F.Barker	Rare

2917BC

Brunsvigia herrei F.M.Leight. ex W.F.Barker	Vulnerable
Brunsvigia pulchra (W.F.Barker) D.& U.Müll.-Doblies	Rare
Brunsvigia radula (Jacq.) Aiton	Vulnerable
Haemanthus namaquensis R.A.Dyer	Rare
Hessea pilosula D.& U.Müll.-Doblies	Rare
Strumaria merxmuelleriana (D.& U.Müll.-Doblies) Snijman	Rare
Strumaria villosa Snijman	Rare
Aloe krapohliana Marloth	Data Deficient
Bulbine disimilis G.Will.	Rare
Bulbinella nana P.L.Perry	Vulnerable
Othonna euphorbioides Hutch.	Data Deficient
Othonna pavelkae Lavranos	Rare
Wahlenbergia buseriana Schltr. & Brehmer	Rare
Colchicum cruciatum (U.& D.Müll.-Doblies) J.C.Manning & Vinn.	Vulnerable

Crassula exilis Harv. subsp. exilis	Rare
Crassula thunbergiana Schult. subsp. minutiflora	Rare
Eriospermum coactum P.L.Perry	Vulnerable
Eriospermum filicaule P.L.Perry	Rare
Eriospermum fragile P.L.Perry	Rare
Eriospermum papilliferum A.V.Duthie	Data Deficient
Eriospermum spirale Schult.	Vulnerable
Lotononis arenicola Schltr.	Rare
Pelargonium bubonifolium (Andrews) Pers.	Rare
Lachenalia concordiana Schltr. ex W.F.Barker	Rare
Lachenalia doleritica G.D.Duncan	Vulnerable

2917BD

Brunsvigia pulchra (W.F.Barker) D.& U.Müll.-Doblies	Rare
Haemanthus lanceifolius Jacq.	Vulnerable
Quaqua cincta (C.A.Lückh.) Bruyns	Rare
Aloe krapohliana Marloth	Data Deficient
Bulbinella nana P.L.Perry	Vulnerable
Euryops pleiodontus B.Nord.	Data Deficient
Othonna euphorbioides Hutch.	Data Deficient
Wahlenbergia buseriana Schltr. & Brehmer	Rare
Wahlenbergia sonderi Lammers	Data Deficient
Crassula exilis Harv. subsp. exilis	Rare
Eriospermum ratelpoortianum P.L.Perry	Rare
Lotononis arenicola Schltr.	Rare
Lotononis plicata B.-E.van Wyk	Vulnerable
Pelargonium bubonifolium (Andrews) Pers.	Rare
Daubenya namaquensis (Schltr.) J.C.Manning & Goldblatt	Data Deficient
Lachenalia polypodantha Schltr. ex W.F.Barker	Rare
Lachenalia verticillata W.F.Barker	Rare
Moraea indecora Goldblatt	Vulnerable
Conophytum regale Lavis	Critically Rare
Oxalis exserta T.M.Salter	Rare
Oxalis inconspicua T.M.Salter	Rare

2917CA

Gethyllis grandiflora L.Bolus	Vulnerable
Ceropegia occidentalis R.A.Dyer	Near Threatened
Aloe arenicola Reynolds	Near Threatened
Aloe krapohliana Marloth	Data Deficient
Aloe microstigma Salm-Dyck subsp. framesii	Near Threatened
Tylecodon decipiens Toelken	Rare
Lachenalia valeriae G.D.Duncan	Rare
Babiana lanata Goldblatt & J.C.Manning	Vulnerable
Lapeirousia tenuis (Goldblatt) Goldblatt & J.C.Manning	Rare
Moraea rivulicola Goldblatt & J.C.Manning	Rare
Conophytum meyeri N.E.Br.	Rare
Leipoldtia frutescens (L.Bolus) H.E.K.Hartmann	Vulnerable

2917CB

Aloe striata Haw. subsp. komaggasensis (Kritzinger & Van Jaarsv.) Glen & D.S.Hardy	Vulnerable
Babiana tritonioides G.J.Lewis	Vulnerable
Lapeirousia tenuis (Goldblatt) Goldblatt & J.C.Manning	Rare
Oxalis crocea T.M.Salter	Vulnerable
Leucospermum praemorsum (Meisn.) E.Phillips	Vulnerable

2917DA

Brunsvigia herrei F.M.Leight. ex W.F.Barker	Vulnerable
Brunsvigia pulchra (W.F.Barker) D.& U.Müll.-Doblies	Rare
Gethyllis grandiflora L.Bolus	Vulnerable
Chlorophytum lewisiae Oberm.	Rare
Helichrysum tricostatum (Thunb.) Less.	Near Threatened
Oedera nordenstamii (K.Bremer) Anderb. & K.Bremer	Rare
Adromischus mammillaris (L.f.) Lem.	Endangered
Tylecodon atropurpureus Bruyns	Rare
Tylecodon hirtifolius (W.F.Barker) Toelken	Rare
Dioscorea elephantipes (L'Hér.) Engl.	Declining
Eriospermum armianum P.L.Perry	Rare
Eriospermum pusillum P.L.Perry	Rare
Euphorbia oxystegia Boiss.	Data Deficient

Acacia erioloba E.Mey.	Declining
Lotononis anthyllopsis B.-E.van Wyk	Rare
Otholobium pustulatum C.H.Stirt.	Rare

2917DB

Brunsvigia herrei F.M.Leight. ex W.F.Barker	Vulnerable
Strumaria merxmuelleriana (D.& U.Müll.-Doblies) Snijman	Rare
Quaqua cincta (C.A.Lückh.) Bruyns	Rare
Cullumia rigida DC.	Rare
Othonna diversifolia (DC.) Sch.Bip.	Rare

2918AA

Othonna cyclophylla Merxm.	Rare
Conophytum blandum L.Bolus	Near Threatened

2918AB

2918AC

Helichrysum tricostatum (Thunb.) Less.	Near Threatened
Conophytum blandum L.Bolus	Near Threatened

2918AD

Othonna euphorbioides Hutch.	Data Deficient
Oxalis inconspicua T.M.Salter	Rare

2918BC

Daubenya namaquensis (Schltr.) J.C.Manning & Goldblatt	Data Deficient
Conophytum limpidum S.A.Hammer	Near Threatened

2918BD

2918CA

Crassula exilis Harv. subsp. exilis	Rare
Lachenalia concordiana Schltr. ex W.F.Barker	Rare
Gladiolus salteri G.J.Lewis	Rare
Moraea indecora Goldblatt	Vulnerable
Cyphia longiflora Schltr.	Near Threatened

2918CB

Brunsvigia radula (Jacq.) Aiton	Vulnerable
Cephalophyllum staminodiosum L.Bolus	Rare
Conophytum smorenskaduense de Boer	Vulnerable
Conophytum verrucosum (Lavis) G.D.Rowley	Rare
Lampranthus amoenus (Salm-Dyck ex DC.) N.E.Br.	Endangered

Please note: Species that are listed on the SANBI website as “*Thr” (i.e. suspected to be threatened but not assessed) are listed here as Data Deficient (suspected to be threatened but unable to assess due to lack of data).

Appendix 2: Threatened vertebrate species with a geographical distribution that includes the current study area.

MAMMALS

Common name	Taxon	Distribution & habitat[1]	Status[2]	Likelihood of occurrence
Black rhinoceros	*Diceros bicornis bicornis*	Wide variety of habitats, but currently only occurs in game reserves.	CR	**NONE**, only occurs in game reserves
Hartmann's mountain zebra	*Equus zebra hartmannae*	Rocky barren areas, ecotones between mountains and plains / flats, grazer.	EN	**MEDIUM,** historical record from Richtersveld grids and Springbok grid, overall geographical distribution includes most of study area, habitat is suitable. Outside Namibia, mostly occurs in reserves, including Richtersveld and Augrabies Falls National Parks.
Angolan Wing-gland Bat	*Cistugo seabrai*	West coast of southern Africa in arid and semi-arid areas.. Occurs in areas with less than 100 mm rainfall. Usually found in riverine vegetation of dry river beds.	LC[1], (VU in SA)[3]	**HIGH**, previously recorded in neighbouring grid, within geographical distribution range.
De Winton's Golden Mole	*Cryptochloris wintoni*	Occurs only in the vicinity of Port Nolloth in Namaqualand. Known from only a few specimens from the type locality collected more than 50 years ago (Mills & Hes 1997, Bronner 2008).	CR	**HIGH**, previously recorded in grid at Port Nolloth

[1]Distribution according to Friedmann & Daly 2004.
[2]Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 10 January 2011.
[3]National status according to Monadjem et al. 2010

AMPHIBIANS

Common name	Species	Distribution & habitat[1]	Status[2]	Likelihood of occurrence
Desert rain frog	*Breviceps macrops*	From the highwater mark up to 10 km inland along the Namaqualand coast (Namibia to near Hondeklipbaai.	VU	**LOW**, alignments are just inland of known distribution range.
Namaqua Stream Frog	*Strongylopus springbokensis*	Confined to mountainous areas of Namaqualand in which it survives harsh conditions by keeping close to seeps and springs. In study area distribution co-incides with escarpment	VU	**HIGH**, within known distribution range and suitable habitats in study area.

[1]Distribution according to du Preez & Carruthers 2009.
[2]Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 10 January 2011.

REPTILES

Common name	Species	Habitat	Status[2]	Likelihood of occurrence
Armadillo girdled lizard	*Cordylus cataphractus*	Rock cracks and crevices. Diet consists mainly of termites, beetles and grasshoppers	VU[2]	**HIGH**, within known distribution range, previously recorded in grids in study area
Namaqua plated lizard	*Gerrhosaurus typicus*	Dry sandy areas and bare rocky hillsides	NT[2]	**HIGH**, overall geographical distribution includes this area, previously recorded in grid in study area
Speckled padloper	*Homopus signatus*	Rocky or stony areas, often on ridges or plateaus. Horizontal rock crevices.	NT	**HIGH**, overall geographical distribution includes this area

[1]Distribution according to Alexander & Marais 2008.
[2]Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 10 January 2011.

Appendix 3: List of protected tree species (National Forests Act).

Acacia erioloba	*Acacia haematoxylon*
Adansonia digitata	*Afzelia quanzensis*
Balanites subsp. *maughamii*	*Barringtonia racemosa*
Boscia albitrunca	*Brachystegia spiciformis*
Breonadia salicina	*Bruguiera gymnhorrhiza*
Cassipourea swaziensis	*Catha edulis*
Ceriops tagal	*Cleistanthus schlectheri* var. *schlechteri*
Colubrina nicholsonii	*Combretum imberbe*
Curtisia dentata	*Elaedendron (Cassine) transvaalensis*
Erythrophysa transvaalensis	*Euclea pseudebenus*
Ficus trichopoda	*Leucadendron argenteum*
Lumnitzera racemosa var. *racemosa*	*Lydenburgia abottii*
Lydenburgia cassinoides	*Mimusops caffra*
Newtonia hildebrandtii var. *hildebrandtii*	*Ocotea bullata*
Ozoroa namaensis	*Philenoptera violacea* (*Lonchocarpus capassa*)
Pittosporum viridiflorum	*Podocarpus elongatus*
Podocarpus falcatus	*Podocarpus henkelii*
Podocarpus latifolius	*Protea comptonii*
Protea curvata	*Prunus africana*
Pterocarpus angolensis	*Rhizophora mucronata*
Sclerocarya birrea subsp. *caffra*	*Securidaca longependunculata*
Sideroxylon inerme subsp. *inerme*	*Tephrosia pondoensis*
Warburgia salutaris	*Widdringtonia cedarbergensis*
Widdringtonia schwarzii	

Acacia erioloba, *Acacia haematoxylon*, *Boscia albitrunca*, *Euclea pseudebenus* have a geographical distribution that coincides with the study area.

Appendix 4: Animal species with a geographical distribution that includes the study area.

Mammals:
Black rhinoceros
Hartmann's mountain zebra
Springbok
Klipspringer
Gemsbok
Steenbok
Common duiker
Rock hyrax
Cape clawless otter
Water mongoose
Black-backed jackal
Caracal
Yellow mongoose
Black-footed cat
African wild cat
Small grey mongoose
Small-spotted genet
Brown hyaena
Striped polecat
Honey badger
Bat-eared fox
Leopard
Aardwolf
Suricate
Cape fox
Angolan Wing-gland Bat
Long-tailed serotine bat
Sundevall's leaf-nosed bat
Cape serotine bat
Egyptian slit-faced bat
Cape horseshoe bat
Geoffroy's horseshoe bat
Rupells' horseshoe bat
Flat-headed free-tail bat
Egyptian free-tailed bat
Cape Golden Mole (Port Nolloth)
Reddish-grey musk shrew
Lesser red musk-shrew
De Winton's Golden Mole
Namaqua Dune Mole-rat
Littledale's Whistling Rat
Dassie Rat
Grant's Golden mole
Lesser dwarf shrew
Cape hare
Scrub hare
Vervet monkey
Chacma baboon
Namaqua rock mouse
Short-tailed gerbil
Hairy-footed gerbil
Rock dormouse
Porcupine

Large-eared mouse
Karoo Bush rat
Brant's whistling rat
Springhare
Pygmey rock mouse
Striped mouse
Highveld gerbil
Cape Rock elephant shrew
Smith's rock elephant shrew
Round-eared elephant shrew
Aardvark

Reptiles:
Western dwarf chameleon
Namaqua chameleon
Puff adder
Many-horned adder
Desert mountain adder
Horned adder
Namaqua dwarf adder
Cape cobra
Black spitting cobra
Coral snake
Spotted harlequin snake
Dwarf beaked snake
Karoo whip snake
Namib sand snake
Spotted skaapsteker
Beetz's tiger snake
Brown house snake
Spotted rock snake
Fisk's house snake
Mole snake
South-western shovel snout
Spotted bush snake
Common egg-eater
Delalande's beaked blind snake
Schinz's beaked blind snake
Namaqua worm snake
Ground agama
Anchieta's agama
Southern rock agama
Southern spiny agama
Water monitor
Smith's desert lizard
Wedge-snouted desert lizard
Knox's desert lizard
Western sandveld lizard
Cape sand lizard
Namaqua sand lizard
Western sand lizard
Cape legless skink
Striped dwarf burrowing skink
Karoo girdled lizard
Cape girdled lizard
Armadillo girdled lizard
Augrabies flat lizard

Namaqua plated lizard
Dwarf plated lizard
Striped dwarf leaf-toed gecko
Namaqualand dwarf leaf-toed gecko
Richtersveld dwarf leaf-toed gecko
Giant ground gecko
Bibron's tubercled gecko
Austen's dune gecko
Speckled gecko
Rough gecko
Namaqua gecko
Marico gecko
Day gecko
Common barking gecko
Speckled padloper
Angulate tortoise
Karoo tent tortoise

Amphibians
Desert rain frog
Namaqua rain frog
Karoo toad
Paradise toad
Marbled rubber frog
Common platanna
Namaqua caco
Common river frog
Cape river frog
Namaqua stream frog
Cape sand frog

Appendix 5: Species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)
(as updated in R. 1187, 14 December 2007)

CRITICALLY ENDANGERED SPECIES
Reptilia
Loggerhead sea turtle
Leatherback sea turtle
Hawksbill sea turtle

Aves
Wattled crane
Blue swallow
Egyptian vulture
Cape parrot

Mammalia
Riverine rabbit
Rough-haired golden mole

Flora
Adenium swazicum
Aloe pillansii
Diaphananthe millarii
Dioscorea ebutsniorum
Encephalartos aemulans
Encephalartos brevifoliolatus
Encephalartos cerinus
Encephalartos dolomiticus
Encephalartos heenanii
Encephalartos hirsutus
Encephalartos inopinus
Encephalartos latifrons
Encephalartos middelburgensis
Encephalartos nubimontanus
Encephalartos woodii

ENDANGERED SPECIES
Reptilia
Green turtle
Giant girdled lizard
Olive ridley turtle
Geometric tortoise

Aves
Blue crane
Grey crowned crane
Saddle-billed stork
Bearded vulture
White-backed vulture
Cape vulture
Hooded vulture

Pink-backed pelican
Pel's fishing owl
Lappet-faced vulture

Mammalia
Robust golden mole
Tsessebe
Black rhinoceros
Mountain zebra
African wild dog
Gunning's golden mole
Oribi
Red squirrel
Four-toed elephant-shrew

Flora
Angraecum africae
Encephalartos arenarius
Encephalartos cupidus
Encephalartos horridus
Encephalartos laevifolius
Encephalartos lebomboensis
Encephalartos msinganus
Jubaeopsis caffra
Siphonochilus aethiopicus
Warburgia salutaris
Newtonia hilderbrandi

VULNERABLE SPECIES
Aves
White-headed vulture
Tawny eagle
Kori bustard
Black stork
Southern banded snake eagle
Blue korhaan
Taita falcon
Lesser kestrel
Peregrine falcon
Bald ibis
Ludwig's bustard
Martial eagle
Bataleur
Grass owl

Mammalia
Cheetah
Samango monkey
Giant golden mole
Giant rat
Bontebok
Tree hyrax

Roan antelope
Pangolin
Juliana's golden mole
Suni
Large-eared free-tailed bat
Lion
Leopard
Blue duiker

Flora
Aloe albida
Encephalartos cycadifolius
Encephalartos Eugene-maraisii
Encephalartos ngovanus
Merwilla plumbea
Zantedeschia jucunda

PROTECTED SPECIES
Amphibia
Giant bullfrog
African bullfrog

Reptilia
Gaboon adder
Namaqua dwarf adder
Smith's dwarf chameleon
Armidillo girdled lizard
Nile crocodile
African rock python

Aves
Southern ground hornbill
African marsh harrier
Denham's bustard
Jackass penguin

Mammalia
Cape clawless otter
South African hedgehog
White rhinoceros
Black wildebeest
Spotted hyaena
Black-footed cat
Brown hyaena
Serval
African elephant
Spotted-necked otter
Honey badger
Sharpe's grysbok
Reedbuck
Cape fox

Flora
Adenia wilmsii
Aloe simii
Clivia mirabilis
Disa macrostachya
Disa nubigena
Disa physodes
Disa procera
Disa sabulosa
Encephelartos altensteinii
Encephelartos caffer
Encephelartos dyerianus
Encephelartos frederici-guilielmi
Encephelartos ghellinckii
Encephelartos humilis
Encephelartos lanatus
Encephelartos lehmannii
Encephelartos longifolius
Encephelartos natalensis
Encephelartos paucidentatus
Encephelartos princeps
Encephelartos senticosus
Encephelartos transvenosus
Encephelartos trispinosus
Encephelartos umbeluziensis
Encephelartos villosus
Euphorbia clivicola
Euphorbia meloformis
Euphorbia obesa
Harpagophytum procumbens
Harpagophytum zeyherii
Hoodia gordonii
Hoodia currorii
Protea odorata
Stangeria eriopus