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Final Terrestrial Ecosystems Assessment of the proposed Ndumo - Gezisa Power Line

Submitted to:
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REPORT

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Golder Associates

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Zitholele Consulting appointed Golder Associates Africa (Pty) Ltd to undertake a terrestrial ecosystems assessment of the proposed Eskom power-line routes, linking Gezisa Substation to Ndumu Substation, in Maputaland, KwaZulu-Natal, South Africa. The study focused on describing the biodiversity and ecological characteristics of the proposed route alternatives (hereafter referred to as the study area), with a view of identifying and assessing the possible ecological impacts associated with each proposed route and to highlight a preferred option from a terrestrial ecology perspective. This document presents the findings of the terrestrial ecosystems assessment.

2.0 TERMS OF REFERENCE

The objectives of the terrestrial ecosystems assessments are to:

- Present a description of the study area's existing biodiversity (flora and fauna) characteristics and identify species of conservation importance that occur, or potentially occur, in the study area;
- Confirm the presence and extent of sensitive and important vegetation units and the ecological integrity thereof;
- Identify potential project-related impacts and conduct a comparative assessment of these in relation to the five proposed power-line route alternatives; and
- Highlight a preferred power-line route and provide biodiversity management recommendations for inclusion into the environmental management plan.

Note: A separate avifauna survey for the proposed project was conducted by the Endangered Wildlife Trust (EWT). This report therefore does not contain results or conculsions regarding birds.

3.0 METHODOLOGY

The methodology used during the terrestrial ecosystems assessment consists of three components, namely a literature review, field survey and impact assessment. These are briefly summarised below:

- Literature review – A literature review of existing reports, scientific studies, databases, reference works, guidelines and legislation relevant to the study area was conducted to establish a historical baseline condition of the site's ecology. Species lists of potential flora and fauna occurring in the study area, with specific emphasis on Red Data and protected species were also compiled (Refer to APPENDIX B for detailed methodology);
- Field survey – The field survey was aimed at determining the general biodiversity/ecological characteristics of the study area. Based on satellite imagery, vegetation communities within the study area were delineated at a desktop level. These vegetation communities were then sampled, by means of line and belt transects for flora. Fauna were sampled at specific sampling sites situated in representative vegetation communities, by means of traps, active searches and observations of their presence (burrows, faeces, tracks etc.). Based on the findings of the field survey, the ecological integrity, suitability as habitat for Red data and protected species and conservation importance of each vegetation community was determined (Refer to APPENDIX B for detailed methodology); and
- Impact assessment – With reference to the findings of the literature review and field survey, potential negative environmental impacts associated with the each proposed power-line route alternative were identified and assessed for significance. Based on the assessment, a preferred power-line route was identified and suitable mitigation measures recommended for inclusion into the project's environmental management programme (EMP) (refer to Section 5.1 for detailed impact assessment methodology).

Applicable legislation

The following national and provincial legislation were consulted during the terrestrial ecosystems assessment:

- The Constitution of the Republic of South Africa (No. 108 of 1996) – Section 24;
- National Environmental Management Act (No. 107 of 1998) (NEMA);
- National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEMBA);
- Environmental Conservation Act (CARA) (No. 73 of 1989);
- National Forests Act (No. 84 of 1998); and
- KwaZulu-Natal nature Conservation Management Amendment Act (No. 5 of 1999).

4.0 ECOLOGICAL BASELINE CONDITIONS

4.1 Site Location

The study area is located on the Makhatini Flats of Maputaland, in northern KwaZulu-Natal, approximately 15 kilometres west of Kosi Bay and 50 km north-east of Jozini (Figure 1). The study area comprises various power-line route alternatives linking the proposed Ndumo Substation with the Gezisa Substation.

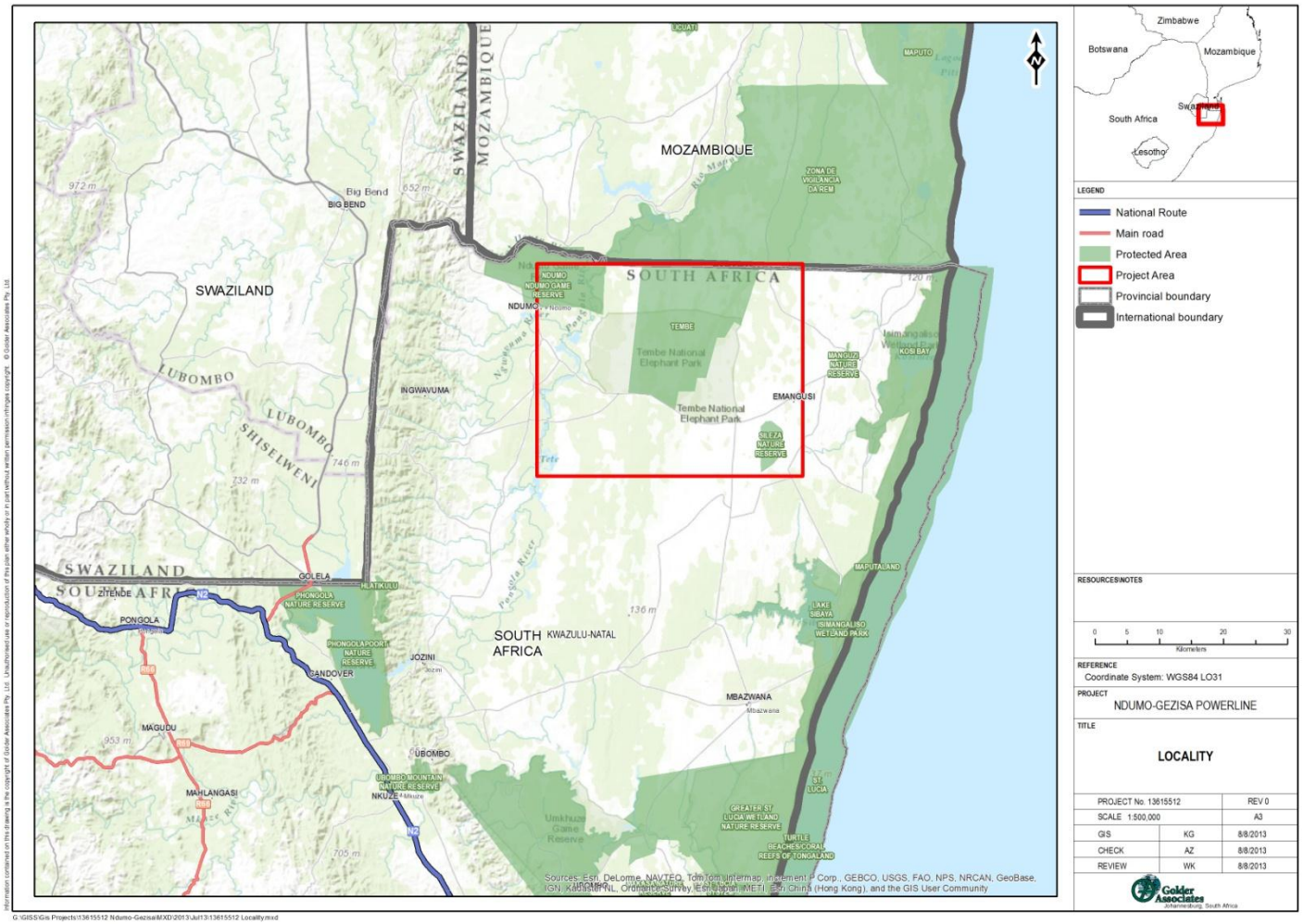

Figure 1: Regional location of the proposed Ndumo – Gezisa Power line Project, KwaZulu-Natal

4.2 General Biophysical Environment

The study area is located in the Savanna and Indian Ocean Coastal Belt biomes of South Africa, and based on Mucina & Rutherford's (2006) delineation of country's vegetation types, the area is represented by ten vegetation types, namely:

- Lowveld Riverine Forest;
- Maputaland Coastal Belt;
- Maputaland Wooded Grassland;
- Subtropical Alluvial Vegetation;
- Subtropical Freshwater Wetlands;
- Tembe Sandy Bushveld
- Western Maputaland Clay Bushveld;
- Western Maputaland Sandy Bushveld; and
- Sand Forest.

The distribution of the Mucina & Rutherford (2006) vegetation types are shown in Figure 2 and the associated characteristics of each are briefly discussed, below, from Section 4.2.1 to 4.2.9.

4.2.1 Lowveld Riverine Forest

This vegetation types is associated with the numerous large river systems draining eastward into the Indian Ocean (Mucina & Rutherford, 2006).

Vegetation and Landscape features

Lowveld Riverine Forests are characterised by tall forests, varied and often contiguous lower flora strata and a well-developed shrub layer (Mucina & Rutherford, 2006).

Important Plant Taxa

Based on Mucina & Rutherford's (2006) vegetation classification, important plant taxa are those species that have a high abundance, a frequent occurrence (not being particularly abundant) or are prominent in the landscape within a particular vegetation type. They note the following species are important in the Lowveld Riverine Forest vegetation type:

Trees: *Acacia robusta*, *Breonadia salicina, Diospyros mespiliformis, Faidherbia albida, Ficus sycomorus, Kigelia africana, Berchemia discolor, Combretum erythrophyllum, Combretum imberbe, Ekebergia capensis, Philenoptera violacea, Rauvolfia caffra, Spirostachys africana, Trichilia emetica, Xanthocercis zambesica, Combretum hereroense, Croton megalobotrys, Hyphaene coriacea, Nuxia oppositifolia* and *Phoenix reclinata.*

Shrubs: *Abutilon angulatum, Acacia schweinfurthii, Ficus capreifolia* and *Hypoestes aristata.*

Grasses*: Digitaria eriantha, Panicum maximum, Echinochloa pyramidalis, Panicum coloratum, Setaria mauritianus, Setaria incrassata, Setaria sphacelata* and *Sporobolus consimilis.*

Herbs: *Achyranthes aspera.*

Conservation

Lowveld Riverine Forests are considered critically endangered according to Mucina & Rutherford (2006). Factors such as cultivation, exotic species encroachment, water extraction, dam construction and mining have caused considerable degradation and transformation of this vegetation type (Mucina & Rutherford, 2006).

4.2.2 Maputaland Coastal Belt

This vegetation types occurs as a broad (circa 35km) strip along the coast of the Indian Ocean, from Mozambique southward to Mtunzini in South Africa (Mucina & Rutherford, 2006).

Vegetation and Landscape features

The Maputaland Coastal Belt is characterised by a flat coastal plain, comprising primary and secondary grassland interspersed by pockets of forest, thickets, exotic plantations and sugar cane fields (Mucina & Rutherford, 2006).

Important Plant Taxa

The following are important taxa in the Maputaland Coastal Belt vegetation type:

Trees: *Syzygium cordatum, Acacia natalitia, Annona senegalensis, Apodytes dimidiata, Bridelia cathartica, Canthium inerme, Chrysanthemoides monilifera, Euclea natalensis, Ficus burtt-davyi, Hyphaene coriacea, Kraussia floribunda, Ozoroa obovata, Phoenix reclinata and Rhus natalensis*, *Strychnos spinosa* and *Synaptolepis kirkii.*

Shrubs: *Agathisanthemum bojeri, Helichrysum kraussii, Helichrysum adenocarpum, Diospyros galpinii, Indigofera williamsonii, Rhus kwazuluana* and *Tephrosia longipes.*

Grasses*: Diheteropogon amplectens, Eragrostis sclerantha, Ischaemum fasciculatum, Themeda triandra, Urelytrum agropyroides, Aristida stipitata, Cymbopogon pospischilii, Elionurus muticus, Eragrostis inamoena, Sporobolus subulatus, Trachypogon spicatus, Trichoneura grandiglumis* and *Tristachya leucothrix.*

Herbs: *Achyranthes aspera, Centella asiatica, Chamaecrista plumosa, Hermbstaedtia odorata, Nidorella tongensis, Senecio ngoyanus, Vernonia centaureoides* and *Vernonia oligocephala.*

Conservation

The Maputaland Coastal Belt is considered vulnerable (Mucina & Rutherford, 2006), with clearing for cultivation, plantations and urbanisation the primary cause of habitat loss. Encroachment of the exotic species *Chromolaena odorata* and *Lantana camara* is also common (Mucina & Rutherford, 2006).

4.2.3 Maputaland Wooded Grassland

Areas of Maputaland Wooded Grassland occur from the Mozambique border southward toward Richards Bay in South Africa.

Vegetation and Landscape features

Maputaland Wooded Grassland areas are generally flat and comprise coastal sandy grasslands, with a rich herbaceous assemblage of geoxylic suffrutices, dwarf shrubs and small trees (Mucina & Rutherford, 2006).

Important Plant Taxa

The following are important taxa in the Maputaland Wooded Grassland vegetation type:

Trees: *Parinari curatellifolia, Salacia kraussii, Ancylobotrys petersiana, Diospyros galpinii, Eugenia capensis*, *Dichrostachys cinerea, Diospyros lycioides, Hyphaene coriacea, Terminalia sericea* and *Syzygium cordatum.*

Shrubs*: Agathisanthemum bojeri, crotalaria monteiroi* and *Helichrysum kraussii.*

Graminiodes: *Diheteropogon amplectens, Themeda triandra, Aristida stipitata, Bewsia biflora, Digitaria natalensis, Eustachya paspaloides, Setaria sphacelata, Sporobolus fimbriatus, Sporobolus subulatus* and *Urelytrum agropyroides.*

Herbs: *Chamaecrista plumosa* and *Cyrtanthus galpinii.*

Endemic Taxon*: Oxygonum robustum*, *Tricliceras mossambicense*, *Ochna* species (Suffrutex form) and *Brachystelma vahrmeijeri*.

Conservation

Maputaland Wooded Grasslands are classified as endangered (Mucina & Rutherford, 2006). Like the Maputaland Coastal Belt vegetation type, cane cultivation, timber plantations and rural developments are primary causes of habitat loss (Mucina & Rutherford, 2006).

4.2.4 Subtropical Alluvial Vegetation

Subtropical Alluvial Vegetation occurs on broad river alluvia and around river-fed pans in the subtropical regions of eastern South Africa. In the study area, these primarily are found along the Pongola River.

Vegetation and Landscape features

Areas of Subtropical Alluvial Vegetation are typically flat alluvial riverine terraces that support an intricate complex of riparian vegetation (Mucina & Rutherford, 2006).

Important Plant Taxa

The following are some of the important taxa in Subtropical Alluvial Vegetation:

Trees: *Acacia natalitia, Acacia robusta, Combretum erythrophyllum, Phoenix reclinata, Ziziphus mucronata, Salvadora angustifolia, Euclea divinorum, Grewia bicolor* and *Gymnosporia senegalensis*.

Shrubs*: Justicia flava* and *Ocimum canum.*

Graminiodes: *Cynodon dactylon*, *Eragrostis trichophora, Panicum maximum, Setaria incrassata, Sporobolus ioclados, Chloris virgata, Dactyloctenium aegyptium, Phragmites australis* and *Urochloa mossambicensis*.

Herbs: *Alternanthera sessilis* and *Amaranthus praetermissus.*

Endemic Taxon: *Crotalaria mollii*

Conservation

Much of the former range of Subtropical Alluvial Vegetation has been transformed by cultivation, urban and road development (Mucina & Rutherford, 2006).

4.2.5 Subtropical Freshwater Wetlands

Areas of Subtropical Freshwater Wetlands occur throughout eastern South Africa.

Vegetation and Landscape features

Subtropical Freshwater Wetlands are found in areas of flat topography that support low reed beds and grasses. These may occur along the edges of seasonal pools, in aeolian depressions and alluvial backwater pans (Mucina & Rutherford, 2006).

Important Plant Taxa

The following are some of the important taxa in Subtropical Freshwater Wetlands:

Trees: *Hyphaene coriacea* and *Phoenix reclinata.*

Shrubs*: Justicia flava* and *Ocimum canum.*

Graminiodes: *Cynodon dactylon*, *Chloris virgata, Dactyloctenium aegyptium, Echinochloa pyramidalis, Hemarthria altissima, Imperata cylindrica, Phragmites australis, Urochloa mossambicensis* and various *Cyperacae* species.

Endemic Taxon: *Cyperus sensilis, Crinum campanulatum* and *Isoetes wormaldii.*

Conservation

Considered least threatened, large areas of Subtropical Freshwater Wetlands are under statutory conservation. Threats include cultivation, urban sprawl, exotic species encroachment and overgrazing (Mucina & Rutherford, 2006).

4.2.6 Tembe Sandy Bushveld

This vegetation type occurs as a band to the east of the Pongola River, from Mozambique in the north southward through Tembe Elephant Park to the confluence of the Mkuze and Msunduzi Rivers in the south.

Vegetation and Landscape features

Areas comprising Tembe Sandy Bushveld have a flat to undulating topography and are characterised by open to closed woodland, and a species rich shrub layer (Mucina & Rutherford, 2006).

Important Plant Taxa

The following are some of the important taxa in Tembe Sandy Bushveld:

Trees: *Acacia burkei, Sclerocarya birrea, Terminalia sericea, Afzelia quanzensis, Albizia adianthifolia, Albizia versicolor, Combretum molle, Diospyros inhacaensis, Ozoroa engleri, Spirostachys africana, Tabernaemontana elegans, Vepris lanceolata* and *Zanthoxylum capense.*

Shrubs*: Strychnos madagascariensis, Coddia rudis, Crotalaria monteiroi, Dichrostachys cinerea, Euclea natalensis, Gardenia volkensii, Grewia caffra, Monanthotaxis caffra, Rhus gueinzii* and *Strychnos spinosa.*

Graminiodes: *Panicum maximum, Aristida stipitata, Digitaria eriantha, Diheteropogon amplectens, Eragrostis moggii, Hyperthelia dissoluta, Perotis patens* and *Pogonarthria squarrosa.*

Endemic Taxon: *Pavetta vanwykiana* and *Cleome bororensis.*

Conservation

Tembe Sandy Bushveld is considered least threatened, with cultivation the only major threat (Mucina & Rutherford, 2006).

4.2.7 Western Maputaland Clay Bushveld

This vegetation types is restricted to Maputaland and extends from the Lebombo Mountains eastward to the edge of the Tembe Sandy Bushveld vegetation type, and southward to Mkuze Game Reserve and the town of Hluhluwe (Mucina & Rutherford, 2006).

Vegetation and Landscape features

Western Maputaland Clay Bushveld occurs on crests and upper- and mid-slopes of gently undulating terrain. It is characterised by broad-leaf woodlands and wooded grasslands (Mucina & Rutherford, 2006).

Important Plant Taxa

The following are some of the important taxa in Western Maputaland Clay Bushveld:

Trees: *Acacia nigrescens, Acacia nilotica, Acacia tortilis, Acacia gerrardii, Acacia grandicornuta, Bolusanthus speciosus, Spirostachys africana* and *Ziziphus mucronata.*

Shrubs: Dichrostachys cinerea, G*ymnosporia senegalensis, Azima tetramera, Ehretia rigida, Euclea divinorum, Galpinia transvaalica, Grewia caffra* and *Salvadora angustifolia.*

Grasses: *Bothriochloa insculpta, Dactyloctenium australe, Panicum maximum, Themeda triandra, Aristida congesta, Digitaria didactyla, Eragrostis rigidior, Eragrostis superba* and *Panicum coloratum.*

Herbs: *Asystasia gangetica, Chascanum hederaceum, Crossandra greenstockii* and *Hibiscus pusillus.*

Conservation

Western Maputaland Clay Bushveld is considered a vulnerable vegetation types according to Mucina & Rutherford (2006). Cultivation is the main cause of loss of this vegetation type (Mucina & Rutherford, 2006).

4.2.8 Western Maputaland Sandy Bushveld

Western Maputaland Sandy Bushveld occurs as isolated patches on the coastal plain in the Maputaland region east of the Lebombo Mountains (Mucina & Rutherford, 2006).

Vegetation and Landscape features

Western Maputaland Sandy Bushveld occurs on mid- and lower mid-slopes of gently undulating terrain and comprises woodlands and wooded grasslands (Mucina & Rutherford, 2006).

Important Plant Taxa

The following are some of the important taxa in Western Maputaland Sandy Bushveld:

Trees: *Acacia burkei, Combretum molle, Terminalia sericea, Balanites maughamii, Bolusanthus speciosus, Boscia albitrunca Commiphora neglecta* and *Ziziphus mucronata.*

Shrubs: *Brachylaena discolor, Carissa tetramera, Catunaregam obovata, Euclea natalensis, Gardenia volkensii, Grewia bicolor, Mundulea sericea, Pteleopsis myrtifolia, Rhus gueinzii, Strychnos madagascarensis* and *Strychnos spinosa.*

Grasses: *Dactyloctenium australe, Sporobolus fimbriatus, Panicum maximum, Aristida congesta, Eragrostis ciliaris, Eragrostis pallens, Perotis patens* and *Tragus berteronianus.*

Herbs: *Drimia altissima.*

Endemic Taxon: *Plectranthus psammophilus.*

Conservation

Western Maputaland Sandy Bushveld is considered least threatened. Like Western Maputaland Sandy Bushveld, cultivation is the main cause transformation (Mucina & Rutherford, 2006).

4.2.9 Sand Forest

In KwaZulu-Natal, Sand forests occur in a broad, yet highly fragmented band from False Bay Park northward into Mozambique.

Vegetation and Landscape features

Physionomically, Sand forests occur as dense stands of tall trees, with a well-developed shrub layer but a poorly developed herbaceous layer (Mucina & Rutherford, 2006).

Important Plant Taxa

The following summarises some of the important taxa in the Sand Forest vegetation type:

Trees: *Cleistanthus schlechteri, Dialium schlechteri, Newtonia hildebrandtii, Cola greenwayi, Pteleopsis myrtifolia, Psydrax locuples, Drypetes arguta, Drypetes natalensis, Lagynias lasiantha, Lannea antiscorbutica, Strychnos madagascariensis, Toddaliopsis bremekampii, Suregada zanzibariensis, Uvaria lucida* and *Balanites maughamii.*

Shrubs: *Croton pseudopulchellus, Croton steenkampianus, Canthium setiflorum, Haplocoelum foliolosum, Pavetta catophylla, Tricalysia junodii* and *Warneckea sousae.*

Graminiodes: *Panicum laticomum* and *Eragrostis moggii.*

Herbs: *Crassula maputensis.*

Endemic Taxon: *Erythrophleum lasianthum, Oxyanthus latifolius, Schlechterina mitostemmatoides, Strophanthus luteolus, Psydrax fragrantissima, Tricalysia delagoensis, Bonatea lamprophylla* and *Brachychloa schiemanniana, inter alia.*

Conservation

Sand forests are species rich, and show high levels of both plant and animal endemism (Gaugris & Van Rooyen, 2008). Mucina & Rutherford (2006) noted that these forests form the core of the Maputaland-Pondoland-Albany hotspot of Biodiversity and the Maputaland Centre of Plant Endemism (see Section 4.3).

Accordingly, the Sand Forest vegetation type is classified as a Critically Endangered vegetation type (Mucina & Rutherford, 2006). Within formally conserved areas (e.g. Tembe Elephant Park and Sileza Nature Reserve), Sand forests are under threat from continued and increasing disturbances caused by large herbivores, such as elephant (Gaugris & Van Rooyen, 2008). Outside conservation areas these forests are also under increasing threat due to increases in human population growth (Gaugris & Van Rooyen, 2008). Cultivation, timber plantations and wood harvesting are major causes of historic Sand Forest loss (Mucina & Rutherford, 2006).

4.3 Maputaland Centre of Endemism

The Maputaland Centre of Endemism is the northern most portion of the Maputaland-Pondoland-Albany hotspot of biodiversity and extends over 17 000km^2 (Smith *et al.* 2008). The flora of the centre is exceptionally diverse, and comprises a mosaic of swamps, grassland, savanna and forest as determined by local edaphic factors (Van Wyk 1996).

The centre constitutes the southernmost range limit of many tropical plants (Van Rensburg *et al.* 1999). Approximately 2500 species of vascular plant are found in the centre, of which at least 203 are endemic or near-endemic to the region. The Maputaland Centre of Endemism also has an exceptionally high diversity of fauna, and many endemics covering the entire taxonomic spectrum (Van Wyk 1996) - one mammal (14 of subspecies rank), five birds, 23 reptiles, three frogs and eight fresh water fishes.

The conservation importance of the Maputaland Centre of Endemism is globally recognised (Smith *et al.* 2008), and efforts have been made to provide a number of formally protected areas (PA) including two in Mozambique, 12 in South Africa & two in Swaziland (Smith *et al.* 2008). However, the present system only meets 45% of representative targets (Smith *et al.* 2008).

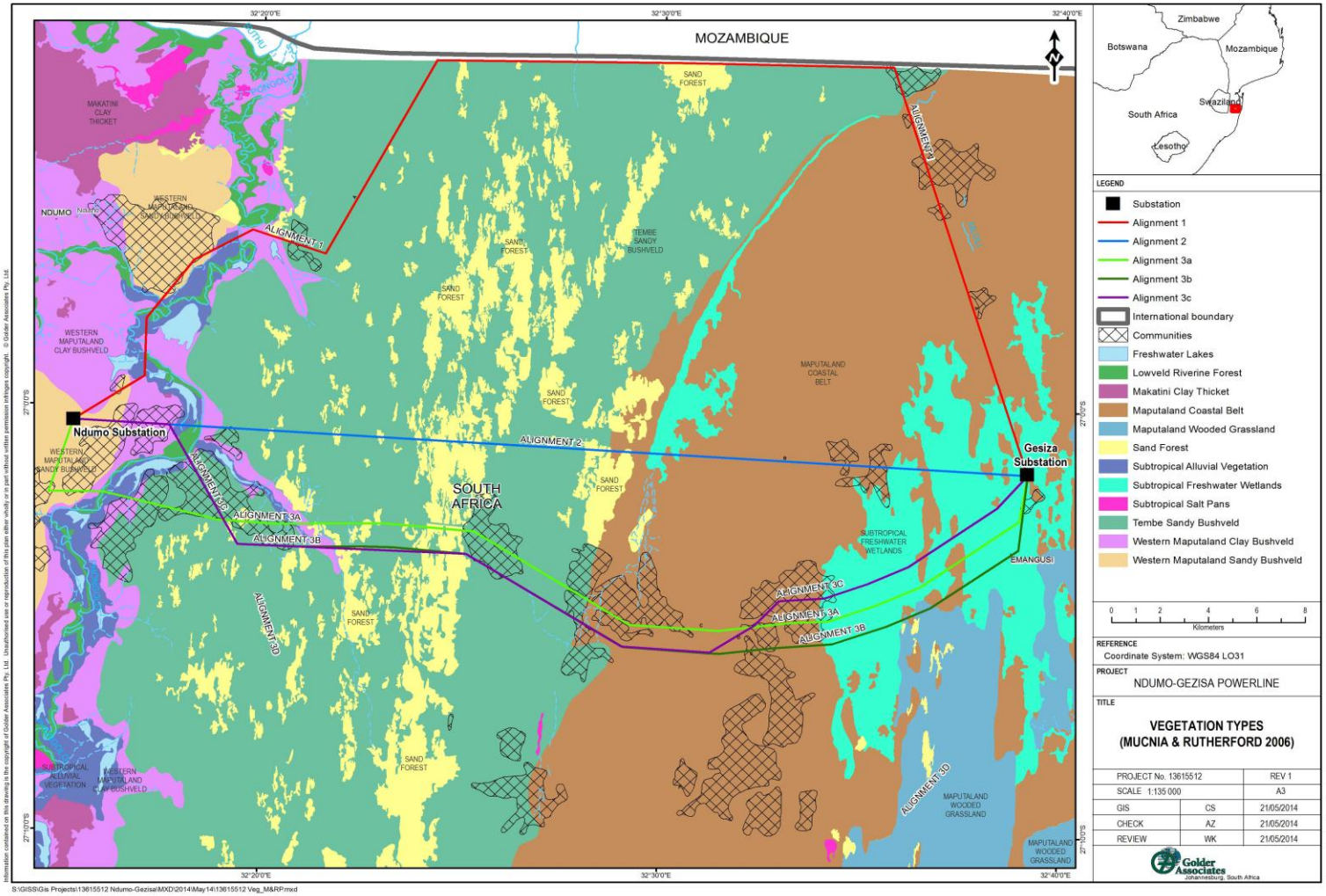

Figure 2: Study area in relation to the regional vegetation types, as described by Mucina & Rutherford (2006).

4.4 Flora Assessment

4.4.1 Surrounding landscape matrix

The natural topography of the study area is variable with the western portion characterised by an undulating landscape defined by the Pongola River, various drainage channels and upland areas. Conversely, the eastern portion is generally more flat and characterised by large wetland-type habitats on the former coastal plain.

The majority of the Maputaland region falls under rural community land-use. As such, large sections of the study area and surrounding landscape are characterised by rural villages and scattered households, with associated activities, such as subsistence agriculture, livestock farming and natural resource harvesting.

Areas displaying high levels of anthropogenic development or impacts are typically aligned with the main Jozini - eMangusi/Kosi Bay arterial road and the various rural feeder roads, as well as along prominent water courses such as the Pongola River. Beyond these high-impact zones, the land is generally in a natural to semi-natural condition and used primarily for the grazing of cattle and goats.

Evidence suggests that fire is frequently used in grassland and bushveld areas to promote grass production. Other prominent non-rural land-uses observed in the landscape matrix include timber plantations. These are predominantly sited in eastern portion of the study area.

Two regionally important conservation areas, namely Tembe Elephant Park and Ndumu Game Reserve, are located in this region of Maputaland. The former is situated in the centre of the study area, while the latter is situated to the north-west. Moreover, the smaller, less well known Sileza Nature Reserve is located in the south-eastern portion.

4.4.2 Study area characteristics

Five broad vegetation communities/units were recognised in the study area during the 2013 field survey. Delineations are largely based on those presented by Mucina & Rutherford (2006). The communities were recognised based on species composition, physiognomy, moisture regime, slope and disturbance characteristics. These are:

- *Hyphaene* moist grasslands;
- *Strychnos – Terminalia* sand bushveld;
- Mixed bushveld;
- Sand forest; and
- Riparian vegetation community.

Although recorded as such, there is natural variation within the vegetation communities as a result of various natural influences, as well as current and historic anthropogenic disturbance. The characteristics of the recognised vegetation communities are detailed in Sections 4.4.2.1 to 4.4.2.5 and their distributions are shown in Figure 11.

4.4.2.1 Hyphaene Moist Grasslands

This vegetation community occurs on the very sandy, leached soils of the former coastal plain in the eastern portion of the study area. The topography is generally flat, with occasional depressed zones providing moister patches characterised by hygrophilous vegetation.

The vegetation in the *Hyphaene* moist grassland vegetation community is typified by open, grasslands with scattered individual or pockets of the palm *Hyphaene coriacea* (*Figure 3*). In larger *Hyphaene* pockets other common woody species were noted, including *Combretum molle, Dichrostachys cinerea* and *Phoenix reclinata.* These woody thickets have an approximate height of 2 to 4 m.

Other less common woody species recorded in this vegetation community include *Acacia burkei, Acacia nilotica, Bridelia micrantha, Euclea natalensis, Kraussia floribunda, Mundulea sericea, Ozoroa sphaerocarpa, Parinari curatellifolia, Rhus nebulosa, Sclerocarya birrea, Strychnos decussata, Strychnos madagascariensis, Spirostachys africana, Syzygium cordatum* and *Terminalia sericea* (Figure 4). More established and extensive, yet less common patches of thicket were also noted in this community. The vegetation of these forested patches approximates that recorded in the *Strychnos* Sand Bushveld vegetation community, detailed in Section 4.4.2.2.

The grassland component of this vegetation community is variable. Depressed areas are seasonally wet, and are dominated by hygrophilous grasses and sedges. Drier areas support a variety of grasses and forbs, as well woody suffrutex species such as *Eugenia capensis*. The shrublet *Helichrysum kraussii* is particularly common in these grasslands as are *inter alia* various *Cyperaceae* species, *Cynodon dactylon, Eragrostis gummiflua and Paspalum distichum*.

Other herbaceous recorded in *Hyphaene* moist grassland vegetation community include *Arctotis arctotoides, Aristida bipartita, Asparagus setaceus, Azania krebsiana, Chamaecrista mimosoides, Crotalaria lanceolata, Cymbopogon plurinodis, Digitaria eriantha, Eragrostis racemosa, Eugenia albanensis, Gomphocarpus fruticosa, Helichrysum nudifolium, Hyperthelia dissoluta, Juncus* reeds, *Kyphocarpa angustifolia, Monocymbium ceresiiforme, Nidorella auriculata, Perotis patens, Sida dregei, Solanum panduriforme, Tephrosia purpurea, Tephrosia polystachya, Themeda triandra, Trachypogon spicatus, Tricholaena monachne* and *Tricliceras mossambicense.*

Fire coupled with high soil moisture levels are the primary agents maintaining this vegetation community in a grass dominated state. It is noted that cattle and to a lesser extent goat grazing is common, as is the harvesting of palm oil from *Phoenix reclinata.* The pine (*Pinu*s sp.) plantations are also primarily found in this vegetation community.

Figure 3: Typical view of Hyphaene moist grassland.

Figure 4: Pocket of denser woody vegetation within Hyphaene moist grassland vegetation community.

Sensitivity Aspects and Ecological Integrity Rating

Hyphaene moist grasslands are one of the larger vegetation communities in the study area. Although subject to heavy grazing they do provide important grassland and ephemeral wetland type habitat for a variety of flora and fauna species, some of which are endemic or of conservation importance (e.g. the protected trees *Sclerocarya birrea* & *Spirostachys africana*).

The ecological integrity of this vegetation community is rated at C/B (fair to good ecological integrity). Accordingly, the conservation importance of areas of this vegetation community is also Moderate (refer to Figure 12 and Figure 13).

4.4.2.2 Strychnos Sand Bushveld

The woody component of the *Hyphaene* moist grassland increases toward the west and this vegetation community grades into *Strychnos* sand bushveld, which extends across the central portion of the study area. The *Strychnos* sand bushveld vegetation community is underlain by sandy soils and is characterised by open- to closed bushveld, consisting of a mixture of woody, predominantly broad-leaf species of a mean height of 2 - 4 m.

The woody composition of this vegetation community is rich, containing elements of the *Hyphaene* moist grasslands and the Sand forest vegetation communities (see Section 4.4.2.3 for account of the latter). *Strychnos madagascariensis* is very abundant, as are a number of other woody species including *Acacia burkei, Aloe parvibracteata, Catunaregam spinosa, Dichrostachys cinerea* and *Hyphaene coriacea.*

Other common woody species include *Acacia karroo, Acacia nilotica, Acacia robusta, Albizia adianthifolia, Albizia forbesii, Albizia versicolor, Balanites maughamii, Buxus natalensis, Bridelia cathartica, Cassine aethiopica, Carissa bispinosa, Canthium inerme, Combretum kraussii, Combretum molle, Commiphora neglecta, Croton pseudopulchellus, Dialium schlechteri, Ehretia amoena, Euclea divinorum, Euclea natalensis, Eugenia capensis, Euphorbia triangularis, Flueggea virosa, Garcinia livingstonei, Gardenia cornuta, Grewia microthyrsa, Gymnosporia senegalensis, Kraussia floribunda, Landolphia kirkii, Mundulea sericea, Newtonia hildebrandtii, Opuntia ficus-indica*, Phoenix reclinata, Phyllanthus reticulata, Portulacaria afra, Pseudobersama mossambicensis, Psidium guajava, Pteleopsis myrtifolia, Pterocelastrus echinatus, Rhus guenzii, Sapium integerrimum, Schotia brachypetala, Sclerocarya birrea, Sideroxylon inerme, Spirostachys africana, Strychnos decussata, Strychnos madagascariensis, Strychnos spinosa,*

Tabernaemontana elegans, Terminalia sericea, Tricalysia lanceolata, Trichilia emetica, Vangueria infausta, Vitex ferruginea, Zanthoxylum capense and *Ziziphus mucronata.*

Species recorded in the herbaceous layer include the grasses *Aristida bipartita, Aristida congesta* subsp. *congesta, Cymbopogon plurinodis, Digitaria eriantha, Eragrostis ciliaris, Eragrostis superba, Panicum maximum, Perotis patens, Pogonarthria squarrosa* and *Themeda triandra*, and the forbs *Ceratotheca triloba, Kalanchoe brachyloba, Kyphocarpa angustifolia, Sansevieria hyacinthoides, Sansevieria pearsonii, Senecio* species, *Sida dregei* and *Tecomaria capensis* amongst others.

Like *Hyphaene* moist grasslands, areas of *Strychnos* sand bushveld appear to be regularly burnt and used for livestock grazing.

Figure 5: Strychnos sand bushveld

Sensitivity Aspects and Ecological Integrity Rating

Strychnos sand bushveld is one of the larger vegetation communities in the study area. Notwithstanding the fact that large sections of this community along the Jozini - eMangusi/Kosi Bay arterial road are disturbed, *Strychnos* sand bushveld areas do form important habitat for flora and fauna, some of which are species of conservation importance (e.g. the protected trees *Balanites maughamii*, *Newtonia hildebrandtii* & *Sclerocarya birrea*). Moreover, although not considered sensitive, it is anticipated that *Strychnos* sand bushveld areas do act as important ecological support habitat for the important Sand forest vegetation community – see section 4.4.2.3.

Overall the ecological integrity rating of this vegetation community was classified as “C/B” (fair to good ecological integrity) and it is considered to be of moderate-high conservation importance (refer to Figure 12 and Figure 13).

4.4.2.3 Sand Forest

Sand forests in the study area occur as pockets of varying size, scattered along a north-south band through the *Strychnos* sand bushveld vegetation community. These pockets are characteristically densely wooded, and consist of medium-sized to tall trees (up to 15 m in height), with a well-developed lower canopy (Figure 6).

Forest pockets are often punctuated by grass patches or corridors that display similar herbaceous composition to the *Strychnos* sand bushveld. Wood harvesting and other anthropogenic activities in Sand forest areas close to human habitation have created additional openings in the forest, allowing more bushveld-type species to establish. Although fire rarely penetrates forest patches, forest boundaries are noticeably abrupt as a consequence of fires in the surrounding grass and savanna areas. Numerous cattle paths were noted in and between forest patches and it is expected that cattle frequently move along these paths to graze.

In terms of vegetation composition, Sand forests are typically species rich. Common woody plants recorded in the upper canopy include trees such as *Afzelia quanzensis, Balanites maughamii, Cleistanthus schlechteri, Dialium schlechteri, Mimusops caffra* and *Pteleopsis myrtifolia.*

Species comprising the lower canopy include *inter alia, Acacia burkei, Acacia kraussiana, Albizia adianthifolia, Ancylobothrys petersiana, Buxus natalensis, Capparis sepiaria, Canthium inerme, Cassine aethiopica, Cheilanthes viridis, Cissus quadrangularis, Cryptocarya woodii, Dalbergia obovata, Dodonaea angustifolia, Brachylaena discolor, Cola greenwayi, Commiphora neglecta, Croton pseudopulchellus, Cussonia sphaerocephala, Drypetes arguta, Drypetes gerardii, Euclea natalensis, Eugenia capensis, Euphorbia grandidens, Euphorbia tirucalli, Grewia microthyrsa, Hymenocardia ulmoides, Kraussia floribunda, Manilkara concolor, Monanthotaxis caffra, Pseudobersama mossambicensis , Psydrax locuples, Putterlickia verrucosa, Rawsonia lucida, Rhus guenzii, Salacia kraussii, Sclerocarya birrea, Suregada zanzibariensis, Spirostachys africana, Strychnos decussata, Strychnos henningsii, Strychnos madagascariensis, Teclea gerrardii, Toddaliopsis bremekampii, Terminalia sericea, Uvaria caffra, Wrightia natalensis* and *Ziziphus mucronata.*

Unlike savanna habitats, the high shade levels resulting from the dense upper canopy prevents the establishment of a highly productive herbaceous layer in Sand forests. Grasses recorded are typically those growing of the edges of forest patches, such as *Aristida* species*, Eragrostis ciliaris, Eragrostis superba, Panicum maximum, Perotis patens Digitaria eriantha* and *Tricholaena monachne.* Other shrubs and forbs noted in the herbaceous layer include *inter alia*, *Abrus precatorius, Aloe parvibracteata, Cussonia arenicola, Erianthermum dregei, Eulophia petersii, Helichrysum kraussii, Sansevieria hyacinthoides, Senecio barbertonicus* and *Senecio* species.

Figure 6: Sand forest.

Sensitivity Aspects and Ecological Integrity Rating

The Sand forest vegetation community is considered the most valuable and rarest in Maputaland, having high levels of both flora and fauna endemism (Gaugris & Van Rooyen, 2008), and a number of species listed as Red Data and/or protected.

Patches of Sand forest along the Jozini - eMangusi arterial road show signs of localised anthropogenic disturbances associated with timber harvesting. Be that as it may, the ecological integrity, of undisturbed patches of this vegetation community, is classified as "A" (excellent ecological integrity). This vegetation community is considered threatened and sensitive to additional degradation and fragmentation. Accordingly, is regarded as being of high the conservation importance and measures should be taken to minimise additional disturbances (refer to Figure 12 and Figure 13).

4.4.2.4 Mixed Bushveld

Mixed Bushveld extends from the edge of the Pongola River riparian zone westward. The soils of this vegetation community are noticeably less sandy than the other communities, having a red colour, a firmer structure and ostensibly higher clay content.

The vegetation composition of upland areas is mixed, but generally dominated by broad-leafed woody species (height 2 to 4m), most notably *Carissa bispinosa, Canthium inerme, Combretum molle, Croton pseudopulchellus* and *Terminalia sericea* (Figure 7). Other less abundant species recorded include *Acacia burkei, Aloe marlothii, Berchemia zeyheri, Boscia albitrunca, Canthium inerme, Combretum apiculatum, Dichrostachys cinerea, Ehretia rigida, Euclea divinorum, Euclea natalensis, Euphorbia ingens, Euphorbia tirucalli, Euphorbia triangularis, Gardenia cornuta, Grewia flavescens, Manilkara mochisia, Maytenus heterophylla, Mundulea sericea, Ozoroa paniculosa, Pappea capensis, Peltophorum africana, Ptaeroxylon obliquum, Rhus guenzii, Sclerocarya birrea, Spirostachys africana, Sterculia rogersii, Strychnos henningsii, Strychnos spinosa, Terminalia sericea, Vangueria infausta, Ximenia americana* and *Ziziphus mucronata.*

Common herbaceous species, in the upland areas, include the grasses *Aristida congesta* subsp. *barbicollis,* Dactyloctenium australis, *Sida dregei, Tricholaena monachne, Aristida congesta,* subsp. *barbicollis, Panicum maximum, Perotis patens, Themeda triandra* and *Tragus berteronianus,* as well as the forbs *Asparagus setaceus, Kalanchoe brachyloba* and *Sansevieria hyacinthoides.*

Figure 7: Upland area of the Mixed bushveld vegetation community

From the upland areas, the clay content of the soil gradually increases toward the low-lying areas adjacent to the Pongola River riparian zone. This is reflected in a gradual transition in the woody species composition from broad-leaf to fine-leaf dominated species, with species such as *Acacia nilotica, Acacia tortilis, Acacia xanthophloea, Albizia anthelmintica* and *Dichrostachys cinerea* becoming particularly dominant (Figure 8). Other woody species recorded in the low lying zones that were not noted/common in upland areas include *Aloe parvibracteata, Azima tetracantha, Balanites maughamii, Brachylaena huilensis, Commiphora neglecta, Croton steenkampianus, Euclea undulata, Grewia microthyrsa, Gymnosporia buxifolia, Maerua caffra, Maerua decumbens, Manilkara mochisia, Newtonia hildebrandtii, Salvadora australis, Schotia brachypetala, Senna petersiana, Strychnos decussata* and *Trichilia emetica.*

In low lying areas of this vegetation community, the annual grass *Sporobolus nitens* is particularly common. This species is abundant in disturbed veld (Van Oudtshoorn, 1999) which indicates the overgrazing is taking place (Figure 8). Other herbaceous species recorded include *Adenium multiform, Argemone mexicana*, Chromolaena odorata*, Gomphocarpus fruticosus* subsp*. decipiens, Cissus cactiformis, Sida cordifolia, Solanum panduriforme and Tribulus terrestris,* while *Litogyne gariepina* and *Pechuel-Loeschea leubnitziae* and *Sesbania bispinosa* were recorded in ephemeral water-filled depressed areas*.*

Figure 8: Low lying areas of Mixed bushveld – note sparse grass cover and dominance of Sporobolus nitens.

Sensitivity Aspects and Ecological Integrity Rating

Areas of Mixed bushveld are heavily utilised by the rural community for *inter alia* grazing and firewood. This notwithstanding, they do form important habitat for flora and fauna, some of which are species of conservation importance (e.g. *Balanites maughamii* & *Boscia albitrunca*). The ecological integrity rating of non-transformed areas of this vegetation community was classified as “C/B” (fair to good ecological integrity) and it is considered to be of moderate conservation importance (refer to Figure 12 and Figure 13).

4.4.2.5 Riparian vegetation community

The Riparian vegetation community is centred on the Pongola River, which is located on the western edge of the study area. Large areas of the Pongola River embankment and associated floodplains have been cleared of natural vegetation by the local communities and used to grow agricultural crops. As such, much of the Pongola River riparian vegetation community in the study area is disturbed and highly fragmented.

Woody plants are generally confined to the immediate river banks or in areas between cultivated fields, and comprise a mixture of tall (> 6 m) obligate riparian species in the upper canopy (e.g. *Ficus sycomorus*) and smaller (~3 m) species growing lower shrub layer. Tall trees contributing to the upper canopy include *Acacia robusta, Acacia xanthophloea, Albizia versicolor, Faidherbia albida, Ficus sycomorus, Garcinia livingstonei, Kigelia africana, Sclerocarya birrea, Schotia brachypetala, Spirostachys africana, Trichilia emetica* and *Ziziphus mucronata.* Numerous exotic Mango (*Mangifera indica*) trees were also recorded growing in the cultivated fields adjacent to the river.

Where not disturbed or cleared, woody species recorded in the lower shrub layer are include *Acacia schweinfurthii, Acacia tortilis, Dichrostachys cinerea, Euclea divinorum, Grewia flavescens, Grewia villosa, Gymnosporia senegalensis, Phoenix reclinata, Phyllanthus pinnatus, Phyllanthus reticulatus* and *Tabernaemontana elegans.*

Figure 9: Riparian vegetation community along the Pongola River.

As a consequence of the high levels of disturbance, the herbaceous layer comprises a mixture of indigenous and exotic species, such as *inter alia*, *Argemone mexicana*, Chromolaena odorata*, Cynodon dactylon, Cyperus* species*, Eragrostis ciliaris, Gomphocarpus fruticosus* subsp*. decipiens, Gossypium herbaceum* subsp*. africanum, Imperata cylindrica, Leonotis intermedia, Panicum maximum, Pechuel-Loeschea leubnitziae, Phragmites australis, Ricinus communis* var. *communis*, Sesbania bispinosa *, Sida cordifolia, Sorghum* species, *Strelitzia nicolai* and *Xanthium strumarium*.*

Figure 10: Floodplain of the Pongola River cleared and used for crop cultivation.

Sensitivity Aspects and Ecological Integrity Rating

Subsistence agriculture has transformed and disturbed large sections of the Pongola River floodplain comprising the riparian vegetation community. This notwithstanding, riparian areas do form critical fauna and flora habitat and provide important movement and dispersal corridors. Moreover, flora species of conservation importance (e.g. *Sclerocarya birrea* & *Spirostachys africana*) were also noted in this vegetation community.

The ecological integrity of this vegetation community was classified as “C” (fair ecological integrity). However, Riparian vegetation community is sensitive and considered of high conservation importance (refer to Figure 12 and Figure 13). Measures should be taken to minimise additional disturbances.

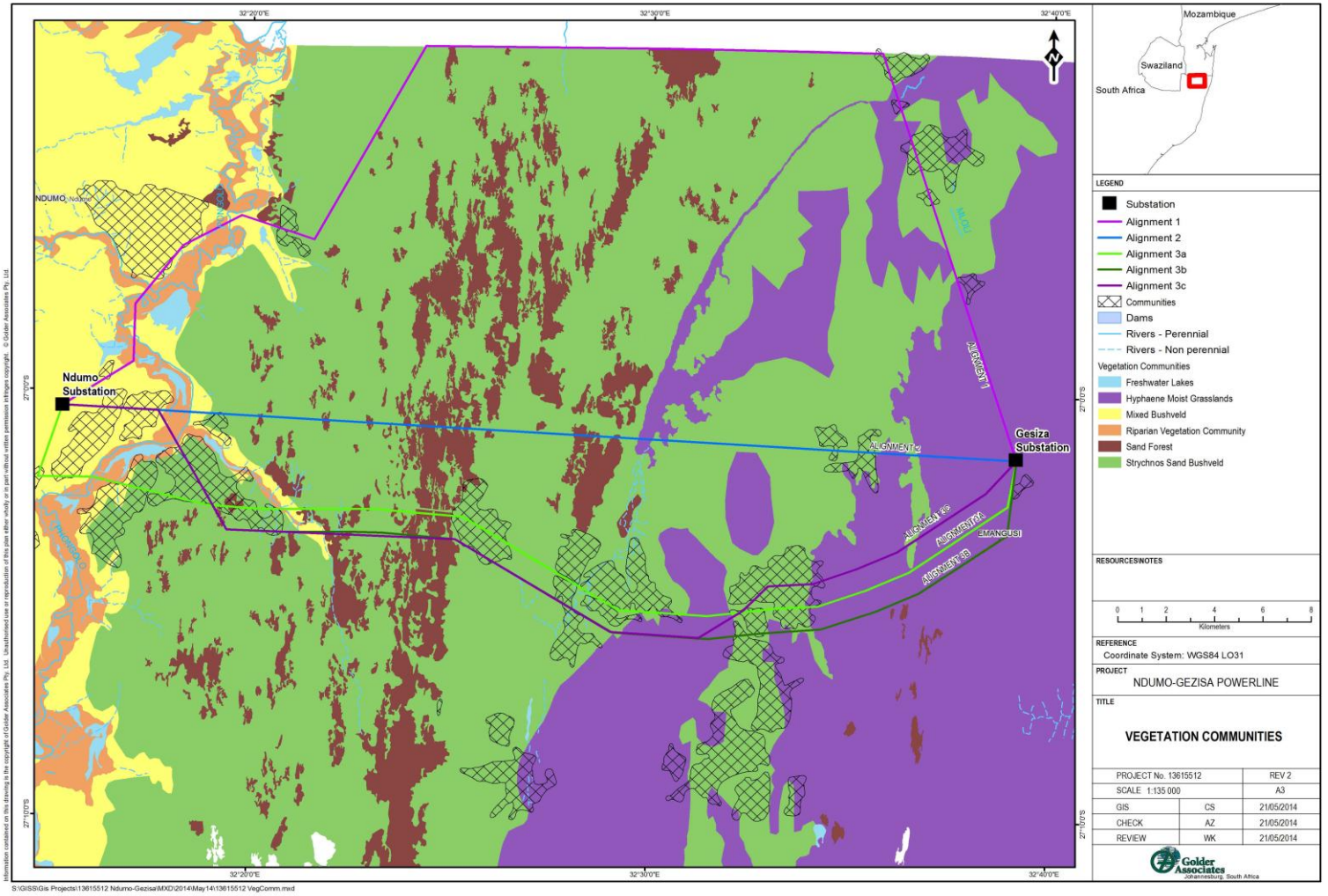

Figure 11: Vegetation communities and developed areas in the study area.

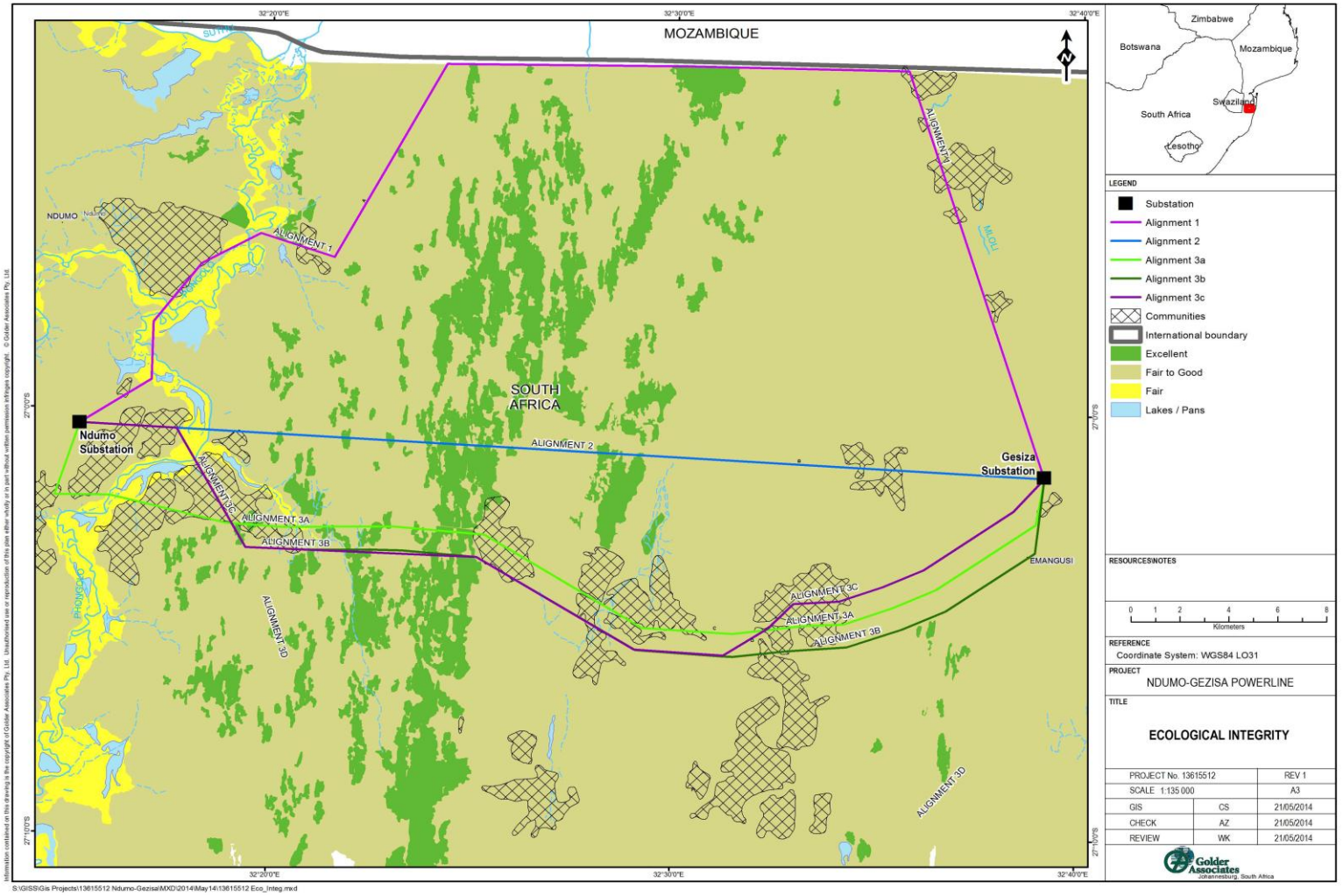

Figure 12: Ecological integrity ratings of the different vegetation communities in the study area.

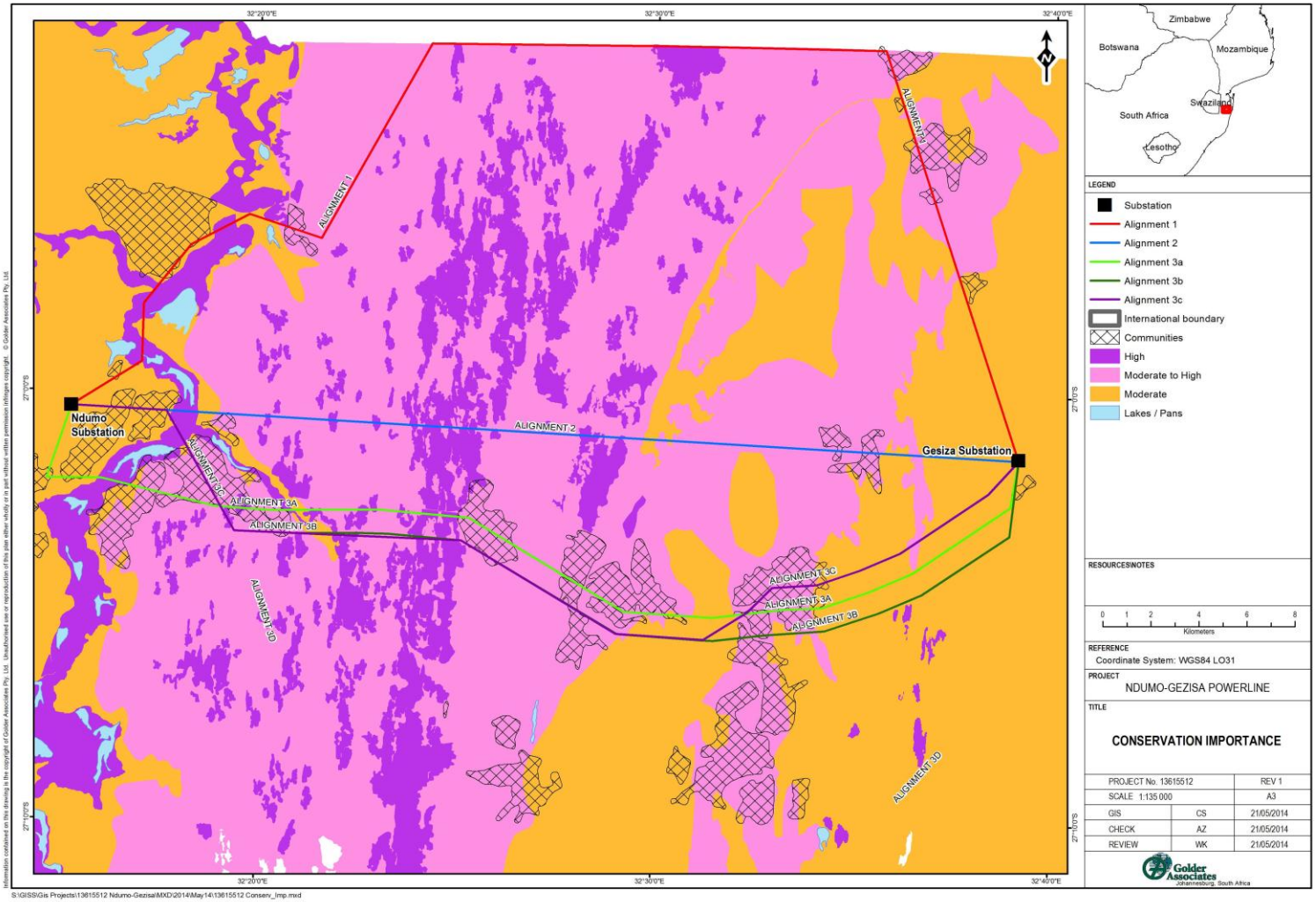

Figure 13: Conservation importance of the different vegetation communities in the study area.

4.4.3 Declared weeds and invader plants

Exotic, or alien, plants are species that occur outside their historic geographic range. In most instances they have been introduced by humans owing to their economic and/or ornamental value. Although many exotic species such as common agricultural and garden plants, are unable to propagate without human intervention (Bromilow, 2010), certain species are able to survive and reproduce under natural conditions. These 'naturalised' species once established, are able to reproduce rapidly and eventually out-compete indigenous vegetation, creating large, almost monospecific stands (Bromilow, 2010). Such infestations can lead to a loss of indigenous biodiversity and a contingent reduction in ecosystems functioning. Exotic invasive plants are consequently responsible for widespread habitat loss and degradation throughout South Africa and adversely affect both the environment and economy.

4.4.3.1 Current and proposed legislation

The only current active legislation concerning exotic and invasive species in South Africa forms part of the Conservation of Agricultural Resources Act (CARA) (Act. 43 of 1983)[1] – specifically Regulations 15 and 16 which concern problem plants. Although the National Environmental Management: Biodiversity Act (NEMBA) (No. 10 of 2004) does include provision for exotic invasive species management, this legislation has yet to be finalised and remains in draft format (ARC, 2010, internet).

The 2001 revision, and amendment of CARA (Act. 43 of 1983), recognises three categories of exotic or alien plant species. The regulations pertaining to each category are summarised below:

Category 1: Declared weeds

Category 1 listed plants have no economic value and possess characteristics harmful to humans, animals or the environment. These species tend to produce high volumes of seed, are wind or bird dispersed, or have efficient vegetative reproduction, and are thus highly invasive causing substantial environmental degradation. As such, Category 1 listed plants may not be planted or propagated in rural and urban areas, and the trade in their seeds, cuttings and other propagatory material is prohibited. Moreover, it is recommended that active measures be taken to control and eradicate populations of these species (ARC, 2010, internet).

Category 2: Declared invader plants with commercial or utility value

Although Category 2 listed plants are invasive species, they do have beneficial properties and general utility. They are permitted in demarcated areas (as granted by the Executive Officer) under controlled conditions, and in bio-control reserves. Seed and propagative material may only be sold to, and acquired by land users of areas demarcated for that particular species, as determined by the Executive Officer. These species may not occur within 30 m of the 1:50 year flood line of a water course or wetland, except under authorisation in terms of the National Water Act (Act 36 of 1998) (ARC, 2010, internet).

Category 3: Mostly ornamental plants

Category 3 plants are exotic plants that are generally popular ornamental and garden species but show high invasive potential, and frequently encroach into natural areas. Existing plants may remain provided they do not occur within 30 m from the 1:50 year flood line of a water course or wetland, and provided all reasonable steps are taken to limit the further spread of that species. No further propagation or trade in propagative material is permitted (ARC, 2010, internet).

[1] CARA is currently in the process of being revised.

The proposed NEMBA exotic and invasive species regulations make provision for four categories, as detailed in Table 1 (ARC, 2010, internet).

Table 1: Proposed NEMBA categories

Category	Regulations
Category 1a	High priority emerging species requiring compulsory control. The breeding, growing and selling of listed species are banned.
Category 1b	Widespread and invasive species, controlled by management programmes.
Category 2	Invasive species controlled by area. Can be grown under permit conditions in demarcated areas. All breeding, growing, moving and selling are banned without a relevant permit.
Category 3	Ornamental plants and other species permitted on a property but may no longer be planted or sold.

4.4.3.2 Exotic plant species recorded in the study area

A number of exotic plant species were recorded in the study area during the field survey. Most of these were recorded around areas of human habitation or high anthropogenic activity. Of exotic plant species recorded in the study area, seven are listed under the Conservation of Agricultural Resources Act (CARA) (No. 43 of 1983)[2], as being problem plants - see Table 2.

Table 2: CARA listed exotic species commonly recorded in the study area

Scientific name	Common name	CARA Category	NEMBA Category (Proposed)
Argemone mexicana	Mexican poppy	1	1b
Cereus jamacara	Queen of the night	1	1b
Chromolaena odorata	Paraffin weed	1	1b
Ipomoea fistulosa	Morning glory bush	-	1b
Lantana camara	Lantana	1	1b
Opuntia ficus-indica	Sweet prickly pear	1	1b
Parthenium hysterophorus	Pathenium	1	1b
Pinus species	Pine	2	2
Ricinus communis var. *communis*	Castor oil plant	2	1b
Xanthium strumarium	Large cocklebur	1	1b

4.4.4 Flora species of conservation importance

Eight plant species of conservation importance were recorded in the study area during the field survey. An additional seven species may potentially occur in the study area, as per the South African Biodiversity Institute's SIBIS database which lists species recorded in the quater degree squares in which the study area is located.

[2] CARA is in the process of being revised.

Flora species of conservation importance that were recorded in the study area during the 2013 field survey, or that are likely to occur are listed in Table 3.

Table 3: Flora species of conservation importance recorded in the study area

Species	International Union for the Conservation of Nature (IUCN)	Protected Tree Species (National Forest Act No. 84 of 1998)	KwaZulu-Natal - Protected Species (1999)	Observation
Afzelia quanzensis	-	Protected	-	Recorded
Aloe cooperi	Declining	--	-	-
Balanites maughamii	Declining	Protected	-	Recorded
Boscia albitrunca	-	Protected	-	Recorded
Cleistanthus schlechteri	-	Protected	-	Recorded
Combretum mkuzense	Near Threatened	-	-	-
Erythrophleum lasianthum	Near Threatened	-	-	-
Ficus trichopoda	-	-	Protected	-
Nesaea wardii	Vulnerable	-	-	-
Newtonia hildebrandtii	Declining	Protected	Protected	Recorded
Pelargonium tongaense	Rare	-	-	-
Sclerocarya birrea subsp. *caffra*	-	Protected	-	Recorded
Sideroxylon inerme	-	Protected	Protected	Recorded
Spirostachys africana	-	Protected	-	Recorded
Warburgia salutaris	Endangered	-	-	-

Refer to APPENDIX C for a list of all flora species recorded in project area as per the SANBI SIBIS database.

4.5 Fauna Assessment

4.5.1 Mammals

Six mammal species were recorded in the study area during the 2013 dry season field survey. These comprise an antelope species and 5 species of rodent. Rodents observed include the Pouched mouse (*Saccostomus campestris*), Chestnut climbing mouse (*Dendromus mystacalis*), Woodland mouse (*Grammomys* sp.), Pouched mouse (*Mastomys* sp.) and Grey climbing mouse (*Dendromus melanotus*). Recorded rodents are generally common species, with widespread distributions throughout the bushveld regions of southern South Africa and Mozambique.

Faecal deposits of a small antelope species were noted in Sand Forest patches. Based on the size of the observed pellets, it is suspected that they are from either Suni (*Neotragus moschatus*) or Blue duiker (*Cephalophus monticola*). However, it is also possible that they are from the slightly larger Red duiker (*Cephalophus natalensis*). These antelope species have a limited distribution in South Africa, being confined mainly to coastal areas or inland forested areas (Stuart & Stuart2007) - and all of conservation importance (see below account).

Despite the large areas of suitable habitat throughout the study area, almost all land outside the formal conservation areas and the timber plantations is under communal, open-access land-use. It is thus suspected that hunting is probably widespread and common, and is the major factor contributing to the low mammal abundance and richness observed during the field survey.

Be that as it may, the conservation areas in the region, particularly Ndumu Game Reserve and Tembe Elephant Park have a rich wildlife assemblage, comprising a full spectrum mammal species. These reserves will act as source populations for various mammal species. Although many such species will be confined to these enclosed protected areas, it is expected that highly vagile species, such as Leopard (*Panthera pardus*), may frequently disperse into the adjacent communal areas. An additional 109 mammal species thus possibly occurring throughout the study area, as per the distribution maps presented in Stuart & Stuart (2007) - see APPENDIX D for a full list of potential species.

Red Data and protected mammals

Suni (*Neotragus moschatus*), Red duiker (*Cephalophus natalensis*) and Blue duiker (*Cephalophus monticola*) are all listed as species of concern according to the NEMBA TOPS List (2013) and the Schedule KwaZulu-Natal Nature Conservation Management Amendment Act (No. 5 of 1999). The Blue duiker (*Cephalophus monticola*) is further listed by the IUCN – see Table 4 for species statuses. An additional 16 mammals that potentially occur in the study area are categorised as Red Data and/or protected - see Table 4.

Table 4: Red Data and protected mammals recorded or potentially occurring in the study area

Scientific name	Common Name	IUCN (2013.1)	NEMBA TOPS List (2013)	KwaZulu-Natal - Protected Species (1999)	Probability of Occurrence
Neotragus moschatus	Suni	-	Protected	Specially Protected	High
Cephalophus natalensis	Red duiker	-	Protected	Protected	High
Cephalophus monticola	Blue duiker	Vulnerable	Vulnerable	Protected	High
Aonyx capensis	Cape clawless otter	-	Protected	Specially Protected	High
Cercopithecus mitis	Samango Monkey	Vulnerable	Vulnerable	Protected	High
Civettictis civetta	African civet	-	-	Protected	High
Crocuta crocuta	Spotted hyaena	Near threatened	Protected	Protected	Low
Felis lybica	African wild cat	-	-	Specially Protected	High
Hippotamus amphibius	Hippopotamus	-	-	Protected	High
Leptailurus serval	Serval	Near threatened	Protected	Specially Protected	High
Manis temminckii	Ground Pangolin	Vulnerable	Vulnerable	Specially Protected	Moderate
Mellivroa capensis	Honey badger	-	-	Specially Protected	High
Orycteropus afer	Aardvark	-	Protected	Specially protected	Low
Proteles cristatus	Aardwolf	-	-	Specially Protected	Moderate
Panthera pardus	Leopard	-	Protected	Protected	High
Helogale parvula	Dwarf mongoose			Protected	High
Paracynictis selousi	Selous's mongoose	-	-	Protected	High
Tragelaphus angasii	Nyala	-	Protected	-	Recorded
Tragelaphus scriptus	Bushbuck	-	Protected	-	High

4.5.2 Herpetofauna (Reptiles and Amphibians)

Four herpetofauna species were recorded during the 2013 dry-season field survey, namely the Common rough-scaled lizard (*Ichnotropis squamulosa*), Sandveld lizard (*Nucras* species) and Variable skink (*Mabuya varia*) and the Foam nest frog (*Chiromantis xerampelina*). The recorded species are all common to bushveld areas and are not considered threatened.

Maputaland has a high herpetofauna species richness owing to the great variability of habitats The distribution maps presented in Branch (1998), indicates a total of 102 reptile species potentially occur in the study area, while those in Carruthers (2001) indicates a possible 43 species of amphibians – refer to APPENDIX F for a list of all herpetofauna.

Red Data and protected herpetofauna

Of herpetofauna potentially occurring in the study area, 18 reptiles and four amphibians are listed as species of conservation importance (see Table 5). Most of these however, are listed only at a provincial level according to Schedule 4 and 5 of the KwaZulu-Natal Nature Conservation Management Amendment Act (No. 5 of 1999) and not at a national level. Considering the varied nature of habitats in the study area, the probability that these species may be present is considered high.

Table 5: Red Data and protected herpetofauna potentially occurring in the study area.

Scientific name	Common Name	IUCN (2012.2)	NEMBA TOPS List (2013)	KwaZulu-Natal - Protected Species (1999)
REPTILES				
Amblyodipsas microphthalma	White-lipped snake	-	-	Protected
Bitis gabonica	Gabon adder	-	Protected	Specially Protected
Bradypodion setaroi	Setaro's dwarf chameleon	-	-	Specially Protected
Cordylus warren	Warren's girdled lizard	-	-	protected
Crocodylus niloticus	Nile crocodile	-	Vulnerable	Protected
Cryptoblepharus boutonii	Bouton's skink	-	-	Specially Protected
Dasypeltis medici	East African egg eater	-	-	Protected
Kinixys natalensis	Natal hinged tortoise	Near threatened	-	Protected
Leptotyphlops sylvicolus	Forest thread snake	-	-	Protected
Lycophidion pygmaeum	Pygmy wolf snake	-	-	Protected
Meizodon semiornatus	Semiornate snake	-	-	Protected
Natriciteres variegata	Forest marsh snake	-	-	Protected
Pelusios castanoides	Yellow-bellied hinged terrapin	-	-	Specially Protected
Philothamnus angolensis	Western green snake	-	-	Protected
Prosymna janii	Mozambique shovel-snout	-	-	Protected
Python natalensis	Southern African python	-	Protected	Specially Protected
Scelotes fitzsimonsi	FitzSimon's dwarf burrowing skink	-	-	Protected
Xenocalamus transvaalensis	Quill-snouted snake	-	-	Protected
AMPHIBIANS				
Cacosternum nanum	Bronze caco	-	-	Protected
Hildebrandtia ornata	Ornate frog	-	-	Protected
Hyperolius marmoraus	Painted reed frog	-	-	Protected
Phrynobatrachus acridoides	East African puddle frog	-	-	Protected

4.5.3 Arthropods

Twenty eight arthropod taxa were recorded during the 2013 dry season field surveys (Table 6). None of the recorded taxa are restricted in terms of habitat and distribution (Picker *et. al.,* 2008), or classified as species of conservation importance. It is anticipated that substantially more taxa occur in the study area, but it is appreciated that the results represent a dry season survey only.

Red Data and protected arthropods

The KwaZulu-Natal Nature Conservation Management Amendment Act (No. 5 of 1999) lists 16 taxa as Specially Protected (Schedule 4) and 63 taxa as protected (Schedule 5) in KwaZulu-Natal - refer to APPENDIX G.

Table 6: Arthropoda taxa recorded in the study area.

Family	Taxa
SATURNIIDAE	*Imbrasia forda*
LYCOSIDAE	Species 1
	Species 2
	Cophogryllus sp.
FORMICIDAE	*Crematogaster peringueyi*
	Dorylus helvolus
SCOLOPENDROMORPHA	*Scolopendra morsitans* sp.
COLEOPTERA	-
CAPONIIDAE	-
SILVANIDAE	-
GRYLLIDAE	*Cophogryllus*
ACRAEINAE	*Acrea horta*
CULICIDAE	*Aedes* sp.
	Culex sp.
TENEBREIONIDAE	*Psammodes* sp.
NYMPHALINAE	*Junonia hierta cebrene*
	Junonia oenone oenone
	Vanessa cardui
	Princeps demodocus demodocus
PIERIDAE	*Belenois* sp. 1
	Belenois sp. 2
	Colotis sp.
	Pinacopteryx eriphia eriphia
	Nepheronia argia argia
TERMITIDAE	-
MUSCIDAE	-
APIDAE	*Apis mellifera*
ACHATINIDAE	*Natalina cafra*

5.0 IMPACT ASSESSMENT

5.1 IMPACT ASSESSMENT METHODOLOGY

The impacts must be rated according to the methodology described below. Where possible, mitigation measures must be provided to manage impacts. In order to ensure uniformity, a standard impact assessment methodology was utilised so that a wide range of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology is used to describe impacts for each of the aforementioned assessment criteria. A more detailed description of each of the assessment criteria is given in the following sections.

5.1.1 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude, but does not always clearly define these since their importance in the rating scale is very relative. A more detailed description of the impact significance rating scale is given in Table 7.

Table 7: Description of the significance rating scale

Rating		Description
7	Severe	Impact most substantive, no mitigation.
6	Very high	Impact substantive, mitigation difficult/expensive.
5	High	Impact substantive, mitigation possible and easier to implement.
4	Moderate-High	Impact real, mitigation difficult/expensive.
3	Moderate-Low	Impact real, mitigation easy, cost-effective and/or quick to implement.
2	Low	Impact negligible, with mitigation.
1	Very low	Impact negligible, no mitigation required.
0	No impact	There is no impact at all – not even a very low impact on a party or system.

5.1.2 Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at small (study area) or large (provincial or national) scale. The spatial assessment scale is described in more detail in Table 8.

Table 8: Description of the spatial scale

Rating		Description
7	National	The maximum extent of any impact.
6	Provincial	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a provincial scale.
5	District	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a district scale.

Rating		Description
4	Local	The impact will affect an area up to 5 km from the proposed development.
3	Adjacent	The impact will affect the development footprint and a 500 m buffer around the proposed development.
2	Study Area	The impact occurring within the development footprint.
1	Isolated Sites	The impact will affect isolated sites in the development footprint

5.1.3 Duration Scale

In order to accurately describe the impact it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in Table 9.

Table 9: Description of the temporal rating scale

Rating		Description
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium term	The environmental impact identified will operate for the duration of life of facility.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

5.1.4 Degree of Probability

Probability or likelihood of an impact occurring is described as shown in Table 10.

Table 10: Description of the degree of probability of an impact occurring

Rating	Description
1	Practically impossible
2	Unlikely
3	Could happen
4	Very Likely
5	It's going to happen / has occurred

5.1.5 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in Table 11. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 11: Description of the degree of certainty rating scale

Rating	Description
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact, or of the likelihood of an impact occurring.

Rating	Description
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.

5.1.6 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

Impact Risk = ((SIGNIFICANCE **+** *Spatial* **+** Temporal) ÷ 2.714) **X** (Probability ÷ 5)

Table 12: Impact Risk Classes

Rating	Impact class	Significance
0.1-1.0	1	VERY LOW
1.1-2.0	2	LOW
2.1-3.0	3	MODERATE-LOW
3.1-4.0	4	MODERATE-HIGH
4.1-5.0	5	HIGH
5.1-6.0	6	VERY HIGH
6.1-7.0	7	SEVERE

5.2 Direct Impacts

The principle project related concern is the loss, disturbance and fragmentation of natural habitat leading to a reduction in ecological functioning and biodiversity. Specific impacts relating to these primary concerns are listed Table 13 and characterised in Section 5.3.

Table 13: Potential ecological impacts resulting from the proposed project

Impact	Phase
Habitat loss and degradation through vegetation clearing	Construction
Habitat fragmentation through vegetation clearing	Construction Operational
Increased exotic and/or declared Category 1, 2 & 3 invader species	Construction Operational
Killing or injuring of fauna in the study area	Construction
Loss of species of conservation importance	Construction

5.3 Impact characterisation

5.3.1 Habitat loss and degradation associated with vegetation clearing

Nature of impact

Habitat loss refers to the removal of natural habitat. In terrestrial ecosystems habitat loss occurs primarily through the clearing of indigenous vegetation or through the homogenisation of available habitat. This results not only in the immediate destruction of individual plants and some fauna species, but may also lead to a loss of biodiversity and a contingent breakdown in ecosystem functioning. Habitat degradation refers to an extreme form of ecosystem disturbance. In such instances much of the original ecosystem processes have been disrupted and many of the original species have been excluded (Begon *et al*. 2002).

Although habitat loss and degradation are normally associated with the immediate vegetation clearing and earth works that precede construction activities, the impacts can be long term, persisting throughout the life of the project. In certain instances, these impacts can be ameliorated by successful rehabilitation of the site.

Impact in relation to proposed project

The proposed project will require the clearing of natural vegetation throughout the entire length of the selected power-line corridors. This will lead to concomitant habitat loss and degradation. In areas already disturbed by anthropogenic activities the resulting habitat loss/degradation will not be major as the ecological integrity of such areas is already compromised. However, in undisturbed areas the effects of habitat loss will be more severe, but admittedly contingent on the inherent characteristics of each vegetation community.

For instance, in areas of *Hyphaene* moist grasslands habitat loss and degradation is not considered a major impact over the long term as the vegetation in this community is generally in a grassland form. Conversely, vegetation clearing and subsequent vegetation management in the more woody vegetation communities will significantly alter vegetation structure and composition over the long term, as it will be maintained in a grass-scrubland form, and in all likelihood will become dominated by ruderal pioneer (e.g. *Dichrostachys cinerea*) and possibly exotic species.

5.3.2 Habitat fragmentation

Nature of impact

Habitat fragmentation refers to the partitioning and breakup of natural habitat into smaller less viable habitat patches. In essence fragmentation leads to changes in habitat configuration which manifest as a decrease in patch size and an increase in patch number and isolation (Fahrig, 2003). These alterations change the ecological properties of remaining habitat which may affect species diversity and system function (Fahrig, 2003). Linear developments such as fences, pipelines, power-lines, roads and conveyors are primary causes of habitat fragmentation.

In terms of ecological functioning, one of the primary outcomes of habitat fragmentation is an increase in habitat edge effect. Edge effect refers to changes in microclimate near the edge (boundary) of habitat patches that not only reduce the effective size of viable, interior habitat, but may also create parameter conditions that are more conducive to predators, parasites and exotic species invasion (Begon *et al*. 2002). In addition, patch isolation can negatively affect the ability of fauna to disperse and move across the landscape thereby affecting fauna population abundance and distribution (Begon *et al*. 2002). Habitat fragmentation initially occurs during vegetation clearing, but the effects may persist throughout the life of the project.

Impact in relation to proposed project

Although no structural barriers (e.g. fences) will be constructed, initial vegetation clearing and the maintenance of vegetation in a structurally reduced state in the selected power-line corridor will cause habitat fragmentation.

Like the effects of habitat loss and degradation discussed in point 5.3.1, areas of *Hyphaene* moist grasslands will not be critically affected by habitat fragmentation. However, in the more woody vegetation communities, most notably Sand forest, the effects of habitat fragmentation will have severe negative ecological impacts, affecting both ecological integrity and function and consequently species populations.

5.3.3 Increased exotic and/or declared Category 1, 2 & 3 invader species

Nature of impact

Clearing of natural vegetation may create conditions conducive to the establishment and colonisation of exotic and/or declared CARA Category 1, 2 & 3 invader plants. Most exotic, invasive species if left uncontrolled will suppress or replace indigenous plants leading to a concomitant reduction in fauna species diversity and abundance (Bromilow, 2010).

Moreover, certain common invasive plants, such as the exotic *Acacias* (Wattle trees), are highly flammable and can increase the frequency and intensity of fires which may further alter ecosystem structure and functioning. Facilitated by indigenous vegetation clearing, encroachment by exotic invasive species may initially occur during the construction phase. However, if not controlled, the scale and magnitude of infestation may increase and persist for the entire lifecycle of the project.

Impact in relation to proposed project

Moist tropical regions of KwaZulu-Natal, such as Maputaland provide ideal conditions for the establishment and spread of exotic, invasive species. Several such species were noted in disturbed sites throughout the study area and several more are likely to be present and manifest during the growing season. Of particular concern is the presence of the CARA Category 1 and 2 listed species such as *Argemone mexicana*, *Opuntia ficus-indica, Chromolaena odorata, Cereus jamacara, Parthenium hysterophorus, Ricinus communis* var. *communis* and *Xanthium strumarium*. *Chromolaena odorata* in particular is a highly invasive species and will spread rapidly into disturbed areas.

The linear vegetation disturbance caused by the power-line establishment will provide ideal conditions for the spread of this species, as well as other invasive species into adjacent undisturbed areas.

5.3.4 Killing or injuring of fauna in the study area

Nature of impact

Savanna and forested areas in South Africa are typically inhabited by a wide assemblage of wildlife. It is likely that upon commencement of construction activates larger and more vagile wildlife will move-off to avoid disturbance. A number of smaller and less mobile species however, may be trapped and killed/injured during the construction phase of the project. Common causes include:

- Injury and death during vegetation clearing and earth works; and
- Vehicle–wildlife collisions;

Impact in relation to proposed project

It is highly probable that many fauna species will be disturbed during the construction phase when vegetation is cleared and earth works are initiated. This will be particularly acute in the bushveld and forested vegetation communities where substantial woody vegetation will be cleared.

5.3.5 Loss of species of conservation importance

Nature of impact

During initial vegetation clearing and earth works, flora and fauna species of conservation importance, such as Red Data and protected species may be killed, injured or damaged. Moreover, habitat loss, fragmentation and degradation may result in sensitive species populations becoming unsustainable. A number of species of conservation importance occur, or potentially occur in the study area.

Impact in relation to proposed project

Elements of concern *viz.* the proposed project are *inter alia*, the protected trees occurring in the *Strychnos – Terminalia* Sand Bushveld, Mixed Bushveld, Sand Forest and Riparian vegetation communities in study area. These include *Afzelia quanzensis, Balanites maughamii, Boscia albitrunca, Cleistanthus schlechteri, Newtonia hildebrandtii, Sclerocarya birrea* subsp. *caffra, Sideroxylon inerme* and *Spirostachys africana.*

5.4 Impact Assessment

The significance of major impacts associated with the project varies according to each proposed route alternative. Accordingly, major impacts have been assessed per route and the results presented in Table 14. The significance of secondary impacts are generally uniform across all route alternatives and have thus been

assessed collectively and presented in Table 15. The impacts along the preffered option were then assessed for each individual vegetation community along the route and are given in Table 16. Table 16 also gives mitigation measures for each of the impacts.

The results of the assessment are discussed in the comparative site selection evaluation detailed in Section 6.0

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Table 14: Assessment scoring of the major impacts along proposed route alternatives

	Impact		Significance	Spatial Scale	Duration	Probability	Impact risk	Description
Route 1	Habitat loss and degradation through vegetation clearing.	Unmitigated	7	7	4	5	6.6	Severe
		Mitigated	6	7	4	5	6.3	Severe
	Habitat fragmentation through vegetation clearing.	Unmitigated	5	5	4	5	5.2	Very High
		Mitigated	4	5	4	5	4.8	High
Route 2	Habitat loss and degradation through vegetation clearing.	Unmitigated	7	7	4	5	6.6	Severe
		Mitigated	6	7	4	5	6.3	Severe
	Habitat fragmentation through vegetation clearing.	Unmitigated	7	7	4	5	6.6	Severe
		Mitigated	6	7	4	5	6.3	Severe
Route 3a	Habitat loss and degradation through vegetation clearing.	Unmitigated	6	4	4	5	4.8	High
		Mitigated	5	4	3	5	4.4	High
	Habitat fragmentation through vegetation clearing.	Unmitigated	3	3	4	4	2.9	Moderate-low

	Impact		Significance	Spatial Scale	Duration	Probability	Impact risk	Description
		Mitigated	3	3	4	4	2.9	Moderate-low
Route 3b	Habitat loss and degradation through vegetation clearing.	Unmitigated	5	4	4	5	4.8	High
		Mitigated	5	4	3	5	4.4	High
	Habitat fragmentation through vegetation clearing.	Unmitigated	5	4	4	5	4.8	High
		Mitigated	4	3	4	5	4.1	High
Route 3c	Habitat loss and degradation through vegetation clearing.	Unmitigated	5	4	4	5	4.8	High
		Mitigated	5	4	3	5	4.4	High
	Habitat fragmentation through vegetation clearing.	Unmitigated	5	4	4	5	4.8	High
		Mitigated	4	3	4	5	4.1	High

Table 15: Assessment scoring of the secondary impacts applicable to all route alternatives

Impact		Significance	Spatial Scale	Duration	Probability	Impact risk	Description
Increased exotic and/or declared Category 1, 2 & 3 invader species.	Unmitigated	4	3	4	4	2.9	Moderate-High
	Mitigated	3	3	3	4	2.4	Moderate-Low
Killing or injuring of fauna in the study area.	Unmitigated	3	2	2	3	1.4	Low
	Mitigated	2	2	1	2	0.7	Very Low
Loss of species of conservation importance.	Unmitigated	4	3	2	4	2.4	Moderate-Low
	Mitigated	3	2	1	3	1.2	Low

Table 16: Impact Assessment for each impact per vegetation community

Impact	Phase affected	Duration	Considered impact per vegetation commuity									
			Hyphaene moist grasslands		*Strychnos – Terminalia* sand bushveld		Mixed bushveld		Sand forest		Riparian vegetation community	
			Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation
Habitat loss and degradation through vegetation clearing.	Construction, phase.	Life of operation	Moderate	Moderate	Moderate	Low	Moderate	Low	High	High	Moderate	Low

Impact	Phase affected	Duration	Considered impact per vegetation commuity									
			Hyphaene moist grasslands		*Strychnos – Terminalia* sand bushveld		Mixed bushveld		Sand forest		Riparian vegetation community	
			Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation

Impact	Phase affected	Duration	Considered impact per vegetation commuity									
			Hyphaene moist grasslands		*Strychnos – Terminalia* sand bushveld		Mixed bushveld		Sand forest		Riparian vegetation community	
			Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation
Habitat fragmentation through vegetation clearing	Construction, Operation phases	Life of operation	Moderate	Low	Moderate	Low	Moderate	Low	Very High	High	Low	Low
Increased exotic and/or declared Category 1, 2 & 3 invader species.	Construction, operational phases	Permanent	Moderate	Low	Moderate	Low	Moderate	Low	High	Moderate	Moderate	Low

Impact	Phase affected	Duration	Considered impact per vegetation commuity									
			Hyphaene moist grasslands		*Strychnos – Terminalia* sand bushveld		Mixed bushveld		Sand forest		Riparian vegetation community	
			Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation
Killing or injuring of fauna in the study area.	Construction phase	Incidents	Low	Very Low	Low	Very Low	Low	Very Low	Moderate	Low	Low	Very Low
Loss of species of conservation importance.	Construction, phase.	Incidents	Low	Very Low	Low	Very Low	Low	Very Low	Moderate	Low	Low	Very Low

6.0 COMPARATIVE ROUTE SELECTION EVALUATION

The study area's landscape matrix is characterised by subsistence agriculture, timber plantations, rural villages, grazing land and conservation areas. The impacts of the former three land uses on natural habitat are typically negative, while those of the latter two land uses are neutral (generally) and positive. In terms of the proposed project, the impacts associated with the power-line construction will therefore vary according to not only the vegetation communities through which they traverse, but also the degree of existing disturbances within each corridor.

For example, the *Hyphaene* moist grasslands are characteristically open and sparsely-wooded. It is anticipated that these areas will be less severely affected by vegetation clearing than the densely-wooded and sensitive Sand forest areas. Similarly, impacts in degraded and/or small Sand forest patches will be less severe than in larger, undisturbed Sand forest patches.

Selection amongst the alternatives of a preferred power-line route is therefore guided by:

- Minimising the extent to which the power-line corridor traverses through important (i.e. formally conserved) and/or sensitive habitats, most critically Sand Forest and the riparian vegetation community;
- Minimising the extent to which the power-line corridor traverses through currently undisturbed or less disturbed areas; and
- Minimising the overall extent of habitat loss and degradation required for the power-line.

The major impacts associated with the proposed project are habitat loss/degradation and habitat fragmentation. The figures detailed in Table 17 provide an estimate of the hectares of each vegetation community that will be cleared for each proposed route alternatives based on a probable disturbance corridor 100 m wide.

Table 17: Approximate extent of vegetation communities to be cleared for each proposed route.

Vegetation community	Approximate area (ha) to be cleared				
	Route 1	**Route 2**	**Route 3a**	**Route 3b**	**Route 3c**
Hyphaene moist grassland	102	61	128	175	140
Strychnos sand bushveld	254	222	121	144	140
Sand forest	22	42	26	21	26
Mixed bushveld	69	27	45	32	32
Riparian vegetation community	38	11	16	12	12

6.1 Route Alternative 1

Route alternative 1 is one of the longer possible routes and consequently has one of the largest impact footprints, requiring the clearing of approximately 487 ha of land, much of which is currently in an undisturbed condition. The route traverses along the boundaries of Ndumu Game Reserve and Tembe Elephant Park, bisecting a large patch of Sand Forest (~22 ha) on the northern boundary of latter reserve. Moreover, this route requires three crossings of the Pongola River and runs adjacent to a number of fresh-water pans.

The ecological footprint of this proposed route in undisturbed and formally conserved habitat is considerable and the major impacts are rated from severe to high. From terrestrial ecology perspective Route alternative 1 is thus considered a No-Go option.

6.2 Route Alternative 2

Route alternative 2 is the most direct route from the proposed Ndumo Substation to the Gezisa Substation and correspondingly has the lowest overall extent (~395 ha) of habitat loss and degradation. However, this route traverses directly though the Tembe Elephant Park – a protected area specifically proclaimed to conserve the regions rare Sand forests and the remnants of the coastal African elephant (*Loxodonta africana*) population (Gaugris & Van Rooyen, 2008). Indeed, Tembe Elephant Park is one of the few protected areas where Sand forests are statutorily protected. It is thus critical that every effort is made to preserve the integrity of these forests, as well as all other extant vegetation communities within the park.

The proposed Route alternative 2 will lead to the direct loss of approximately 42 ha of conserved and undisturbed Sand forest and *Strychnos – Terminalia* sand bushveld, respectively. Moreover, the ecological integrity of remaining forest patches, as well as other extant vegetation communities will be compromised through the effects of fragmentation caused by the proposed power-line corridor. The significance of the major impact are rated as severe and from terrestrial ecology perspective Route alternative 2 is accordingly considered a No-Go option.

6.3 Route Alternative 3a

Route alternative 3a follows the main road for virtually its entire length, only diverging from it to link with the Ndumo and Gezisa substations in the east and west respectively. As such, much of the vegetation in the footprint of this proposed route is already disturbed (~30%) and fragmented, thus limiting the severity of additional habitat loss and degradation. Moreover, closely aligning the power-line with the existing road will reduce additional habitat fragmentation. This will be particularly beneficial in Sand forest patches, of which this route alternative will impact on approximately 26 ha. Route alternative 3a has the lowest negative environmental impacts and is thus considered the preferred option.

6.4 Route Alternative 3b

Route alternative 3b runs parallel to route 3a, approximately 800 m to the south. Although sections of the route are disturbed, the extent of disturbance is not as great as that along route 3a. Moreover, this route is not closely aligned to the main road and the effects of habitat fragmentation on ecosystem integrity and functioning will be higher than 3a, particularly in Sand forest patches of which this route impacts on approximately 21 ha.

6.5 Route Alternative 3c

Route alternative 3c follows the same corridor as route 3b before heading north across the Jozini - eMangusi/Kosi Bay road, from where is runs parallel to the road before linking with the Gezisa substation. Large sections of this route, once it diverges from 3b, are disturbed by timber plantations and rural land-uses. The ecological impacts of route 3c are therefore considered on a par with route 3b.

Note: After consideration of the findings of the various environmental disciplines associated, including the terrestrial ecosystems assessment, it was indicated by project management that a preferred corridor route (Corridor 3P), has been identified. Section 9.0 of this report contains an addendum discussing Corridor 3P.

7.0 MITIGATION MEASURES

Table 18 provides a list of potential mitigation and monitoring measures recommended for inclusion into the environmental management programme.

Table 18: Impacts and recommended mitigation/monitoring measures

Impact	Proposed mitigation measures
Habitat loss and degradation through vegetation clearing.	Vegetation clearing should be restricted to the proposed development corridor and sites associated with supporting infrastructure and activities (e.g. towers and access roads), with no unnecessary clearing permitted outside of these areas.
	Areas to be cleared should be demarcated to prevent unnecessary clearing and disturbance outside of these areas.
	Where necessary, removed topsoil should be stockpiled and used to rehabilitate disturbed areas.
	It is recommended that the supervisor of the vegetation clearing contractors receive adequate training as to the presence, identity and management of species of conservation importance, and that a botanical specialist/ECO be appointed during vegetation clearing to conduct monthly on-site audits of the vegetation clearing process.
	A suitable rehabilitation programme should be developed and a suitable contractor should be appointed to implement rehabilitation during the defects period (usually 12 months) to ensure successful stabilisation and revegetation of the areas disturbed by construction.
	It is recommended that the ECO should be responsible for monitoring the rehabilitation programme.
Habitat fragmentation through vegetation clearing	Where practically possible, power-line corridors should be closely aligned with existing linear infrastructure or routed through already transformed / degraded areas.
	The width of the power-line corridor where vegetation is actively maintained during the operational phase must be kept at an absolute minimum.
Increased exotic and/or declared Category 1, 2 & 3 invader species.	An exotic species control programme, including monitoring, must be developed and implemented to reduce the encroachment of exotic invasive species in the power-line corridor.
	It is recommended that monitoring inspections and subsequent exotic species control interventions should be conducted at least once a year during the growing/wet season for the first 3 years of the power-lines operations.

Impact	Proposed mitigation measures
Killing or injuring of fauna in the study area.	It is recommended that the supervisors of the vegetation clearing and construction contractors receive adequate training as to the presence, identity and management of on-site fauna.
	A low speed limit should be enforced on site to reduce wildlife-collisions.
	Employees and contractors should be made aware of the presence of, and rules regarding fauna through suitable induction training and on-site signage.
Loss of species of conservation importance.	It is recommended that the botanical specialist/ECO should be responsible for monitoring for Red Data/protected fauna.
	Prior to construction all Red Data/protected flora species in the development footprint must be located and marked and a permit for their removal/relocation obtained from the provincial or relevant authority.
	It is recommended that Red Data/protected plants rescued prior to vegetation clearing should be relocated to adjacent undisturbed areas.

8.0 CONCLUSION AND RECOMMENDATIONS

Of high concern in the study area are the numerous Sand forests patches. Sand forests form the core of the Pondoland-Albany hotspot of Biodiversity and the Maputaland Centre of Plant Endemism (Mucina & Rutherford, 2006) - having considerable species richness and high levels of both plant and animal endemism (Gaugris & Van Rooyen, 2008). Accordingly, Sand forests are classified as a Critically Endangered by Mucina & Rutherford (2006).

Sand forests occur as scattered pockets in a north-south trending band down the centre of the study area. A large portion of these are formally conserved in the Tembe Elephant Park and Sileza Nature Reserve. It is noted however that even in conserved areas Sand forests are under threat from large herbivores, such as elephant (Gaugris & Van Rooyen, 2008). Moreover, most protected areas are not large enough to sustain critical ecosystem processes or contain a viable population of wide-ranging species (Smith *et al.* 2008). Indeed, Matthews *et al.* (2001) suggest that large tracts of land holding many patches of Sand forest will be required to adequately conserve a representative sample of Sand forest vegetation.

It is thus critical that efforts are made to minimise the loss or disturbance of Sand forests in the study area, even those that occur outside, but adjacent to protected areas. Evidence suggests that wood harvesting and slash-and-burn agriculture are widespread in the study area – a trend which is likely to amplify in the future as human populations increase (Smith *et al.* 2008). This will place increasing pressure on remaining natural bushveld and forest areas. It is probable however that the proposed power-line may actually facilitate the preservation of Sand forest patches, and indeed other vegetation communities over the long term, as it is expected that the power-line will improve access to electricity for the local community, thereby reducing demands on wood and natural resources. From this standpoint, the proposed power-line project is desirable.

Land in the Maputaland region is predominantly under communal tenure and characterised by several land uses. The impact that the various land uses have on terrestrial ecosystems in the study area ranges considerably, but a general pattern exists of high anthropogenic activity and disturbance centred on the Jozini - eMangusi/Kosi Bay arterial road, with a decreasing level of activity and disturbance as one moves north and south away from the road. From a proposed project perspective, it is therefore advantageous to

align the power-line as closely as possible with the arterial road, as this will reduce habitat loss and degradation in undisturbed areas, and limit additional habitat fragmentation.

Based on this rationale, route alternative 3a is the preferred option and route alternatives 1 and 2 are considered No-Go Options (see Table 19 for alternative rankings). It is crucial that the management measures as outlined in this report be implemented to mitigate additional negative environmental impacts.

Table 19: Ranking of proposed route alternatives

Ranking	Route Alternatives
1 – Most Preferred	3a
2	3b and 3c
4 – No Go Option	1
5 – No Go Option	2

Note: Refer to Section 9.0: Addendum of this report for an evaluation of the overall preferred route - Corridor 3P.

9.0 ADDENDUM – CORRIDOR 3P ECOLOGICAL EVALUATION

After consideration of the findings of the various environmental disciplines associated with the proposed Ndumo-Gezisa powerline project, it was indicated by project management that an 'overall' preferred corridor route (referred to as Corridor 3P), has been identified. This addendum thus discusses Corridor 3P within the context of on-site terrestrial ecology, as defined in the preceding sections of this report.

9.1 Status Quo

Over much of its length, particularly in the eastern half of the project area, Corridor 3P runs parallel (either 100m to the north or south) to the Jozini - eMangusi/Kosi Bay arterial road, and is therefore closely aligned to Route Alternative 3a (Corridor 3a). It does however diverge from Route Alternative 3a and the main arterial road at certain points along its length. The most noticeably divergence is in the west, where Corridor 3P follows the D1861 district road in a north-westerly direction, before crossing the Pongola River and linking with the Ndumo substation site. As such, like Route alternative 3a, much of the vegetation in the Corridor 3P footprint is already disturbed and fragmented, thus limiting the severity of additional habitat loss and degradation.

Refer to Figure 14 for a map showing Corridor 3P in relation to study areas vegetation types.

9.2 Ecological Concerns

A factor of concern *viz.* Corridor 3P is the possible siting of the powerline in the proposed corridor as it traverses through areas comprising Sand Forest. In these highly sensitive and important habitats, the proposed 500 m wide powerline corridor diverges to the south of the arterial road by between 114 to 270 m. If the powerline is ultimately sited on the southern side of the proposed corridor, with the existing road, it will effectively result in two linear, yet spatially separate disturbances in the Sand Forest (Figure 15).

In such an instance the cumulative area of likely disturbance on Sand Forests caused by habitat fragmentation from both the existing arterial road and the proposed powerline will be considerably enlarged, as it is highly likely that the integrity and functioning of Sand Forests between the two linear developments, will be compromised through *inter alia* edge effects[3], species invasions and a loss of connectivity.

More succinctly, the footprint of disturbance will encompass not only habitat lost and degraded in and immediately adjacent to the powerline, but also the Sand Forest occurring between the powerline and the road.

[3] *Changes in population or community structures that occur at the boundary of two habitats.*

9.3 Recommendations

- It is therefore recommended that in Sand Forest areas, the powerline must be sited on the northern edge of the 500 m corridor, immediately adjacent to the existing road servitude, thus aligning and indeed possibly overlapping the disturbance footprints of both linear developments (see Figure 15).
- If factors beyond terrestrial ecology (e.g. social considerations) prevent the above recommendation from being enacted, it is recommended that an experienced Sand Forest expert be appointed to conduct a detailed study of Sand Forest patches in the study area and that from this, suitable mitigation measures are developed and implemented.

9.4 Conclusions

The protection of Sand forests in the study area is of high importance. The increased electricity supply resulting from the proposed powerline will in all likelihood reduce pressures on forest patches for fire-wood and other natural products. This notwithstanding, it is important that every effort is made to minimise the loss of Sand Forests caused by the potential powerline development.

It is therefore strongly suggested that the recommendations contained in Section 9.3 of this addendum as well as those in Section 7.0 of the report be implemented.

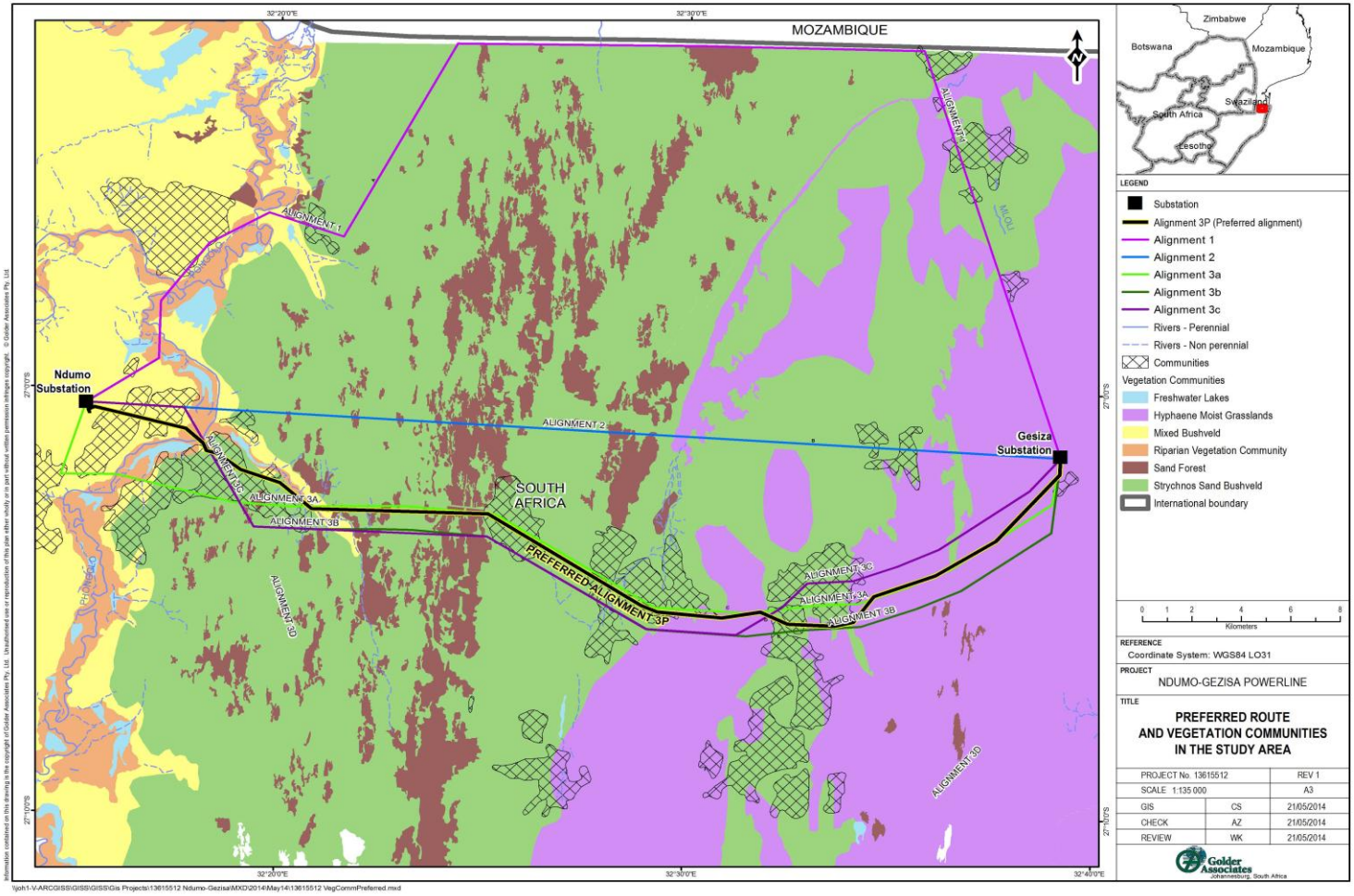

Figure 14: Alignment of Corridor 3P in relation to vegetation communities in the study area.

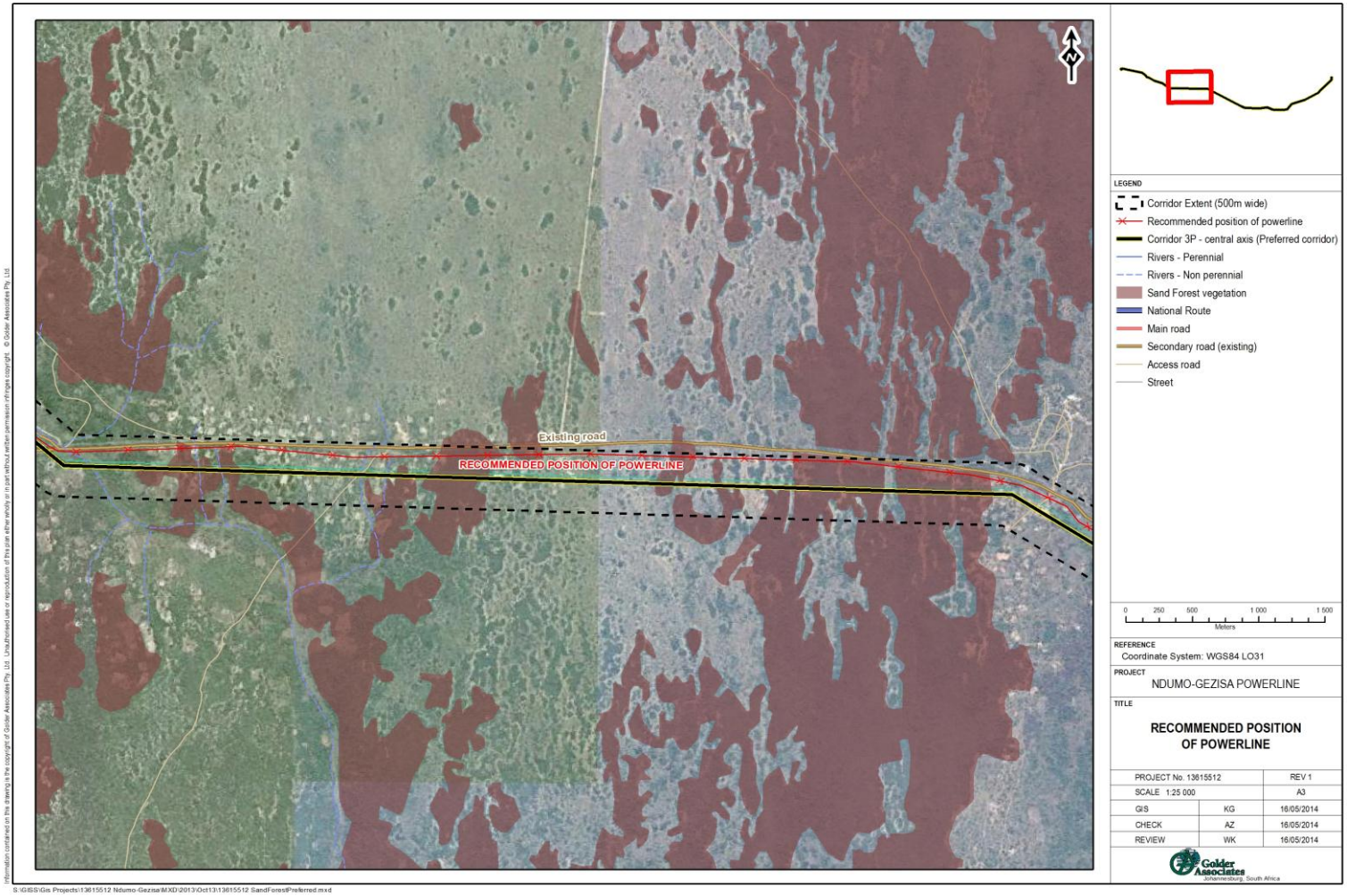

Figure 15: Recommended positioning of powerline in Corridor 3P through Sand Forest areas.

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Please note reference books, field guides and guidelines not necessarily referenced in the text but used in the field work and in the compilation of this report have also been included in the above reference list.

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APPENDIX A

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APPENDIX B

Detailed Methodology

September 2014
Report No. 13615512-12277-1

Literature Review Component

Vegetation

Flora species lists and general vegetation characteristics for the relevant grid square (2732AB & 2732BA) were obtained from the PRECIS (National Herbarium Pretoria Computer Information System) database (SIBIS: SABIF, 2009, internet) and other literature sources, including Mucina & Rutherford (2006) and Gaugris & Van Rooyen (2008).

Mammals

A list of expected mammal species was compiled by consultation of Skinner & Smithers (1990) and Stuart & Stuart (2007).

Herpetofauna (reptiles and amphibians)

Expected reptile and amphibian species lists were compiled by consultation of various field guides. Branch (1994) and Alexander & Marais (2010) were used for reptiles, while Carruthers (2001) and Du Preez & Carruthers (2009) were used for amphibian species.

Red Data and protected flora and fauna

In order to assess the Red Data and / or protected status of species in the study area, the following sources were consulted:

- National Environmental Management: Biodiversity Act (No. 10 of 2004) – Lists of critically endangered, endangered, vulnerable and protected species (NEMBA TOPS List 2013);
- International Union for the Conservation of Nature (IUCN) Red List of Threatened Species (2013.1);
- National Forests Act (No. 84 of 1998) – List of Protected Tree Species;
- KwaZulu-Natal Nature Conservation Management Amendment Act (No. 5 of 1999):
  - Schedule 4 – Specially protected species; and
  - Schedule 5 – Protected species.

Field Sampling Methodology

Vegetation sampling

As a first approximation, plant communities were roughly delineated based on satellite imagery. In order to study the vegetation in greater detail, vegetation releveés were selected in representative areas of each community along the proposed power-lines routes.

These were surveyed from the 21st to 26th July 2013. Woody species data were collected by means of belt transects. All woody species within the belt transects were recorded, and an approximation of mean vegetation height was determined. Areas were also traversed on foot in order to observe uncommon flora species and to identify existing disturbances and impacts. Owing to the dry season conditions prevalent at the time of the field survey, the herbaceous layer was sampled by recording species readily identifiable.

Flora species that were not identified in the field were photographed for identification at a later stage, using additional literature sources including Van Wyk & Van Wyk (1997), Van Wyk & Malan (1998), Van Oudtshoorn (1999), Palgrave (2002), Pooley (2003), Pooley (2005), Schmidt *et al*. (2002) and Bromilow (2010).

Fauna surveys

Fauna surveys were conducted from the 21st to 26th July 2013.

Mammals

Mammal sampling was undertaken using both active and passive methods. Active sampling included the use of Sherman traps and cage traps placed at fauna survey sites in the representative vegetation communities. These data were augmented with data obtained through actual visual sightings, and observations of mammal tracks, faeces, burrows, feedings signs. As required, Stuart & Stuart (2007) and Stuart & Stuart (2013) was used for identification purposes.

Herpetofauna (Reptiles and Amphibians)

Herpetofauna sampling was undertaken using active sampling involving the placement of pitfall traps at each of the fauna survey sites. Moreover, active searching was conducted on foot and included searching all suitable habitats such as rocks, logs, bark, and in pools and streams. Branch (1994) and Alexander & Marais (2010) were used for reptile identification, while Carruthers (2001) and Du Preez & Carruthers (2009) were used to identify observed amphibians.

Anthropoda

Active searching and pitfall traps were used to sample for arthropods at each of the fauna survey sites. Active searching was conducted on foot and included searching suitable habitats (rocks, logs, artificial cover, leaf litter, bark, leaf axils, etc.), and scanning sites where specimens were likely to be found. Migdoll (1994), Filmer (1995), Leeming (2003), Leroy & Leroy (2003) and Picker *et al* (2004) were used to identify species were applicable. Identification was done to the lowest possible taxonomic level.

Floristic Sensitivities

Red Data Assessment

Based on the potential Red Data species lists compiled during the literature review and on the findings of the field survey, the probability of occurrence of Red Data species in the study area were determined for each relevant taxon. The following parameters were used in the assessment:

Habitat requirements (HR): Most Red Data species have very specific habitat requirements and the presence of these habitat characteristics in the study area was evaluated.

Habitat status (HS): The status or ecological condition of available habitat in the area was assessed. Often a high level of habitat degradation prevalent in a specific habitat will negate the potential presence of Red Data species (this is especially evident in wetland habitats).

Habitat linkage (HL): Movement between areas for breeding and feeding forms an essential part of the existence of many species. Connectivity of the study area to surrounding habitat and the adequacy of these linkages are evaluated for the ecological functioning of Red Data species within the study area.

Probability of occurrence is presented in four categories, namely:

- Low;
- Moderate;
- High; and
- Recorded.

Habitat Integrity

The habitat integrity for each vegetation community was determined based on a rapid habitat integrity scoring system tool that incorporates and assesses key ecological tributes such as:

- Landscape structure,
- Buffer, width, length and condition;
- Size of study area, both relative and absolute;

- Vegetation condition, accounting for indigenous, exotic plant structure and abundance;
- Natural disturbance regimes; and
- Soil condition.

Descriptions of Ecological Integrity Rank value

RANK VALUE	Description
A	Occurrence is believed to be, on a global or range-wide scale, among the highest quality examples with respect to major ecological attributes functioning within the bounds of natural disturbance regimes. Characteristics include: the landscape context contains natural habitats that are essentially unfragmented (reflective of intact ecological processes) and with little to no stressors; the size is very large or much larger than the minimum dynamic area ; vegetation structure and composition, soil status, and hydrological function are well within natural ranges of variation, exotics (non-natives) are essentially absent or have negligible negative impact; and, a comprehensive set of key plant and animal indicators are present.
B	Occurrence is not among the highest quality examples, but nevertheless exhibits favourable characteristics with respect to major ecological attributes functioning within the bounds of natural disturbance regimes. Characteristics include: the landscape context contains largely natural habitats that are minimally fragmented with few stressors; the size is large or above the minimum dynamic area, the vegetation structure and composition, soils, and hydrology are functioning within natural ranges of variation; invasive species and exotics (non-natives) are present in only minor amounts, or have or minor negative impact; and many key plant and animal indicators are present
C	Occurrence has a number of unfavourable characteristics with respect to the major ecological attributes, natural disturbance regimes. Characteristics include: the landscape context contains natural habitat that is moderately fragmented, with several stressors; the size is small or below, but near the minimum dynamic area; the vegetation structure and composition, soils, and hydrology are altered somewhat outside their natural range of variation; invasive species and exotics (non-natives) may be a sizeable minority of the species abundance, or have moderately negative impacts; and many key plant and animal indicators are absent. Some management is needed to maintain or restore these major ecological attributes.
D	Occurrence has severely altered characteristics (but still meets minimum criteria for the type), with respect to the major ecological attributes. Characteristics include: the landscape context contains little natural habitat and is very fragmented; size is very small or well below the minimum dynamic area; the vegetation structure and composition, soils, and hydrology are severely altered well beyond their natural range of variation; invasive species or exotics (non-natives) exert a strong negative impact, and most, if not all, key plant and animal indicators are absent. There may be little long-term conservation value without restoration, and such restoration may be difficult or uncertain.

Rating of conservation importance

Rank	Conservation importance
High	Ecosystems with high species richness and usually provide suitable habitat for a number of threatened species. Usually termed ‘no-go’ areas and unsuitable for development, and should be protected.
Moderate	Ecosystems with intermediate levels of species diversity without any threatened species. Low-density development may be allowed, provided the current species diversity is conserved.
Low	Areas with little or no conservation potential and usually species poor (most species are usually exotic).

APPENDIX C

Plant species recorded in the QDS 2732AB & 2732BA according to SANBI SIBIS

September 2014
Report No. 13615512-12277-1

Family	Scientific name
CYPERACEAE	*Abildgaardia hygrophila*
CYPERACEAE	*Abildgaardia triflora*
FABACEAE	*Abrus precatorius subsp. africanus*
FABACEAE	*Acacia borleae*
FABACEAE	*Acacia burkei*
FABACEAE	*Acacia karroo*
FABACEAE	*Acacia nilotica subsp. kraussiana*
FABACEAE	*Acacia robusta. subsp. robusta*
EUPHORBIACEAE	*Acalypha sonderiana*
EUPHORBIACEAE	*Acalypha villicaulis*
AMARANTHACEAE	*Achyranthes aspera var. aspera*
AMARANTHACEAE	*Achyranthes aspera var. aspera*
MALPIGHIACEAE	*Acridocarpus natalitius. var. linearifolius*
FABACEAE	*Aeschynomene micrantha*
FABACEAE	*Afzelia quanzensis*
LORANTHACEAE	*Agelanthus transvaalensis*
FABACEAE	*Albizia adianthifolia var. adianthifolia*
FABACEAE	*Albizia anthelmintica*
FABACEAE	*Albizia forbesii*
FABACEAE	*Albizia versicolor*
CYPERACEAE	*Alinula paradoxa*
ASPHODELACEAE	*Aloe barberae*
ASPHODELACEAE	*Aloe chabaudii var. chabaudii*
ASPHODELACEAE	*Aloe cooperi subsp. cooperi*
ASPHODELACEAE	*Aloe ecklonis*
AMARANTHACEAE	*Alternanthera sessilis*
FABACEAE	*Alysicarpus rugosus subsp. perennirufus*
APOCYNACEAE	*Ancylobotrys petersiana*
COMMELINACEAE	*Aneilema arenicola*
ANNONACEAE	*Annona senegalensis subsp. senegalensis*
MELASTOMATACEAE	*Antherotoma phaeotricha*
APONOGETONACEAE	*Aponogeton junceus*
APONOGETONACEAE	*Aponogeton natalensis*
IRIDACEAE	*Aristea angolensis subsp. angolensis*
ANNONACEAE	*Artabotrys monteiroae*
ASPARAGACEAE	*Asparagus densiflorus*
ASPARAGACEAE	*Asparagus falcatus*
ASPARAGACEAE	*Asparagus virgatus*
APOCYNACEAE	*Aspidoglossum delagoense*

Family	Scientific name
CONVOLVULACEAE	*Astripomoea malvacea var. malvacea*
ACANTHACEAE	*Asystasia gangetica subsp. micrantha*
AZOLLACEAE	*Azolla pinnata. subsp. africana*
BALANITACEAE	*Balanites maughamii subsp. maughamii*
BALANITACEAE	*Balanites pedicellaris subsp. pedicellaris*
ACANTHACEAE	*Barleria elegans*
ACANTHACEAE	*Barleria gueinzii*
ACANTHACEAE	*Barleria obtusa*
FABACEAE	*Bauhinia tomentosa*
ACANTHACEAE	*Blepharis integrifolia var. integrifolia*
ACANTHACEAE	*Blepharis maderaspatensis*
ASTERACEAE	*Blumea dregeanoides*
CYPERACEAE	*Bolboschoenus glaucus*
CAPPARACEAE	*Boscia foetida subsp. longipedicellata*
ASTERACEAE	*Brachylaena discolor*
ASTERACEAE	*Brachylaena huillensis.*
ASPHODELACEAE	*Bulbine asphodeloides*
CYPERACEAE	*Bulbostylis burchellii*
CYPERACEAE	*Bulbostylis contexta*
CYPERACEAE	*Bulbostylis hispidula*
CYPERACEAE	*Bulbostylis parvinux*
CAPPARACEAE	*Cadaba natalensis*
CAPPARACEAE	*Capparis brassii*
APOCYNACEAE	*Carissa bispinosa*
ICACINACEAE	*Cassinopsis tinifolia*
EUPHORBIACEAE	*Cavacoa aurea*
AMARANTHACEAE	*Celosia trigyna*
APIACEAE	*Centella asiatica*
CELTIDACEAE	*Chaetacme aristata*
FABACEAE	*Chamaecrista mimosoides*
FABACEAE	*Chamaecrista plumosa mimosoides*
ANTHERICACEAE	*Chlorophytum comosum*
ANTHERICACEAE	*Chlorophytum galpinii var. galpinii*
ANTHERICACEAE	*Chlorophytum modestum*
ASTERACEAE	*Chrysocoma mozambicensis*
MALVACEAE	*Cienfuegosia hildebrandtii*
CAPPARACEAE	*Cladostemon kirkii*
CAPPARACEAE	*Cleome bororensis*
CAPPARACEAE	*Cleome gynandra*

Family	Scientific name
EUPHORBIACEAE	*Clutia abyssinica var. abyssinica*
CUCURBITACEAE	*Coccinia rehmannii*
MALVACEAE	*Cola greenwayi var. greenwayi*
COMMELINACEAE	*Coleotrype natalensis*
COMBRETACEAE	*Combretum apiculatum subsp. apiculatum*
COMBRETACEAE	*Combretum microphyllum*
COMBRETACEAE	*Combretum mkuzense*
COMBRETACEAE	*Combretum molle*
COMBRETACEAE	*Combretum padoides*
COMBRETACEAE	*Combretum zeyheri*
COMMELINACEAE	*Commelina africana var. africana*
COMMELINACEAE	*Commelina erecta*
COMMELINACEAE	*Commelina livingstonii*
BURSERACEAE	*Commiphora neglecta*
BURSERACEAE	*Commiphora zanzibarica*
CONVOLVULACEAE	*Convolvulus farinosus L.*
MALVACEAE	*Corchorus junodii Br.*
CRASSULACEAE	*Cotyledon orbiculata var. oblonga*
FABACEAE	*Craibia zimmermannii*
CRASSULACEAE	*Crassula alba var. alba*
AMARYLLIDACEAE	*Crinum paludosum*
FABACEAE	*Crotalaria lanceolata subsp. lanceolata*
FABACEAE	*Crotalaria pallida var. pallida*
FABACEAE	*Crotalaria sphaerocarpa subsp. sphaerocarpa*
EUPHORBIACEAE	*Croton gratissimus var. gratissimus*
EUPHORBIACEAE	*Croton pseudopulchellus*
EUPHORBIACEAE	*Croton steenkampianus*
APOCYNACEAE	*Cryptolepis delagoensis*
COMMELINACEAE	*Cyanotis speciosa*
CYPERACEAE	*Cyathocoma bachmannii*
APOCYNACEAE	*Cynanchum ellipticum*
CYPERACEAE	*Cyperus articulatus.*
CYPERACEAE	*Cyperus austro-africanus*
CYPERACEAE	*Cyperus chersinus*
CYPERACEAE	*Cyperus cuspidatus*
CYPERACEAE	*Cyperus cyperoides subsp. cyperoides*
CYPERACEAE	*Cyperus distans*
CYPERACEAE	*Cyperus dubius var. dubius*
CYPERACEAE	*Cyperus fastigiatus*

Family	Scientific name
CYPERACEAE	*Cyperus imbricatus*
CYPERACEAE	*Cyperus indecorus var. inflatus*
CYPERACEAE	*Cyperus macrocarpus*
CYPERACEAE	*Cyperus margaritaceus var. margaritaceus*
CYPERACEAE	*Cyperus natalensis*
CYPERACEAE	*Cyperus obtusiflorus var. obtusiflorus*
CYPERACEAE	*Cyperus pseudovestitus*
CYPERACEAE	*Cyperus solidus*
CYPERACEAE	*Cyperus sphaerospermus*
CYPERACEAE	*Cyperus tenax*
CYPERACEAE	*Cyperus tenuispica*
CYPERACEAE	*Cyperus vestitus*
CYPERACEAE	*Cyperus zollingeri*
AMARYLLIDACEAE	*Cyrtanthus galpinii*
FABACEAE	*Dalbergia nitidula*
FABACEAE	*Dalbergia obovata*
EUPHORBIACEAE	*Dalechampia scandens var. natalensis*
FABACEAE	*Desmodium dregeanum*
FABACEAE	*Dialium schlechteri*
FABACEAE	*Dichrostachys cinerea subsp. africana var. africana*
ACANTHACEAE	*Dicliptera heterostegia*
IRIDACEAE	*Dietes flavida*
DIOSCOREACEAE	*Dioscorea quartiniana*
EBENACEAE	*Diospyros galpinii*
EBENACEAE	*Diospyros inhacaensis*
EBENACEAE	*Diospyros lycioides subsp. guerkei*
HYACINTHACEAE	*Dipcadi viride*
FABACEAE	*Dolichos trilobus subsp. transvaalicus*
MALVACEAE	*Dombeya burgessiae.*
MALVACEAE	*Dombeya cymosa*
FABACEAE	*Dumasia villosa var. villosa*
ACANTHACEAE	*Ecbolium glabratum*
BORAGINACEAE	*Ehretia amoena*
CYPERACEAE	*Eleocharis atropurpurea*
CYPERACEAE	*Eleocharis limosa*
GENTIANACEAE	*Enicostema axillare subsp. axillare*
FABACEAE	*Eriosema lucipetum*
FABACEAE	*Eriosema psoraleoides*
EUPHORBIACEAE	*Erythrococca berberidea*

Family	Scientific name
FABACEAE	*Erythrophleum lasianthum*
ERYTHROXYLACEAE	*Erythroxylum delagoense*
ERYTHROXYLACEAE	*Erythroxylum emarginatum*
EBENACEAE	*Euclea daphnoides*
EBENACEAE	*Euclea divinorum*
EBENACEAE	*Euclea natalensis subsp. natalensis*
EUPHORBIACEAE	*Euphorbia grandidens.*
EXORMOTHECACEAE	*Exormotheca holstii*
FABACEAE	*Faidherbia albida.*
CONVOLVULACEAE	*Falkia oblonga*
MORACEAE	*Ficus trichopoda*
CYPERACEAE	*Fimbristylis bivalvis*
CYPERACEAE	*Fimbristylis complanata*
CYPERACEAE	*Fimbristylis cymosa*
CYPERACEAE	*Fimbristylis dichotoma subsp. dichotoma*
CYPERACEAE	*Fimbristylis ferruginea*
CYPERACEAE	*Fuirena ciliaris.*
CYPERACEAE	*Fuirena leptostachya forma nudiflora*
CYPERACEAE	*Fuirena obcordata*
CYPERACEAE	*Fuirena pubescens var. pubescens*
CYPERACEAE	*Fuirena umbellata*
FABACEAE	*Galactia tenuiflora var. villosa*
ASTERACEAE	*Gamochaeta pensylvanica*
ASTERACEAE	*Gazania krebsiana subsp. serrulata*
GERANIACEAE	*Geranium wakkerstroomianum*
GISEKIACEAE	*Gisekia africana var. africana*
IRIDACEAE	*Gladiolus densiflorus*
COLCHICACEAE	*Gloriosa superba*
APOCYNACEAE	*Gonioma kamassi*
MALVACEAE	*Grewia bicolor var. bicolor*
MALVACEAE	*Grewia caffra*
MALVACEAE	*Grewia microthyrsa*
MALVACEAE	*Grewia monticola*
MALVACEAE	*Grewia occidentalis. var. occidentalis*
CELASTRACEAE	*Gymnosporia markwardii*
ASTERACEAE	*Helichrysopsis septentrionalis*
ASTERACEAE	*Helichrysum adenocarpum subsp. ammophilum*
ASTERACEAE	*Helichrysum athrixiifolium*
ASTERACEAE	*Helichrysum caespititium*

Family	Scientific name
ASTERACEAE	*Helichrysum candolleanum*
ASTERACEAE	*Helichrysum decorum*
ASTERACEAE	*Helichrysum kraussii*
ASTERACEAE	*Helichrysum longifolium*
ASTERACEAE	*Helichrysum nudifolium var. nudifolium*
ASTERACEAE	*Helichrysum tongense*
AMARANTHACEAE	*Hermbstaedtia caffra*
AMARANTHACEAE	*Hermbstaedtia odorata var. aurantiaca*
MALVACEAE	*Hibiscus altissimus*
MALVACEAE	*Hibiscus calyphyllus*
MALVACEAE	*Hibiscus physaloides.*
MALVACEAE	*Hibiscus surattensis*
LAMIACEAE	*Hoslundia opposita*
APOCYNACEAE	*Huernia hystrix. subsp. parvula*
ARALIACEAE	*Hydrocotyle bonariensis*
HYPERICACEAE	*Hypericum lalandii*
ARECACEAE	*Hyphaene coriacea*
ACANTHACEAE	*Hypoestes forskaolii*
HYPOXIDACEAE	*Hypoxis angustifolia var. angustifolia*
HYPOXIDACEAE	*Hypoxis filiformis*
HYPOXIDACEAE	*Hypoxis iridifolia*
HYPOXIDACEAE	*Hypoxis longifolia*
FABACEAE	*Indigofera arrecta.*
FABACEAE	*Indigofera inhambanensis*
FABACEAE	*Indigofera laxeracemosa*
FABACEAE	*Indigofera podophylla*
FABACEAE	*Indigofera sordida*
CONVOLVULACEAE	*Ipomoea albivenia*
CONVOLVULACEAE	*Ipomoea bolusiana*
CONVOLVULACEAE	*Ipomoea magnusiana*
CONVOLVULACEAE	*Ipomoea wightii*
EUPHORBIACEAE	*Jatropha variifolia*
JUNCACEAE	*Juncus kraussii*
JUNCACEAE	*Juncus lomatophyllus*
ACANTHACEAE	*Justicia anagalloides*
ACANTHACEAE	*Justicia betonica*
ACANTHACEAE	*Justicia petiolaris*
ACANTHACEAE	*Justicia protracta*
CRASSULACEAE	*Kalanchoe neglecta*

Family	Scientific name
BIGNONIACEAE	*Kigelia africana*
CARYOPHYLLACEAE	*Krauseola mosambicina*
CYPERACEAE	*Kyllinga alata*
CYPERACEAE	*Kyllinga erecta*
APOCYNACEAE	*Landolphia kirkii*
ANACARDIACEAE	*Lannea schweinfurthii*
HYACINTHACEAE	*Ledebouria cooperi*
LAMIACEAE	*Leucas glabrata*
MOLLUGINACEAE	*Limeum viscosum subsp. viscosum var. glomeratum*
ALISMATACEAE	*Limnophyton obtusifolium*
CYPERACEAE	*Lipocarpha micrantha*
ASTERACEAE	*Litogyne gariepina*
LOBELIACEAE	*Lobelia erinus*
LOBELIACEAE	*Lobelia flaccida subsp. mossiana*
LOPHIOCARPACEAE	*Lophiocarpus latifolius*
LYCOPODIACEAE	*Lycopodiella caroliniana*
CAPPARACEAE	*Maerua angolensis subsp. angolensis*
CELASTRACEAE	*Maytenus peduncularis*
CELASTRACEAE	*Maytenus procumbens*
CELASTRACEAE	*Maytenus undata*
APOCYNACEAE	*Microloma armatumvar. armatum*
EUPHORBIACEAE	*Monadenium lugardiae*
ANNONACEAE	*Monodora junodii var. junodii*
FABACEAE	*Mundulea sericea subsp. sericea*
COMMELINACEAE	*Murdannia simplex*
CELASTRACEAE	*Mystroxylon aethiopicum subsp. aethiopicum*
FABACEAE	*Neonotonia wightii*
FABACEAE	*Neptunia oleracea*
LYTHRACEAE	*Nesaea wardii*
FABACEAE	*Newtonia hildebrandtii var. hildebrandtii*
ASTERACEAE	*Nidorella auriculata*
ASTERACEAE	*Nidorella resedifolia subsp. resedifolia*
MENYANTHACEAE	*Nymphoides thunbergiana*
LAMIACEAE	*Ocimum americanum var. americanum*
LAMIACEAE	*Ocimum filamentosum*
LAMIACEAE	*Ocimum reclinatum*
HYACINTHACEAE	*Ornithogalum tenuifolium subsp. tenuifolium*
LAMIACEAE	*Orthosiphon suffrutescens*
ANACARDIACEAE	*Ozoroa obovata var. obovata*

Family	Scientific name
CHRYSOBALANACEAE	*Parinari capensis subsp. capensis*
GERANIACEAE	*Pelargonium luridum*
GERANIACEAE	*Pelargonium tongaense*
CACTACEAE	*Pereskia aculeata*
APOCYNACEAE	*Pergularia daemia subsp. daemia*
APOCYNACEAE	*Periglossum angustifolium*
ARACEAE	*Pistia stratiotes*
LAMIACEAE	*Plectranthus saccatus var. longitubus*
CELASTRACEAE	*Prionostemma delagoensis var. delagoensis*
AMARANTHACEAE	*Psilotrichum scleranthum*
COMBRETACEAE	*Pteleopsis myrtifolia*
CELASTRACEAE	*Putterlickia pyracantha*
CYPERACEAE	*Pycreus atribulbus*
CYPERACEAE	*Pycreus nitidus*
CYPERACEAE	*Pycreus polystachyos var. polystachyos*
CYPERACEAE	*Pycreus pumilus*
FABACEAE	*Rhynchosia caribaea*
FABACEAE	*Rhynchosia totta var. totta*
FABACEAE	*Rhynchosia venulosa*
CYPERACEAE	*Rhynchospora barrosiana*
CYPERACEAE	*Rhynchospora brownii*
CYPERACEAE	*Rhynchospora holoschoenoides*
CYPERACEAE	*Rhynchospora rubra subsp. africana*
APOCYNACEAE	*Riocreuxia torulosa var. torulosa*
ACANTHACEAE	*Ruellia patula.*
CELASTRACEAE	*Salacia leptoclada*
DRACAENACEAE	*Sansevieria concinna*
DRACAENACEAE	*Sansevieria hyacinthoides*
APOCYNACEAE	*Sarcostemma viminale subsp. viminale*
HYACINTHACEAE	*Schizocarphus nervosus*
CYPERACEAE	*Schoenoplectus erectus*
FABACEAE	*Schotia capitata*
CYPERACEAE	*Scleria sobolifer*
EUPHORBIACEAE	*Sclerocroton integerrimus*
GENTIANACEAE	*Sebaea natalensis*
ASTERACEAE	*Senecio barbertonicus*
ASTERACEAE	*Senecio deltoideus*
ASTERACEAE	*Senecio inaequidens*
ASTERACEAE	*Senecio viminalis*

Family	Scientific name
FABACEAE	*Senna petersiana*
FABACEAE	*Sesbania bispinosa var. bispinosa*
EUPHORBIACEAE	*Shirakiopsis elliptica*
MALPIGHIACEAE	*Sphedamnocarpus pruriens subsp. pruriens*
LEMNACEAE	*Spirodela polyrhiza*
APOCYNACEAE	*Stapelia gigantea.*
APOCYNACEAE	*Stomatostemma monteiroae*
ARACEAE	*Stylochaeton natalensis*
FABACEAE	*Stylosanthes fruticosa*
EUPHORBIACEAE	*Suregada zanzibariensis*
APOCYNACEAE	*Tabernaemontana elegans*
DICHAPETALACEAE	*Tapura fischeri*
BIGNONIACEAE	*Tecoma capensis*
FABACEAE	*Tephrosia linearis*
FABACEAE	*Tephrosia lupinifolia*
FABACEAE	*Tephrosia purpurea subsp. leptostachya var. leptostachya*
COMBRETACEAE	*Terminalia phanerophlebia*
COMBRETACEAE	*Terminalia sericea*
ACANTHACEAE	*Thunbergia pondoensis L*
ASPHODELACEAE	*Trachyandra saltii var. saltii*
MELIACEAE	*Trichilia emetica subsp. emetica*
LENTIBULARIACEAE	*Utricularia arenaria*
ANNONACEAE	*Uvaria caffra*
ANNONACEAE	*Uvaria lucida subsp. virens*
ASTERACEAE	*Vernonia inhacensis*
FABACEAE	*Vigna unguiculata subsp. unguiculata var. unguiculata*
FABACEAE	*Vigna vexillata var. vexillata*
LAMIACEAE	*Vitex ferruginea.*
LAMIACEAE	*Vitex patula*
CAMPANULACEAE	*Wahlenbergia abyssinica subsp. abyssinica*
CAMPANULACEAE	*Wahlenbergia undulata*
CANELLACEAE	*Warburgia salutaris*
APOCYNACEAE	*Wrightia natalensis*
CONVOLVULACEAE	*Xenostegia tridentata subsp. angustifolia*
ACHARIACEAE	*Xylotheca kraussiana*
FABACEAE	*Zornia capensis subsp. capensis*

Source: Plant of Southern Africa (2009), Internet, Retrieved July 2013

APPENDIX D

Mammals species potentially occurring in the study area

September 2014
Report No. 13615512-12277-1

Scientific name	Common Name
Aepyceros melampus	Impala
Aethomys chrysophilus	Red veld rat
Amblysomus sp.	-
Aonyx capensis	Cape clawless otter
Atilax paludinosus	Water mongoose
Calcochloris obtusirostris	Yellow golden mole
Canis adustus	Side-striped jackal
Canis mesomelas	Black-backed jackal
Caracal caracal	Caracal
Cephalohpus monticola	Blue duiker
Cephalohpus natalensis	Red duiker
Cercopithecus mitis	Samango monkey
Cercopithecus pygerythrus	Vervet monkey
Chaerephon pumila	Little free-tailed bat
Civettictis civetta	African civet
Cloeotis percivali	Short-eared trident bat
Connochaetes taurinus	Blue wildebeest
Cricetomys gambianus	Gambian giant rat
Crocidura cyanea	Reddish-grey musk shrew
Crocidura fuscomurina	Tiny musk shrew
Crocidura hirta	Lesser red musk shrew
Crocidura mariquensis	Swamp musk shrew
Crocidura silacea	Lesser grey musk shrew
Crocuta crocuta	Spotted hyaena
Cryptomys hottentotus	Common (African) mole-rat
Dasymys incomtus	African marsh rat
Dendromus melanotis	Grey climbing mouse
Dendromus mesomelas	Brant's climbing mouse
Dendromus mystacalis	Chestnut climbing mouse
Eidon helvum	Straw-coloured fruit bat
Epomophorus wahlbergi	Wahlberg's epauletted fruit-bat
Equus quagga	Burchell’s zebra
Felis lybica	African wild cat
Galerella sanguinea	Slender mongoose
Genetta maculata	Large-spotted genet
Glauconycteris variegata	Butterfly bat
Grammomys cometes	Mozambique woodland thicket rat
Grammomys dolichurus	Woodland ticket rat
Graphiurus murinus	Woodland dormouse
Helogale parvula	Dwarf mongoose
Herpestes icheumon	Large grey mongoose

Scientific name	Common Name
Hipposideros caffer	Sundevall's leaf-nosed bat
Hippotamus amphibius	Hippo
Hystrix africaeaustralis	Cape porcupine
Ichneumia albicauda	White-tailed mongoose
Ictonyx striatus	Striped polecat
Kerivoula lanosa	Lesser wooly bat
Kobus ellipsiprymnus	Waterbuck
Lemniscomys rosalia	Single-striped grass mouse
Leptailurus serval	Serval
Lepus saxatillis	Scrub hare
Loxodonta africana	Elephant
Manis temminckii	Ground pangolin
Mastomys coucha	Southern multimammate mouse
Mellivroa capensis	Honey badger
Michaelamys namaquensis	Namaqua rock mouse
Miniopterus schriebersii	Schrieber's long-fingered bat
Mops condylurus	Angola free-tailed bat
Mungos mungo	Banded mongoose
Myotis tricolor	Temminck's hairy bat
Mysorex cafer	Dark-footed musk shrew
Mysorex sclateri	Sclater’s forest shrew
Mysorex varius	Forest shrew
Neoromicia capensis	Cape serotine bat
Neoromicia nanus	Banana bat
Neoromicia zuluensis	Aloe serotine bat
Neotragus moschatus	Suni
Nicticeinops schlieffenii	Schlieffen's bat
Nycteris hispida	Hairy slit-faced bat
Nycteris thebiaca	Egyptian slit-faced bat
Orycteropus afer	Aardvark
Otolemur (Galago) crassicaudatus	Thick-tailed (Greater) galago
Otomys angoniensis	Angoni vlei rat
Panthera pardus	Leopard
Papio cynocephalus ursinus	Savanna baboon
Paracynictis selousi	Selous’s mongoose
Paraxerus palliatus	Tree squirrel
Petrodromus tetradactylus	Four-toed sengi
Phacochoerus africanus	Common warthog
Pipistrellus hesperidus	African pipistrelle
Poecilogale albinucha	African striped weasel
Potamochoerus larvatus	Bushpig

Scientific name	Common Name
Pronolagus crassicaudatus	Natal red rock rabbit
Proteles cristatus	Aardwolf
Raphicerus campestris	Steenbok
Rattus rattus	House rat
Redunca arundinum	Common reedbuck
Rhabdomys pumilio	Four-striped grass mouse
Rhinolophus clivosus	Geoffrey's horseshoe bat
Rhinolophus darlingi	Darling's horseshoe bat
Rhinolophus landeri	Lander's horseshoe bat
Rhinolophus swinnyi	Swinny's horseshoe bat
Rousettus aegyptiacus	Egyptian fruit-bat
Saccostomus campestris	Pouched mouse
Scotophilus dinganii	Yellow house bat
Scotophilus viridus	Lesser yellow house bat
Steatomys pratensis	Fat mouse
Suncus lixus	Greater dwarf shrew
Sylvicapra grimmia	Common duiker
Tadarida aegyptiaca	Egyptian free-tailed bat
Taphozous mauriatianus	Mauritian tomb bat
Tatera brantsii	Highveld gerbil
Tatera leucogaster	Bushveld gerbil
Thallomys nigricaudatus	Black-tailed tree rat
Thallomys paedulcus	Acacia rat
Thryonomys swinderianus	Greater cane-rat
Tragelaphus angasii	Nyala
Tragelaphus scriptus	Bushbuck
Tragelaphus strepsiceros	Kudu

Source: Stuart & Stuart (2007)

Herpetofauna potentially occurring in the study area

September 2014
Report No. 13615512-12277-1

Golder Associates

Scientific Name	Common name
Reptiles	
Acanthocercus atricollis	Tree agama
Acontias plumbeus	Giant legless skink
Afroedura marleyi	Marley's flat gecko
Afroedura pondolia	Pondo flat gecko
Agama armata	Peter's ground agama
Amblyodipsas microphthalma	White-lipped snake
Amblyodipsas polylepis	Common purple-glossed snake
Aparallactus capensis	Black-headed centipede-eater
Atractaspis bibronii	Side-stabbing snake
Bitis arietans	Puffadder
Bitis gabonica	Gaboon adder
Bradypodion setaroi	Setaro's dwarf chameleon
Buberria variegata	Variegated slug eater
Causus defilippii	Snouted night adder
Causus rhombeatus	Rhombic night adder
Chamaeleo dilepis	Flap-necked chameleon
Chamaesaura macrolepis	Large-scaled grass lizard
Cordylus tropidosternum	Jones' girdled lizard
Cordylus warreni	Warren's girdled lizard
Crocodylus niloticus	Nile crocodile
Crotaphopeltis hotamboeia	Herald snake
Cryptoblepharus boutonii	Bouton's skink
Dasypeltis medici	East African egg eater
Dasypeltis scabra	Common egg-eater
Dendroaspis angusticeps	Green mamba
Dendroaspis polylepis	Black mamba
Dipsadoboa aulica	Marbled tree snake
Dispholidus typus	Tree snake
Elapsoidea boulengeri	Half-banded garter snake
Elapsoidea sunderwallii	Sundevall's garter snake
Geochelone pardalis	Leopard tortoise
Gerrhosaurus flavigularis	Yellow-throated plated lizard
Gerrhosaurus major	Rough-scaled plated lizard
Gerrhosaurus validus	Giant plated lizard
Hemidactylus mabouia	Tropical gecko
Homopholis wahlbergi	Velvety gecko
Ichnotropis capensis	Cape rough-scaled sand lizard
Ichnotropis squamulosa	Rough-scaled lizard
Kinixys belliana	Bell's hinged-back tortoise
Kinixys natalensis	Natal hinged tortoise
Lamprophis fuliginosus	Brown house snake
Latysaurus lebomboensis	Lebombo flat liazrd
Leptotyphlops conjunctus	Eastern thread snake
Leptotyphlops distanti	Distant's tread snake
Leptotyphlops scutifrons	Peters' thread snake
Leptotyphlops sylvicolus	Forest thread snake
Leptotyphlops telloi	Tello's thread snake
Lycodonomorphus rufulus	Common brown water snake

Scientific Name	Common name
Lycophidion capense	Cape wolf snake
Lycophidion pygmaeum	Pygmy wolf snake
Lygodactylus capensis	Common Dwarf gecko
Mabuya capensis	Cape skink
Mabuya depressa	Eastern coastal skink
Mabuya quinquetaeniata	Rainbow skink
Mabuya striata	Stripped skink
Mabuya varia	Variegated skink
Macrelaps microlepidotus	Natal black snake
Mehelya capensis	Cape file snake
Mehelya nyassae	Black file snake
Meizodon semiornatus	Semiornate snake
Monopeltis sphenorhynchus	Slender spade-snouted worm lizard
Naja annulifera	Snouted cobra
Naja melanoleuca	Forest cobra
Naja mossambica	Mozambique spitting cobra
Natriciteres variegata	Forest marsh snake
Nucras holubi	Holob's Sand lizard
Nucras ornata	Ornate sandveld lizard
Pachydactylus maculatus	Spotted tick-toed gecko
Pachydactylus turneri	Turner's thick-toed gecko
Pachydactylus vansoni	Van son's thick-toed gecko
Panaspis whalbergii	Wahlberg's snake-eyed skink
Pelomedusa subrufa	Marsh terrapin
Pelusios castanoides	Yellow-bellied hinged terrapin
Pelusios sinuatus	Serrated terrapin
Philothamnus angolensis	Western green snake
Philothamnus hoplogaster	Green water snake
Philothamnus natalensis	Eastern green snake
Philothamnus semivariegatus	Spotted bush snake
Platysaurus intermedius	Common flat lizard
Prosymna janii	Mozambique shovel-snout
Prosymna stuhlmannii	East African shovel-snout
Prosymna sundevalli	Sundevall's shovel-snout
Psammophis brevirostris	Short-snouted sand snake
Psammophis mossambicus	Olive grass snake
Pseudaspis cana	Mole snake
Python natalensis	African python
Rhinotyphlops schlegelii	Schlegel's beaked blind snake
Scelotes arenicolus	Zululand dwarf burrowing skink
Scelotes bidigittatus	Lowveld dwarf burrowing skink
Scelotes fitzsimonsi	FitzSimon's dwarf burrowing skink
Scelotes mossambicus	Mozambique dwarf burrowing skink
Scelotes vestigifer	Coastal dwarf burrowing skink
Telescopus semiannulatus	Eastern tiger snake
Tetradactylus africanus	African long-tailed seps
Thelotornis capensis	Vine snake
Typhlops fornasinii	Fornasini's blind snake
Typhlosaurus aurantiacus	Golden blind legless skink
Varanus albigularis	Rock monitor

Scientific Name	Common name
Varanus niloticus	Water monitor
Xenocalamus bicolor	Bicoloured quill-snouted snake
Xenocalamus transvaalensis	Quill-snouted snake
Zygaspis vandami	Van Dam's round-headed worm lizard
Amphibians	
Afrixalus aureus	Golden leaf-folding frog
Afrixalus delicatus	Delicate leaf-folding frog
Afrixalus fornasinii	Greater leaf-folding frog
Amieta angolensis	Common rana
Amietophrynus garmani	Olive toad
Amietophrynus gutturalis	Common toad
Amietophrynus maculatus	Flat-backed toad
Amietophrynus rangeri	Raucous toad
Arthroleptis wahlbergi	Bush squaeker
Arthropletis stenodactylus	Shovel-footed squaker
Breviceps adspersus adspersus	Bushveld rain frog
Breviceps mossambicus	Mozambique rain frog
Cacosternum boettgeri	Common caco
Cacosternum nanum	Bronze caco
Chiromantis xerampelina	Foam nest frog
Hemisus marmoratus	Mottled shovel-nosed frog
Hildebrandtia ornata	Ornate frog
Hyperolius acuticeps	Sharp-nosed reed frog
Hyperolius argus	Argus reed frog
Hyperolius marmoraus	Painted reed frog
Hyperolius pusillus	Water lily frog
Hyperolius semidiscus	Yellow-striped reed frog
Hyperolius tuberilinguis	Tinker reed frog
Kassina maculata	Red-legged kassina
Kassina senegalensis	Bubbling kassina
Leptopelis mossambicus	Brown-backed tree frog
Phrynobatrachus acridoides	East African puddle frog
Phrynobatrachus mababiensis	Dwarf puddle frog
Phrynobatrachus natalensis	Snoring puddle frog
Phrynomantis bifasciatus	Red-banded rubber frog
Poyntonophrynus fenoulheti	Northern pygmy toad
Ptychadena anchietae	Plain grass frog
Ptychadena mascareniensis	Mascarene grass frog
Ptychadena mossambica	Broad-banded grass frog
Ptychadena oxyrhynchus	Broad-banded grass frog
Ptychadena porosissima	Stripped grass frog
Ptychadena taenioscelis	Dwarf grass frog
Pyxicephalus edulis	African bullfrog
Schismaderma carens	Red toad
Tomopterna cryptotis	Tremelo sand frog
Tomopterna krugerensis	Knocking sand frog
Tomopterna natalensis	Natal sand frog
Xemopus muelleri	Muller's platanna

Source: Branch (1994) and Du Preez & Carruthers (2009).

APPENDIX E

Specially protected and protected arthropods occurring in KwaZulu-Natal

September 2014
Report No. 13615512-12277-1

Golder Associates

Specially Protected - Schedule 4		
Butterflies and moths	**Fruit chafers**	**Dragonflies**
Stygionympha wichgrafi grisea	*Ichnestoma nasula*	*Seudagrion umsingaziense*
Ornipholidotos peucetia penningtoni	*Lamellithyrea descarpentriesi*	*Syncordulia gracilis*
Durbania amakosa albescens	*Elaphinuis pumila*	*Urothemis luciana*
Lolaus lulua	*Acrothyrea rufofemorata*	-
Lepidochrysops ketsi leucomacula	*Eudicella trimeni*	-
Orachrysops ariadne	-	-
Chrysoritis orientalis	-	-
Callioratis millari	-	-
Protected - Schedule 5		
Butterflies	**Fruit chafers**	**Dragonflies**
Dingana alaedeus	*Pachnoda discolor*	*Chlorolestes draconicus*
Dingana dingana	*Uloptera planate*	*Pseudagrion newtoni*
Acraea rabbaiae	*Cythothyrea rubriceps*	*Enallagma rotunipenne*
Acraea satis	*Trichocephala brincki*	*Enallagma sinuatum*
Euryphura achlys	*Caelorrhina relucens*	*Agriocnemis falcifera*
Durbania amakosa flavida	*Lonochothyrea mozambica*	*Agriocnemi gratiosa*
Aslauga australis	*Heteroclite raeuperi*	*Agriocnemi pinheyi*
Lolaus diametra natalica	*Anoplochelius globosus*	*Agriocnemi ruberrima*
Hypolycaena lochmophila	*Phoxomeloides laticinata*	*Onychogomphus supinus*
Capys penningtoni	*Raceloma natalensis*	*Gynacantha zuluensis*
Aloeides merces	*Diplognatha striata*	*Hemicordulia asiatica*
Chrysortis oreas	*Rhinocoeta cornuta*	*Orthetrum robustum*
Chrysortis phosphor borealis	*Xeloma aspera*	*Diplacodes deminunta*
Anthene minima	*Xeloma leprosa*	*Trithemis pluvialis*
Lepidochrysops pephredo	*Cosmiophaenia rubescens*	*Zyxomma altanticum*
Papilo euphranor	*Rhabdotis semipunctata*	*Parazyxommia flavicans*
Spailia confusa confusa	*Rhabdotis sobrina*	*Aethriamanta rezia*
Abantis bicolor	*Polystalatica furfurosa*	*Taurhina splendens*
Metisella meninx	*Discopeltis bellula*	*Anisorrhina serripes*
Metisella syrinx	*Discopeltis tricolor*	*Raceloma jansoni*
Borbo ferruginea dondo	*Pseudoclinteria cincticollis*	-
Fresna nyassae	-	-

Source: KwaZulu-Natal Nature Conservation Management Amendment Act (No. 5 of 1999).

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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