ECOLOGICAL FAUNA AND FLORA HABITAT SURVEY

Proposed Kuruman Churchill, Northern Cape Province, South Africa

Trunk of *Vachellia erioloba* (Camel Thorn Tree) at the site.
Photo: R.F. Terblanche.

JANUARY 2020

COMPILED BY:

Reinier F. Terblanche

(M.Sc : Ecology, *Cum Laude*; Pr.Sci.Nat, Reg. No. 400244/05)

TABLE OF CONTENTS

I) SPECIALIST EXPERTISE

SYNOPTIC CV: REINIER. F. TERBLANCHE

Reinier is an ecologist and in particular a habitat specialist with an exceptional combination of botanical and zoological expertise which he keeps fostering, updating and improving. He is busy with a PhD for which he registered at the Department of Conservation Ecology at the University of Stellenbosch in July 2013. The PhD research focuses on the landscape ecology of selected terrestrial and wetland butterflies in South Africa. Reinier's experience includes being a lecturer in ecology and zoology at the North West University, Potchefstroom Campus (1998-2008). Reinier collaborates with a number of institutes, organizations and universities on animal, plant and habitat research.

Qualifications:

Qualification	**Main subject matter**	**University**
M.Sc *Cum Laude*, **1998:** Botany: Ecology	Quantitative study of invertebrate assemblages and plant assemblages of rangelands in grasslands.	North-West University, Potchefstroom
B.Sc Honns *Cum Laude*, **1992** Botany: Taxonomy	Distinctions in all subjects: Plant Anatomy, Taxonomy, Modern Systematics, System Modelling, Plant Ecology, Taxonomy Project. Also included: Statistics Attendance Course.	North-West University, Potchefstroom
B.Sc Botany, Zoology	Main subjects: Botany, Zoology.	North-West University, Potchefstroom
Higher Education Diploma, 1990	Numerous subjects aimed at holistic training of teachers.	North-West University, Potchefstroom

In research Reinier specializes in conservation biology, threatened butterfly species, vegetation dynamics and ant assemblages at terrestrial and wetland butterfly habitats as well as enhancing quantitative studies on butterflies of Africa. He has published extensively in the fields of taxonomy, biogeography and ecology in popular journals, peer-reviewed scientific journals and as co-author and co-editor of books (see 10 examples beneath).

Reinier practices as an ecological consultant and has been registered as a Professional Natural Scientist by SACNASP since 2005: Reg. No. 400244/05. His experience in consultation includes: Flora and fauna habitat surveys, Threatened species assessments, Riparian vegetation index surveys, Compilation of Ecological Management Plans, Biodiversity Action Plans and Status quo of biodiversity for Environmental Management Frameworks, Wetland Assessments, Management of Rare Wetland Species.

Recent activities/ awards: Best Poster Award at Oppenheimer De Beers Group Research Conference 2015, Johannesburg. One of the co-authors of Guidelines for Standardised Global Butterfly Monitoring, 2015, Group on Earth Observations Biodiversity Observation Network, Leipzig, Germany (UNEP-WCMC), GEO BON Technical Series 1. Awarded the prestigious Torben Larsen Memorial Tankard in October 2017; one is awarded annually to the person responsible for the most outstanding written account on Afrotropical Lepidoptera. Lectured as Conservationist-in-Residence in the Wildlife Conservation Programme of the African Leadership University, Kigali, Rwanda, 9-23 February 2019. Reinier won a photographic competition which resulted his photograph of the Critically Endangered *Erikssonia edgei* (Waterberg Copper) being on the front cover of the Synthesis Report of the National Biodiversity Assessment (2018) prepared by SANBI. Reinier is a Research Fellow at the University of South Africa (Unisa) from 1 January 2020.

EXPERIENCE

Lecturer: Zoology 1998-2008	Main subject matter and level	Organization
Lectured subjects	- 3rd year level Ecology, Plantparasitology - 2nd year level Ethology - *Master's degree* Evolutionary Ethology, Systematics in Practice, Morphology and Taxonomy of Insect Pests, Wetlands.	North-West University, Potchefstroom and University of South Africa
Co-promoter	PhD: Edge, D.A. 2005. Ecological factors that influence the survival of the Brenton Blue butterfly	North-West University, Potchefstroom
Study leader/ assistant study leader	Six MSc students, One BSc Honn student: Various quantitative biodiversity studies (terrestrial and aquatic).	North-West University, Potchefstroom
Teacher 1994-1998	Biology and Science, Secondary School	Afrikaans Hoër Seunskool, Pretoria
Owned Anthene Ecological CC 2008 – present	- Flora and Fauna habitat surveys - Highly specialized ecological surveys - Riparian vegetation index surveys - Ecological Management Plans - Biodiversity Action Plans - Biodiversity section of Environmental Management Frameworks - Wetland assessments	Private Closed Corporation that has been subcontracted by many companies
Herbarium assistant 1988-1991	- Part-time assistant at the A.P. Goossens herbarium, Botany Department, North-West University, 1988, 1989, 1990 and 1991 (as a student).	North-West University, Potchefstroom

10 EXAMPLES OF PUBLICATIONS OF WHICH R.F. TERBLANCHE IS AUTHOR/ CO-AUTHOR
(Three books, two chapters in books and five articles are listed here as examples)

1. HENNING, G.A., **TERBLANCHE, R.F.** & BALL, J.B. (eds) **2009.** *South African Red Data Book: butterflies*. *SANBI Biodiversity Series* 13. South African National Biodiversity Institute, Pretoria. 158p. ISBN 978-1-919976-51-8
2. MECENERO, S., BALL, J.B., EDGE, D.A., HAMER, M.L., HENNING, G.A., KRÜGER, M, PRINGLE, E.L., **TERBLANCHE, R.F.** & WILLIAMS, M.C. (eds). 2013. *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and atlas.* Saftronics (Pty) Ltd., Johannesburg & Animal Demography Unit, Cape Town.
3. VAN SWAAY, C., REGAN, E., LING, M., BOZHINOVSKA, E., FERNANDEZ, M., MARINI-FILHO, O.J., HUERTAS, B., PHON, C.-K., KŐRÖSI, A., MEERMAN, J., PE'ER, G., UEHARA-PRADO, M., SÁFIÁN, S., SAM, L., SHUEY, J., TARON, D., **TERBLANCHE, R.F**. & UNDERHILL, L. 2015. Guidelines for Standardised Global Butterfly Monitoring. Group on Earth Observations Biodiversity Observation Network, Leipzig, Germany. GEO BON Technical Series 1.
4. **TERBLANCHE, R.F.** & HENNING, G.A. **2009.** *A framework for conservation management of South African butterflies in practice.* In: Henning, G.A., Terblanche, R.F. & Ball, J.B. (eds). *South African Red Data Book: Butterflies. SANBI Biodiversity Series 13.* South African National Biodiversity Institute, Pretoria. p. 68 – 71.
5. EDGE, D.A., **TERBLANCHE, R.F**., HENNING, G.A., MECENERO, S. & NAVARRO, R.A. 2013. Butterfly conservation in southern Africa: Analysis of the Red List and threats. In: Mecenero, S., Ball, J.B., Edge, D.A., Hamer, M.L., Henning, G.A., Krüger, M., Pringle, E.L., Terblanche, R.F. & Williams, M.C. (eds). *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas.* pp. 13-33. Saftronics (Pty) Ltd., Johannesburg & Animal Demography Unit, Cape Town.
6. **TERBLANCHE, R.F.**, SMITH, G.F. & THEUNISSEN, J.D. **1993.** Did Scott typify names in *Haworthia* (Asphodelaceae: Alooideae)? *Taxon* **42**(1): 91–95. (International Journal of Plant Taxonomy).
7. **TERBLANCHE, R.F.**, MORGENTHAL, T.L. & CILLIERS, S.S. **2003.** The vegetation of three localities of the threatened butterfly species *Chrysoritis aureus* (Lepidoptera: Lycaenidae). *Koedoe* **46**(1): 73-90.
8. EDGE, D.A., CILLIERS, S.S. & **TERBLANCHE, R.F. 2008**. Vegetation associated with the occurrence of the Brenton blue butterfly. *South African Journal of Science* **104**: 505 - 510.
9. GARDINER, A.J. & **TERBLANCHE, R.F. 2010.** Taxonomy, biology, biogeography, evolution and conservation of the genus *Erikssonia* Trimen (Lepidoptera: Lycaenidae) *African Entomology* **18**(1): 171-191.
10. **TERBLANCHE, R.F.** 2016. *Acraea trimeni* Aurivillius, [1899], *Acraea stenobea* Wallengren, 1860 and *Acraea neobule* Doubleday, [1847] on host-plant *Adenia repanda* (Burch.) Engl. at Tswalu Kalahari Reserve, South Africa. *Metamorphosis* 27: 92-102.

* A detailed CV with more complete publication list is available.

II) SPECIALIST DECLARATION

I, Reinier F. Terblanche, as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 (as amended) and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Name of Specialist: Reinier F. Terblanche

Signature of the specialist

Date: 15 January 2020

1 INTRODUCTION

An ecological habitat survey was required for a proposed development Churchill, 19 km north of Kuruman, Northern Cape Province, South Africa (elsewhere referred to as the site). The survey mainly focused on the possibility that Threatened flora and fauna known to occur in Northern Cape Province are likely to occur at the site or not. Species which are not threatened but of conservation concern, for example near threatened, data deficient or declining species also received attention in the survey.

1.1 OBJECTIVES OF THE HABITAT STUDY

The objectives of the habitat study are to provide:

- A detailed fauna and flora habitat survey;
- A detailed habitat survey of possible threatened or localised plant species, vertebrates and invertebrates;
- Recording of possible host plants of fauna such as butterflies.
- Evaluate the conservation importance and significance of the site with special emphasis on the current status of threatened species;
- Literature investigation of possible species that may occur on site;
- Identification of potential ecological impacts on fauna and flora that could occur as a result of the development; and
- Make recommendations to reduce or minimise impacts, should the development be approved.

1.2 SCOPE OF STUDY

- A survey consisting of visits to investigate key elements of habitats on the site, relevant to the conservation of fauna and flora.
- Recording of any sightings and/or evidence of existing fauna and flora.
- The selective and careful collecting of voucher specimens of invertebrates where deemed necessary.
- An evaluation of the conservation importance and significance of the site with special emphasis on the current status of threatened species.
- Recording of possible host plants or foodplants of fauna such as butterflies.
- Literature investigation of possible species that might occur on site.
- Integration of the literature investigation and field observations to identify potential ecological impacts that could occur as a result of the development.
- Integration of literature investigation and field observations to make recommendations to reduce or minimise impacts, should the development be approved.

2 STUDY AREA

The study area is at the proposed Churchill, 19 km north of Kuruman, South Africa (elsewhere referred to as the site). Site is part of the Savanna Biome which is represented by the Kuruman Thornveld vegetation type at the central and eastern parts of the site as well as the Kuruman Vaalbosveld at the eastern parts of the site (Mucina & Rutherford 2006).

To serve as local context for the landscape and vegetation at the site an outline of the Kuruman Vaalbosveld and Kuruman Thornveld from Mucina and Rutherford (2006) follows.

SVk 8 Kuruman Vaalbosveld

Distribution: North-West and Northern Cape Provinces. East of Kuruman to Lykso, south of Bendell towards Good Hope. Altitude: 1300-1500 m.

Vegetation and landscape features: Open tree layer characterised by *Acacia erioloba, Acacia karroo, Searsia lancea* and *Ziziphus mucronata*. Shrub layer poorly developed, with *Grewia flava* and *Tarchonanthus camphoratus* and grass layer open, with much bare soil in places.

Geology and soils: Carbonates and chert of the Vaalian Griqualand West Supergroup and Kalahari sediments from flat, rocky sandy plains with shallow (0.1-0.6 m) red aeolian sands, stony and underlain by rock. Dominant land types Ae and Fc, with Hutton, Clovely and Mispah soil forms common.

Climate: Summer and autumn rainfall with very dry winters. Mean annual precipitation about 350-450 mm. Frost very frequent in winter.

Important taxa: Tall Tree: *Acacia erioloba.* Small Trees: *Acacia karroo, Ziziphus mucronata, Searsia lancea.* Tall Shrubs: *Tarchonanthus camphoratus, Cadaba aphylla, Diospyros austro-africana, Diospyros lycioides* subsp. *lycioides, Grewia flava, Gymnosporia buxifolia.* Low Shrubs: *Amphiglossa triflora, Anthospermum rigidum* subsp. *pumilum, Anthospermum rigidum* subsp. *rigidum, Helichrysum zeyheri.* Geoxylic Suffrutex: *Elephantorrhiza elephantina.* Succulent Shrub*: Ebracteola wilmaniae.* Herbaceous Climber: *Rhynchosia holosericea.* Graminoids: *Anthephora pubescens, Aristida meridionalis, Eragrostis lehmanniana, Stipagrostis uniplumis, Aristida stipitata* subsp. *spicata, Cymbopogon caesius, Digitaria eriantha* subsp. *eriantha, Fingerhuthia africana, Pogonarthria squarrosa, Schmidtia pappophoroides, Themeda triandra, Tragus koelerioides.* Herbs: *Acrotome inflata, Dicoma schinzi, Geigeria ornativa, Heliotropium strigosum, Stachys spathulata, Tripteris aghillana.*

SVk 9 Kuruman Thornveld

Distribution: In South Africa the Kuruman Thornveld is found at the North West and Northern Cape Provinces. Kuruman Thornveld occurs on the flats from the vicinity of Postmasburg and Danielskuil (here west of the Kuruman Hills) in the south extending via Kuruman to Tsineng and Dewar in the north. Altitude is 1100 – 1500 m (Mucina & Rutherford, 2006).

Vegetation and landscape features: Flat rocky plains and some sloping hills with very well-developed, closed shrub layer and well-developed open tree stratum consisting of *Acacia erioloba* (Mucina & Rutherford, 2006).

Geology and soils: Some Campbell Group dolomite and chert and mostly younger, superficial Kalahari Group sediments, with red wind-blown (0.3 – 1.2 m deep) sand. Locally, rocky pavements are formed in places. Most important land types Ae, Ai, Ag and Ah, with Hutton soil form (Mucina & Rutherford, 2006).

Climate: Summer and autumn rainfall with very dry winters. Mean annual precipitation (MAP) about 300-450 mm. Frost frequent in winter (Mucina & Rutherford, 2006).

Important taxa: Tall tree: *Acacia erioloba*. Small trees: *Acacia mellifera* subsp. *detinens*, *Boscia albitrunca*. Tall Shrubs: *Grewia flava, Lycium hirsitum, Tarchonanthus camphoratus, Gymnosporia buxifolia.* Low Shrubs: *Acacia hebeclada* subsp. *hebeclada. Monechma divaricatum, Gnidia polycephala, Helichrysum zeyheri, Hermannia comosa, Pentzia calcarea, Plinthus sericeus.* Geoxylic Suffrutex: *Elephantorrhiza elephantina*. Graminoids: *Aristida meridionalis, Aristida stipitata* subsp. *stipitata, Eragrostis lehmanniana, Eragrostis echinochloidea, Melinis repens.* Herbs: *Dicoma schinzii, Gisekia africana, Harpagophytum procumbens* subsp. *procumbens, Indigofera daleoides, Limeum fenestratum, Nolletia ciliaris, Seddera capensis, Tripteris aghillana, Vahlia capensis* subsp. *vulgaris*.

Note: Though some plant species of the above listed vegetation type are present at the site, not necessarily all of the plant species listed above are present at the site.

Figure 1 Map with indication of the location of the site.

Map information were analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2020).

3 METHODS

A desktop study comprised not only an initial phase, but also it was used throughout the study to accommodate and integrate all the data that become available during the field observations.

Surveys were conducted by R.F. Terblanche on 22 November 2019 to note key elements of habitats on the site, relevant to the conservation of fauna and flora. The main purpose of the site visit was ultimately to serve as a habitat survey that noted the possible presence or not of threatened species and other species of particular conservation concern.

The following sections highlight the materials and methods applicable to different aspects that were observed.

3.1 HABITAT CHARACTERISTICS AND VEGETATION

The habitat was investigated by noting habitat structure (rockiness, slope, plant structure/ physiognymy) as well as floristic composition. Voucher specimens of plant species were only taken where the taxonomy was in doubt and where the plant specimens were of significant relevance for invertebrate conservation. In this case no plant specimens were needed to be collected as voucher specimens or to be send to a herbarium for identification. A wealth of guides and detailed works of plant identifications, ecology and conservation is fortunately available and very useful. Field guides, biogeographic works, species lists, diagnostic outlines, conservation statuses and detail on specific plant groups were sourced from Court (2010), Germishuizen (2003), Germishuizen, Meyer & Steenkamp (2006), Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), Manning (2003), Manning (2009), McMurtry, Grobler, Grobler & Burns (2008), Pooley (1998), Retief & Herman (1997), Smit (2008), Van Ginkel, Glen, Gordon-Gray, Cilliers, Muasya & Van Deventer (2011), Van Jaarsveld (2006), Van Oudtshoorn (2012), Van Wyk (2000), Van Wyk & Smith (2001), Van Wyk & Smith (2014), Van Wyk & Malan (1998) and Van Wyk & Van Wyk (2013). Lists of species, species names and the conservation status of species were mainly sourced from Raimondo, von Staden, Victor, Helme, Turner, Kamundi & Manyama (2009) and updated versions of red lists and species from the Threatened Species Programme of SANBI and the Red List of South African Plants (sanbi.org.za)

.

3.2 MAMMALS

Mammals were noted as sight records by day. For the identification of species and observation of diagnostic characteristics Smithers (1986), Skinner & Chimimba (2005), Cillié, Oberprieler and Joubert (2004) and Apps

(2000) are consulted. Sites have been walked, covering as many habitats as possible. Signs of the presence of mammal species, such as calls of animals, animal tracks (spoor), burrows, runways, nests and faeces were recorded. Walker (1996), Stuart & Stuart (2000) and Liebenberg (1990) were consulted for additional information and for the identification of tracks and signs. Because of the type of threatened mammals that are assessed in the local area such as the blackfooted cat and golden moles or rough-haired golden moles which are not to be trapped in normal way, the poor trapping success with normal traps of species in question such as the White-tailed Mouse as well as the similarity of terrestrial habitats and lack of unique habitats at the sites, trapping was not done since it was not deemed necessary in the case of this study. The focus has been on signs and surveying habitat characteristics to note potential occurrences of mammals of particular conservation concern. Many mammals can be identified from field sightings but, with a few exceptions, bats, rodents and shrews can only be reliably identified in the hand, and then some species needs examination of skulls, or even chromosomes (Apps, 2000).

3.3 BIRDS

Birds were noted as sight records, mainly with the aid of binoculars (10x30). Nearby bird calls of which the observer was sure of the identity were also recorded. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques Ryan (2001) is followed. For information on identification, biogeography and ecology Barnes (2000), Hockey, Dean & Ryan, P.G. (2005), Cillié, Oberprieler & Joubert (2004), Tarboton & Erasmus (1998) and Chittenden (2007) were consulted. Ringing of birds fell beyond the scope of this survey and was not deemed necessary. Sites have been walked, covering as many habitats as possible. Signs of the presence of bird species such as spoor and nests have additionally been recorded. Habitat characteristics were surveyed to note potential occurrences of birds.

3.4 REPTILES

Reptiles were noted as sight records in the field. Binoculars (10x30) can also be used for identifying reptiles of which some are wary. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques, Branch (1998), Marais (2004), Alexander & Marais (2007) and Cillié, Oberprieler and Joubert (2004) were followed. The Atlas and Red List of Reptiles of South Africa, Lesotho and South Africa (Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers, 2014) has been used as the main source to compile the list for assessment. Sites were walked, covering as many habitats as possible. Smaller reptiles are sometimes collected for identification, but this practice was not necessary in the case of this study. Habitat characteristics are surveyed to note potential occurrences of reptiles.

3.5 AMPHIBIANS

Frogs and toads are noted as sight records in the field or by their calls. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques Carruthers (2001), Du Preez (1996), Conradie, Du Preez, Smith & Weldon (2006) and the recent complete guide by Du Preez & Carruthers (2009) are consulted. CD's with frog calls by Carruthers (2001) and Du Preez & Carruthers (2009) are used to identify species by their calls when applicable. Sites are walked, covering as many habitats as possible. Smaller frogs are often collected by pitfall traps put out for epigeal invertebrates (on the soil), but this practice falls beyond the scope of this survey. Habitat characteristics are also surveyed to note potential occurrences of amphibians.

3.6 BUTTERFLIES

Butterflies were noted as sight records or voucher specimens. Voucher specimens are mostly taken of those species of which the taxa warrant collecting due to taxonomic difficulties or in the cases where species can look similar in the veldt. Many butterflies use only one species or a limited number of plant species as host plants for their larvae. Myrmecophilous (ant-loving) butterflies such as the *Aloeides*, *Chrysoritis*, *Erikssonia, Lepidochrysops* and *Orachrysops* species (Lepidoptera: Lycaenidae), which live in association with a specific ant species, require a unique ecosystem for their survival (Deutschländer & Bredenkamp, 1999; Terblanche, Morgenthal & Cilliers, 2003; Edge, Cilliers & Terblanche, 2008; Gardiner & Terblanche, 2010). Known food plants of butterflies were therefore also recorded. After the visits to the site and the identification of the butterflies found there, a list was also compiled of butterflies that will most probably be found in the area in all the other seasons because of suitable habitat. The emphasis of this study remains a habitat survey that focuses on the likelihood of occurrence of threatened, near threatened or rare butterfly species.

3.7 FRUIT CHAFER BEETLES

Different habitat types in the areas were explored for any sensitive or special fruit chafer species. Selection of methods to find fruit chafers depends on the different types of habitat present and the species that may be present. Fruit bait traps would probably not be successful for capturing *Ichnestoma* species in a grassland patch (Holm & Marais 1992). Possible chafer beetles of high conservation priority were noted as sight records accompanied by the collecting of voucher specimens with grass nets or containers where deemed necessary.

3.8 ROCK SCORPIONS

Relatively homogenous habitat / vegetation areas were identified and explored to identify any sensitive or special species. Selected stones that were lifted to search for Arachnids were put back very carefully resulting in the least disturbance possible. All the above actions were accompanied by the least disturbance possible.

3.9 LIMITATIONS

For each site visited, it should be emphasized that surveys can by no means result in an exhaustive list of the plants and animals present on the site, because of the time constraint. There are many invertebrate groups with huge taxonomic and biogeographic impediments which further add to limitations of present surveys. The site survey was conducted during November 2019 which is an optimal time of the season to find sensitive plant and animal species of high conservation priority. Weather conditions during the surveys were favourable for recording fauna and flora. The focus of the present survey remains a habitat survey that concentrates on the possibility that species of particular conservation priority occur on the site or not. It is unlikely that any more visits would reveal information that would change the outcome of this assessment both in terms of ecosystems of special conservation concern or suitable habitats of species of particular conservation concern. Visits that were conducted therefore appear to be sufficient to address the objectives of this study.

4 RESULTS

4.1 HABITAT AND VEGETATION CHARACTERISTICS

Table 4.1 Outline of main landscape and habitat characteristics of the site.

HABITAT FEATURE	DESCRIPTION
Topography	Site is situated on gentle slopes (flat).
Rockiness	No rocky ridges are present.
Presence of wetlands	Two poorly defined narrow non-perennial streambeds with indistinctive riparian zones are found at the northeastern part and the central-eastern part of the site respectively. One small pan, Pan 1, is present at the eastern part of the site.
Broad overview of vegetation	Terrestrial vegetation at the site is an open savanna with few trees that are taller than shrub-height. Patches of shrub-height *Diospyros lycioides* subsp. *lycioides* are present in some areas. Other indigenous tree species at the site include *Vachellia hebeclada* subsp. *hebeclada*, *Senegalia mellifera* subsp. *detinens* (Black Thorn), *Ziziphus mucronata* (Buffalo-thorn), *Tarchonanthus camphoratus* (Camphor Bush), *Grewia flava* (Velvet Raisin Bush) and *Searsia lancea* (Karee). *Vachellia erioloba* (Camel Thorn) is sparsely distributed across the site. Shrublets such as *Gnidia polycephala*, *Elephantorrhiza elephantina* and *Lycium horridum* are found at the site. Herbaceous plant species include *Hermannia tomentosa*, *Heliotropium ciliatum*, *Barleria macrostegia, Hermbstaedtia odorata, Gazania krebsiana* and *Acrotome inflata.* Indigenous grass species at the site include *Eragrostis lehmanniana*, *Eragrostis rigidior, Eragrostis superba*, *Schmidtia papphophoroides, Enneapogon cenchroides* and *Aristida congesta* subsp. *barbicollis*. Some of the alien invasive weed species at hirtherto bare ground or ecologically disturbed areas are *Nicotiana glauca* (Tree Tabacco), *Argemone ochroleuca* (Mexican Poppy), *Schkuhria pinnata* (Dwarf Marigold), *Xanthium spinosum* (Spiny Cocklebur), *Chenopodium album* (White Goosefoot), *Alternanthera pungens* (Paper Thorn) and *Verbesina encelioides* (Wild Sunflower). Conspicuous alien invasive tree species at the site are *Prosopis glandulosa* (Mesquite), *Agave americana* and *Opuntia ficus-indica* (Prickly Pear). Typical wetland plant species are sparse at a small pan (wetland depression) at the site. The grass species *Cynodon dactylon* (Couch Grass) and the sedge *Scirpoides dioecus* are found at the pan at the site. Encroachment by terrestrial plant species such as the exotic *Opuntia ficus-indica* and *Vachellia hebeclada* subsp. *hebeclada* occurs at the pan (wetland depression).
Signs of ecological disturbances	Site appears trampled and overgrazed in many areas. Numerous tracks and some diggings are found at the site. Some old dirt roads at the site are deeply eroded. Numbers of free roaming goats, cattle and donkeys are likely cause of overgrazing. Site is surrounded by settlements, roads, scraped areas and fences. Informal dumping occurs at some parts. Various alien invasive weeds are widespread at the site.
Connectivity	Two poorly defined narrow non-perennial streambeds at the site are corridors of conservation importance in terms of connectivity. The small Pan 1, a wetland depression, at the site is part of a stepping stone corridor system of conservation importance.

Photo 1 View of part of the site.
Photo: R.F. Terblanche.

Photo 2 Patch where cover by shrub-height *Diospyros lycioides* subsp. *lycioides* (Bluebush) is noticeable at site. Free roaming donkeys are also in the picture.
Photo: R.F. Terblanche

Photo 3 Goat and road at the site.
Photo: R.F. Terblanche.

Photo 4 View of part of the site.
Photo: R.F. Terblanche

Photo 5 *Vachellia hebeclada* (Candlepod Thorn) and other indigenous shrub at part of site where tar road crosses through.
Photo: R.F. Terblanche.

Photo 6 Piles at diggings at the site.
Photo: R.F. Terblanche

Photo 7 Trunk of *Vachellia erioloba* (Camel Thorn Tree) at the site.
Photo: R.F. Terblanche.

Photo 8 Foliage and pod of *Vachellia erioloba* (Camel Thorn Tree) at the site.
Photo: R.F. Terblanche

Photo 9 Indigenous trailing herb *Hermannia tomentosa* at the site.
Photo: R.F. Terblanche.

Photo 10 Alien invasive *Nicotiana glauca* at the site.
Photo: R.F. Terblanche

Photo 11 Alien invasive *Opuntia ficus-indica* (Prickly Pear) at the site.
Photo: R.F. Terblanche.

Photo 12 Agressive alien invasive tree *Prosopis glandulosa* (Mesquite) at the site.
Photo: R.F. Terblanche

4.2 ASSESSMENT OF PLANT SPECIES OF PARTICULAR HIGH CONSERVATION PRIORITY

Studying the geographical extent of the Griqualand West Centre of Plant Endemism (van Wyk & Smith, 2001) as well as the Eastern Kalahari Bushveld Bioregion (Mucina & Rutherford, 2006) it is clear that these regions which stretch across the boundaries of Northern Cape and North West Provinces will include similar suitable habitat for localized plant and animal species. A number of other similar Grassland and Savanna Biome Vegetation Types as well as karroid patches occur in both provinces. Because of this occurrence of similar suitable habitat types in the different provinces, the assessment that follows focus on northern Northern Cape Province and North West Province for assessing the likely occurrence or not of species of particular conservation concern.

4.2.1 Plant species of particular conservation concern according to the red list of plants

Table 4.2 Threatened plant species of the North West Province and northern parts of Northern Cape Province which are listed in the **Critically Endangered** category. The list here follows the Red List of South African plant species (Raimondo *et al*. 2009) as well as its updated versions on websites of the South African National Biodiversity Institute (SANBI). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	**Status:** Global status or national status indicated	**Resident at the site**
Brachystelma canum	Critically Endangered	No
Brachystelma gracillimum	Critically Endangered	No

Table 4.3 Threatened plant species of the North West Province and northern parts of Northern Cape Province which are listed in the **Endangered** category. The list here follows the Red List of South African plant species (Raimondo *et al*. 2009) as well as its updated versions on websites of the South African National Biodiversity Institute (SANBI). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	**Status:** Global status or national status indicated	**Resident at the site**
Aginon jaarsveldii	Endangered	No
Aloe peglerae	Endangered	No
Aloidendron pillansii	Endangered	No
Brachystelma discoideum	Endangered	No
Lithops dorotheae	Endangered	No

Table 4.4 Threatened plant species of the North West Province and northern parts of the Northern Cape Province which are listed in the **Vulnerable** category. The list here follows the Red List of South African plant species (Raimondo *et al*. 2009) or recent update. No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	**Status:** Global status or national status indicated	**Resident at the site**
Aloidendron dichotomum *(= Aloe dichotoma)*	Vulnerable	No
Aloidendron ramosissimum	Vulnerable	No
Brachycorythis conica subsp. ***transvaalensis***	Vulnerable	No
Brachystelma incanum	Vulnerable	No
Caesalpinia bracteata	Vulnerable	No
Ceropegia decidua subsp. ***pretoriensis***	Vulnerable	No
Ceropegia stentiae	Vulnerable	No
Conophytum achabense	Vulnerable	No
Dinteranthus pole-evansii	Vulnerable	No
Ledebouria atrobrunnea	Vulnerable	No
Lithops dinteri subsp. ***frederici***	Vulnerable	No
Lithops olivacea	Vulnerable	No
Marsilea farinosa	Vulnerable	No
Melolobium subspicatum	Vulnerable	No
Prunus africana	Vulnerable	No
Rennera stellata	Vulnerable	No
Searsia maricoan	Vulnerable	No
Schwantesia borcherdsi	Vulnerable	No

Table 4.5 Near Threatened plant species of the North West Province and northern parts of the Northern Cape Province. The list here follows the most recent updated red list of South African plant species (Raimondo *et al*. 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	**Status:** Global status or national status indicated	**Resident at the site**
Adromischus umbraticola subsp**.** ***umbraticola***	Near Threatened	No
Ceropegia turricula	Near Threatened	No
Cineraria austrotransvaalensis	Near Threatened	No
Cleome conrathii	Near Threatened	No
Conophytum limpidum	Near Threatened	No
Delosperma leendertziae	Near Threatened	No
Drimia sanguinea	Near Threatened	No
Elaeodendron transvaalense	Near Threatened	No
Kniphofia typhoides	Near Threatened	No
Lithops leslei subsp. ***leslei***	Near Threatened	No

Nerine gracilis	Near Threatened	No
Sporobolus oxyphyllus	Near Threatened	No
Stenostelma umbelluliferum	Near Threatened	No

Table 4.6 Plant species of the North West Province and northern Cape Province which are not threatened and not near threatened but which are of particular conservation concern and listed in the **Critically Rare** category (Raimondo *et al.* 2009). The list here follows the most recent red list of South African plant species (Raimondo *et al*. 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Conservation status	Resident at the site
Bulbine striata	Critically Rare	No
Gladiolus filiformis	Critically Rare	No

Table 4.7 Plant species of the North West Province and northern parts of the Northern Cape Province which are not threatened and not near threatened but of which are of particular conservation concern and listed in the **Rare** category (Raimondo *et al*. 2009). The list here follows the most recent red list of South African plant species (Raimondo *et al*. 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
Adromischus marianiae	Rare	No
Anacampseros bayeriana	Rare	No
Anacampseros scopata	Rare	No
Brachystelma dimorphum susbp. ***gratum***	Rare	No
Cephalophyllum fulleri	Rare	No
Ceropegia insignis	Rare	No
Conophytum bolusiae subsp***. bolusiae***	Rare	No
Eriospermum ernstii	Rare	No
Frithia pulchra	Rare	No
Gnaphalium nelsonii	Rare	No
Habenaria culveri	Rare	No
Hoodia officinalis subsp. ***officinalis***	Rare	No
Ozoroa namaquensis	Rare	No
Schwantesia pillansii	Rare	No
Tridentia virescens	Rare	No
Tylecodon boddleyi	Rare	No
Tylecodon sulphureus var. ***armianus***	Rare	No

Table 4.8 Plant species of the North West Province and northern parts of Northern Cape Province which are not threatened and not near threatened but which are of particular conservation concern and listed in the **Declining** category (Raimondo *et*

al. 2009). The list here follows the most recent red list of South African plant species (Raimondo *et al*. 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
Boophone disticha	Declining	No
Crinum bulbispermum	Declining	No
Crinum macowanii	Declining	No
Drimia altissima	Declining	No
Eucomis autumnalis	Declining	No
Gunnera perpensa	Declining	No
Hypoxis hemerocallidea	Declining	No
Ilex mitis	Declining	No
Pelargonium sidoides	Declining	No
Vachellia erioloba	**Declining**	**Yes**

Table 4.9 Plant species of northern parts of the Northern Cape Province of which the conservation status is uncertain owing to a lack of information and which are listed in the **Data Deficient** category. The list here follows the most recent red list of South African plant species (Raimondo *et al*. 2009). No = Plant species is not a resident on the site; Yes = Plant species is a resident at the site.

Species	Conservation status	Resident at the site
Avonia recurvata subsp. ***minuta***	Data Deficient	No
Cephalaria amerioides	Data Deficient	No
Conophytum lithopsoides subsp. ***boreale***	Data Deficient	No
Cotula loganii	Data Deficient	No
Felicia deserti	Data Deficient	No
Hoodia gordonii	Data Deficient	No
Manulea deserticola	Data Deficient	No
Oxalis extensa	Data Deficient	No
Senecio gariepiensis	Data Deficient	No

4.2.2 Plant species of particular conservation concern: Nationally Protected Tree Species

Table 4.10 Tree species of the North West Province and northern parts of the Northern Cape Province which are listed as **Protected Tree Species** under the National Forests Act No. 84 of 1998, Section 15(1) which was published under Section 12(1)d in GN1602 of 23 December 2016**.** No = Plant species is not a resident on the site; Yes = Plant species is a resident at the site.

Species	Conservation status	Resident at the site
Boscia albitrunca (Shepherd's Tree)	Nationally Protected Tree	No
Combretum imberbe (Leadwood)	Nationally Protected Tree	No
Euclea pseudebenus	Nationally Protected Tree	No

(Ebony Guarri)		
Ozoroa namaquensis (Gariep Resin Tree)	Nationally Protected Tree	No
Prunus africana (Red Stinkwood)	Nationally Protected Tree	No
Sclerocarya birrea subsp. *caffra* (Marula)	Nationally Protected Tree	No
Vachellia erioloba (Camel Thorn Tree)	**Nationally Protected Tree**	**Yes**
Vachellia haematoxylon (Grey Camel Thorn)	Nationally Protected Tree	No

4.2.3 Northern Cape Nature Conservation Act No. 9 of 2009: Specially Protected Plant Species (Schedule 1)

Table 4.11 Plant species of the Northern Cape Province which are listed as **Specially Protected Species** in Schedule 1 of Northern Cape Nature Conservation Act, No. 9 of 2009**.** No = Plant species is not a resident on the site; Yes = Plant species is a resident at the site.

Families andSpecies	Conservation status	Resident at the site
FAMILY AMARYLLIDACEAE		
Clivia mirabilis	Specially Protected Plant (NCNCA, 2009)	No
Haemanthus graniticus	Specially Protected Plant (NCNCA, 2009)	No
Hessea pusilla	Specially Protected Plant (NCNCA, 2009)	No
Strumaria bidentata	Specially Protected Plant (NCNCA, 2009)	No
Strumaria perryae	Specially Protected Plant (NCNCA, 2009)	No
FAMILY ANACARDIACEAE		
Ozoroa spp.	Specially Protected Plant (NCNCA, 2009)	No
Family: APIACEAE		
Centella tridentata	Specially Protected Plant (NCNCA, 2009)	No
Chamarea snijmaniae	Specially Protected Plant (NCNCA, 2009)	No
Family: APOCYNACEAE		
Hoodia gordonii	Specially Protected Plant (NCNCA, 2009)	No
Pachypodium namaquanum	Specially Protected Plant (NCNCA, 2009)	No
Family: ASPHODELACEAE		
Aloe buhrii	Specially Protected Plant (NCNCA, 2009)	No
Aloe dichotoma (Note ***Aloe dichotoma*** is now known as ***Aloidendron dichotomum***)	Specially Protected Plant (NCNCA, 2009)	No

Aloe dichotoma var. ***ramosissima*** (Note ***Aloe ramosissima*** is now regarded as full species ***Aloidendron ramosissimum***)	Specially Protected Plant (NCNCA, 2009)	No
Aloe dabenorisana	Specially Protected Plant (NCNCA, 2009)	No
Aloe erinacea	Specially Protected Plant (NCNCA, 2009)	No
Aloe meyeri	Specially Protected Plant (NCNCA, 2009)	No
Aloe pearsonii	Specially Protected Plant (NCNCA, 2009)	No
Aloe pillansii (Note ***Aloe pillansii*** is now known as ***Aloidendron pillansii***)	Specially Protected Plant (NCNCA, 2009)	No
Trachyandra prolifera	Specially Protected Plant (NCNCA, 2009)	No
Family: ASTERACEAE		
Athanasia adenantha	Specially Protected Plant (NCNCA, 2009)	No
Athanasia spathulata	Specially Protected Plant (NCNCA, 2009)	No
Cotula filifolia	Specially Protected Plant (NCNCA, 2009)	No
Euryops mirus	Specially Protected Plant (NCNCA, 2009)	No
Euryops rosulatus	Specially Protected Plant (NCNCA, 2009)	No
Euryops virgatus	Specially Protected Plant (NCNCA, 2009)	No
Felicia diffusa subsp. ***kamiesbergensis***	Specially Protected Plant (NCNCA, 2009)	No
Othonna armiana	Specially Protected Plant Species (NCNCA, 2009)	No
FAMILY CRASSULACEAE		
Tylecodon torulosus	Specially Protected Plant (NCNCA, 2009)	No
Family DIOSCOREACEAE		
Dioscorea spp.	Specially Protected Plant (NCNCA, 2009)	No
Family: ERIOSPERMACEAE		
Eriospermum erinum	Specially Protected Plant (NCNCA, 2009)	No
Eriospermum glaciale	Specially Protected Plant (NCNCA, 2009)	No
Family: FABACEAE		
Amphithalea obtusiloba	Specially Protected Plant (NCNCA, 2009)	No
Lotononis acutiflora	Specially Protected Plant (NCNCA, 2009)	No
Lotononis polycephala	Specially Protected Plant (NCNCA, 2009)	No

Lessertia spp.	Specially Protected Plant (NCNCA, 2009)	No
Sceletium toruosum	Specially Protected Plant (NCNCA, 2009)	No
Sutherlandia spp.	Specially Protected Plant (NCNCA, 2009)	No
Wiborgia fusca subsp. ***macrocarpa***	Specially Protected Plant (NCNCA, 2009)	No
FAMILY GERANIACEAE		
Pelargonium spp.	Specially Protected Plant (NCNCA, 2009)	No
FAMILY HYACINTHACEAE		
Drimia nana	Specially Protected Plant (NCNCA, 2009)	No
Ornithogalum bicornutum	Specially Protected Plant (NCNCA, 2009)	No
Ornithogalum inclusum	Specially Protected Plant (NCNCA, 2009)	No
Family: IRIDACEAE		
Babiana framesii	Specially Protected Plant (NCNCA, 2009)	No
Ferraria kamiesbergensis	Specially Protected Plant (NCNCA, 2009)	No
Freesia marginata	Specially Protected Plant (NCNCA, 2009)	No
Geissorhiza subrigida	Specially Protected Plant (NCNCA, 2009)	No
Hesperantha minima	Specially Protected Plant (NCNCA, 2009)	No
Hesperantha oligantha	Specially Protected Plant (NCNCA, 2009)	No
Hesperantha rivulicola	Specially Protected Plant (NCNCA, 2009)	No
Lapeirousia verecunda	Specially Protected Plant (NCNCA, 2009)	No
Moraea kamiesensis	Specially Protected Plant (NCNCA, 2009)	No
Moraea namaquana	Specially Protected Plant (NCNCA, 2009)	No
Romulea albiflora	Specially Protected Plant (NCNCA, 2009)	No
Romulea maculata	Specially Protected Plant (NCNCA, 2009)	No
Romulea rupestris	Specially Protected Plant (NCNCA, 2009)	No
Family: MOLLUGINACEAE		
Hypertelis trachysperma	Specially Protected Plant (NCNCA, 2009)	No
Psammotropha spicata	Specially Protected Plant (NCNCA, 2009)	No
Family: ORCHIDACEAE		

Corycium ingaenum	Specially Protected Plant (NCNCA, 2009)	No
Disa macrostachya	Specially Protected Plant (NCNCA, 2009)	No
Family: OXALIDACEAE		
Oxalis pseudo-hirta	Specially Protected Plant (NCNCA, 2009)	No
Family: PEDALIACEAE		
Harpagophytum spp.	Specially Protected Plant (NCNCA, 2009)	No
Family: POACEAE		
Prionanthium dentatum	Specially Protected Plant (NCNCA, 2009)	No
Secale strictum subsp. ***africanum***	Specially Protected Plant (NCNCA, 2009)	No
Family: PROTEACEAE		
Leucadendron meyerianum	Specially Protected Plant (NCNCA, 2009)	No
Mimetes spp.	Specially Protected Plant (NCNCA, 2009)	No
Orothamnus zeyheri	Specially Protected Plant (NCNCA, 2009)	No
Family: ROSACEAE		
Cliffortia arborea	Specially Protected Plant (NCNCA, 2009)	No
Family: SCROPHULARIACEAE		
Charadrophila capensis	Specially Protected Plant (NCNCA, 2009)	No
Family: STANGERIACEAE		
Stangeria spp.	Specially Protected Plant (NCNCA, 2009)	No
Family: ZAMIACEAE		
Encephalartos spp.	Specially Protected Plant (NCNCA, 2009)	No

4.2.4 Northern Cape Nature Conservation Act, No. 9 of 2009: Protected Plant Species (Schedule 2)

Table 4.12 Plant species of the Northern Cape Province which are listed as **Protected Species** in Schedule 2 of Northern Cape Nature Conservation Act, No. 9 of 2009**.** No = Plant species is not a resident on the site; Yes = Plant species is a resident at the site.

Families andSpecies	Conservation status	Resident at the site
Family: ACANTHACEAE		
Barleria papillosa	Protected Plant (NCNCA, 2009)	No
Monechma saxatile	Protected Plant (NCNCA, 2009)	No
Peristrophe spp.	Protected Plant (NCNCA, 2009)	No

Family: ADIANTHACEAE		
Adiantum spp.	Protected Plant (NCNCA, 2009)	No
Family: AGAPANTHACEAE		
Agapanthus spp.	Protected Plant (NCNCA, 2009)	No
Family: AIZOACEAE (MESEMBRYANTHEMACEAE)		
All species of Aizoaceae	Protected Plant (NCNCA, 2009)	No
Family: AMARYLLIDACEAE		
All species of Amaryllidaceae except those listed in Schedule 1	Protected Plant (NCNCA, 2009)	No
Family: ANTHERICACEAE		
All species of Anthericaceae	Protected Plant (NCNCA, 2009)	No
Family: APIACEAE		
All species of Apiaceae except those listed in Schedule 1	Protected Plant (NCNCA, 2009)	No
Family: APOCYNACEAE		
All species of Apocynaceae except those listed in Schedule 1	Protected Plant (NCNCA, 2009)	No
Family: AQUIFOLIACEAE		
Ilex mitis	Protected Plant (NCNCA, 2009)	No
Family: ARACACEAE		
Zantedeschia spp.	Protected Plant (NCNCA, 2009)	No
Family ARALIACEAE		
Cussonia **spp.**	Protected Plant (NCNCA, 2009)	No
Family: ASPHODELACEAE	Protected Plant (NCNCA, 2009)	No
All species of Asphodelaceae except those listed in Schedule 1 and *Aloe ferox*	Protected Plant (NCNCA, 2009)	No
Family: ASTERACEAE	Protected Plant (NCNCA, 2009)	No
Helichrysum jubilatum	Protected Plant (NCNCA, 2009)	No
Felicia deserti	Protected Plant (NCNCA, 2009)	No
Gnaphalium simii	Protected Plant (NCNCA, 2009)	No
Lopholaena longipes	Protected Plant (NCNCA, 2009)	No
Senecio albo-punctatus	Protected Plant (NCNCA, 2009)	No
Senecio trachylaenus	Protected Plant (NCNCA, 2009)	No
Trichogyne lerouxiae	Protected Plant (NCNCA, 2009)	No

Tripteris pinnatilobata	Protected Plant (NCNCA, 2009)	No
Troglophyton acocksianum	Protected Plant (NCNCA, 2009)	No
Vallereophyton lasianthum	Protected Plant (NCNCA, 2009)	No
Family: BURMANNIACEAE		
Burmannia madagascariensis	Protected Plant (NCNCA, 2009)	No
Family: BURSERACEAE		
***Commiphora* spp.**	Protected Plant (NCNCA, 2009)	No
Family: CAPPARACEAE		
Boscia spp.	Protected Plant (NCNCA, 2009)	No
Family: CARYOPHYLLACEAE		
***Dinanthus* spp.**	Protected Plant (NCNCA, 2009)	No
Family: CELASTRACEAE		
***Gymnosporia* spp.**	Protected Plant (NCNCA, 2009)	No
Family: COLCHICACEAE		
***Androcymbium* spp.**	Protected Plant (NCNCA, 2009)	No
***Gloriosa* spp.**	Protected Plant (NCNCA, 2009)	No
FAMILY COMBRETACEAE		
***Combretum* spp.**	Protected Plant (NCNCA, 2009)	No
FAMILY CRASSULACEAE		
All species of Crassulaceae except those listed in Schedule 1	Protected Plant (NCNCA, 2009)	No
Family CUPRESSACEAE		
***Widdringtonia* spp**.	Protected Plant (NCNCA, 2009)	No
Family: CYATHACEAE		
***Cyathea* spp.**	Protected Plant (NCNCA, 2009)	No
Cyathea capensis	Protected Plant (NCNCA, 2009)	No
Family: CYPERACEAE		
Carex acocksii	Protected Plant (NCNCA, 2009)	No
Family: DROSERACEAE		
***Drosera* spp.**	Protected Plant (NCNCA, 2009)	No
Family: DRYOPTERIDACEAE		
***Rumohro* spp.**	Protected Plant (NCNCA, 2009)	No
Family: ERICACEAE		

***Erica* spp.**	Protected Plant (NCNCA, 2009)	No
Family: FABACEAE		
***Aspalathus* spp.**	Protected Plant (NCNCA, 2009)	No
Erythrina zeyheri	Protected Plant (NCNCA, 2009)	No
Argyrolobium petiolare	Protected Plant (NCNCA, 2009)	No
Caesalpinia bracteata	Protected Plant (NCNCA, 2009)	No
Calliandra redacta	Protected Plant (NCNCA, 2009)	No
Crotalaria pearsonii	Protected Plant (NCNCA, 2009)	No
Indigofera limosa	Protected Plant (NCNCA, 2009)	No
Lebeckia bowieana	Protected Plant (NCNCA, 2009)	No
Polhillia involucrata	Protected Plant (NCNCA, 2009)	No
Rhyncosia emarginata	Protected Plant (NCNCA, 2009)	No
Wiborgia humilus	Protected Plant (NCNCA, 2009)	No
Family: HYACINTHACEAE		
***Daubenya* spp.**	Protected Plant (NCNCA, 2009)	No
***Lachenalia* spp.**	Protected Plant (NCNCA, 2009)	No
***Veltheimia* spp.**	Protected Plant (NCNCA, 2009)	No
***Eucomis* spp.**	Protected Plant (NCNCA, 2009)	No
Neopatersonia namaquensis	Protected Plant (NCNCA, 2009)	No
***Ornithogalum* spp.**	Protected Plant (NCNCA, 2009)	No
FAMILY IRIDACEAE		
All species of Iridaceae except those listed in Schedule 1	Protected Plant (NCNCA, 2009)	No
FAMILY LAURACEAE		
***Ocotea* spp.**	Protected Plant (NCNCA, 2009)	No
Family: MESEMBRYANTHEMACEAE (See Aizoaceae)		
All species of Mesembryanthemaceae (see Aizoaceae)	Protected Plant (NCNCA, 2009)	No
Family: MELIACEAE		
Nymania capensis	Protected Plant (NCNCA, 2009)	No

Family: OLEACEAE		
Olea europaea* subsp. *africana	Protected Plant (NCNCA, 2009)	No
Family: ORCHIDACEAE		
All species of Orchidaceae except those listed in Schedule 1	Protected Plant (NCNCA, 2009)	No
Family: OROBANCHACEAE		
***Harveya* spp.**	Protected Plant (NCNCA, 2009)	No
Family: OXALIDACEAE		
All *Oxalis* species except those listed in Schedule 1	Protected Plant (NCNCA, 2009)	No
Family: PLUMBAGINACEAE		
Afrolimon namaquanum	Protected Plant (NCNCA, 2009)	No
Family: POACEAE		
Brachiaria dura var. ***dura***	Protected Plant (NCNCA, 2009)	No
Diregeochloa calviniensis	Protected Plant (NCNCA, 2009)	No
Pentaschistis lima	Protected Plant (NCNCA, 2009)	No
Family: PODOCARPACEAE		
***Podocarpus* spp.**	Protected Plant (NCNCA, 2009)	No
Family: PORTULACACEAE		
***Anacampseros* spp.**	Protected Plant (NCNCA, 2009)	No
***Avonia* spp.**	Protected Plant (NCNCA, 2009)	No
Portulaca foliosa	Protected Plant (NCNCA, 2009)	No
Family: PROTEACEAE		
All species of Proteaceae except those listed in Schedule 1	Protected Plant (NCNCA, 2009)	No
Family: RESTIONACEAE		
All species of Restionaceae	Protected Plant (NCNCA, 2009)	No
Family: RHAMNACEAE		
***Phylica* spp.**	Protected Plant (NCNCA, 2009)	No
Family: RUTACEAE		
***Agathosma* spp.**	Protected Plant (NCNCA, 2009)	No
Family: SCROPHULARIACEAE		
***Diascia* spp.**	Protected Plant (NCNCA, 2009)	No
***Halleria* spp.**	Protected Plant (NCNCA, 2009)	No

***Jamesbrittenia* spp.**	Protected Plant (NCNCA, 2009)	No
***Manulea* spp.**	Protected Plant (NCNCA, 2009)	No
***Nemesia* spp.**	Protected Plant (NCNCA, 2009)	No
***Pyllopodium* spp.**	Protected Plant (NCNCA, 2009)	No
Polycarena filiformis	Protected Plant (NCNCA, 2009)	No
Chaenostoma longipedicellatum	Protected Plant (NCNCA, 2009)	No
Family: STRELITZIACEAE		
***Strelitzia* spp.**	Protected Plant (NCNCA, 2009)	No
Family: TECOPHILAEACEAE		
***Cyanella* spp.**	Protected Plant (NCNCA, 2009)	No
Family: THYMELAEACEAE		
Gnidia leipoldtii	Protected Plant (NCNCA, 2009)	No
Family: ZINGIBERACEAE		
Siphonochilus aethiopicus	Protected Plant (NCNCA, 2009)	No

4.3 ASSESSMENT OF VERTEBRATE SPECIES OF PARTICULAR HIGH CONSERVATION PRIORITY

4.3.1 Mammals of particular high conservation priority

Table 4.13 Threatened mammal species of the North West Province and Northern Cape Province. Literature sources: Friedman & Daly, (2004), Skinner & Chimimba (2005), Wilson & Reeder (2005). With mammal species which normally needs a large range their residential status does not implicate that they are exclusively dependent on the site or use the site as important shelter or for reproduction. No = Not recorded at site/ Unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Species	Threatened Status	Site is part of range	Recorded at site during survey	Likely to be found based on habitat assessment
Bunolagus monticularis Riverine Rabit	Critically Endangered	No	No	No
Chrysospalax villosus Rough-haired golden mole	Vulnerable	No	No	No

Chrysochloris visagiei Visagie's Golden Mole	Critically Endangered	No	No	No
Cryptochloris wintoni De Winton's Golden Mole	Vulnerable	No	No	No
Chryptochloris zyli Van Zyl's Golden Mole	Critically Endangered	No	No	No
Cloeotis percivali Short-eared Trident Bat	Vulnerable/ Near-threatened	No	No	No
Cistugo lesueuri Lesueur's Hairy Bat	Vulnerable	No	No	No
Diceros bicornis Black rhinoceros	Critically Endangered	No	No	No
Eremitalpa granti Grant's Golden Mole	Vulnerable	No	No	No
Felis nigripes Black-footed Cat	Vulnerable	No	No	No
Lycaon pictus African wild dog	Endangered	No	No	No
Loxodonta africana African elephant	Vulnerable	No	No	No
Mystromys albicaudatus White-tailed mouse	Endangered	Yes	No	No
Neamblysomus julianae Juliana's Golden Mole	Critically Endangered	No	No	No
Panthera leo Lion	Vulnerable	No	No	No
Rhinolophus blasii Blasi's Horseshoe Bat	Vulnerable	No	No	No
Smutsia temminckii Ground Pangolin	Near threatened	No	No	No

Table 4.14 Near threatened mammal species known to occur in the North West Province and Northern Cape Province. Literature sources: Skinner & Chimimba (2005). No = Not recorded at site/ unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Species	Threatened Status	Site is part of range	Recorded at site during survey	Likely to be found based on habitat assessment

Ceratotherium simum White Rhinoceros	Near threatened	No	No	No
Cistugo seabrai Angolan Hairy Bat	Near Threatened	No	No	No
Rhinolophus capensis Cape Horseshoe Bat	Near Threatened	No	No	No

Table 4.15 Data deficient (or uncertain) mammal species of the North West Province and Northern Cape Province. Literature sources: Skinner & Chimimba (2005). No = Not recorded at site/ unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Species	Threatened Status	Recorded at site during survey	Likely be a resident at the site
Myosorex varius Forest shrew	Uncertain	No	No
Rhinolophus denti Dent's Horseshoe Bat	Data Deficient	No	No

4.3.2 Birds of particular high conservation priority

Table 4.16 Threatened bird species of the North West Province and Northern Cape Province. Literature sources Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007). No = Not recorded at site/ Unlikely to use site as breeding area or particular habitat on which the species depends. Yes = Recorded at site/ Likely to use site as breeding area or particular habitat on which the species depends.

Species	Common name	Threatened Status	Recorded at site during survey	Likely to use site as breeding area or habitat
Aegypius tracheliotos	**Lappet-faced Vulture**	Vulnerable	No	No
Anthropoides paradiseus	**Blue Crane**	Vulnerable	No	No
Aquila rapax	**Tawny Eagle**	Vulnerable	No	No
Ardeotis kori	**Kori Bustard**	Vulnerable	No	No
Balearica regulorum	**Grey Crowned Crane (Mahem)**	Vulnerable	No	No
Botaurus stellaris	**Eurasian Bittern**	Critically Endangered	No	No
Calendulauda burra	**Red Lark**	Vulnerable	No	No
Circus ranivorus	**African Marsh- Harrier**	Vulnerable	No	No
Crex crex	**Corn Crake**	Vulnerable	No	No
Eupodotis senegalensis	**White-bellied Korhaan**	Vulnerable	No	No

Falco naumanni	**Lesser Kestrel**	Vulnerable	No	No
Geronticus calvus	**Southern Bald Ibis**	Vulnerable	No	No
Gorsachius leuconotus	**White-backed Night-heron**	Vulnerable	No	No
Gypaetus barbatus	**Bearded Vulture**	Endangered	No	No
Gyps africanus	**White-backed Vulture**	Vulnerable	No	No
Gyps coprotheres	**Cape Vulture**	Vulnerable	No	No
Neophron percnopterus	**Egyptian Vulture**	Regionally almost extinct	No	No
Neotis ludwigii	**Ludwig's Bustard**	Vulnerable	No	No
Pelecanus rufescens	**Pink-backed Pelican**	Vulnerable	No	No
Polemaetus bellicosus	**Martial Eagle**	Vulnerable	No	No
Rhynchops flavirostris	**African Skimmer**	Endangered	No	No
Sagittarius serpentarius	**Secretarybird**	Vulnerable	No	No
Sarothrura ayresi	**White-winged Flufftail**	Critically Endangered	No	No
Therathopius ecaudatus	**Bateleur**	Vulnerable (in South Africa)	No	No
Tyto capensis	**African Grass-Owl**	Vulnerable	No	No

***** Though some of the above bird species that roams over large areas may ocassionally be found at the site, the site does not appear to be a habitat of particular importance to these birds, and these birds also do not use the site as breeding area.

Table 4.17 Near threatened bird species of the North West Province and Northern Cape Province. Literature sources Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007). No = Not recorded at site/ Unlikely to be particularly dependent on the site as breeding area or habitat. Yes = Recorded at site/ Likely to be particularly dependant on the site as breeding area or habitat.

Species	Common name	Threatened Status	Recorded at site during survey	Likely to use site breeding area or habitat
Buphagus erythrorynchus	**Red-Billed Oxpecker**	Near threatened	No	No
Certhilauda chuana	**Short-clawed Lark**	Near threatened	No	No
Calendulauda barlowi	**Barlow's Lark**	Near Threatened	No	No
Charadrius pallidus	**Chestnut-banded Plover**	Near threatened	No	No
Ciconia nigra	**Black Stork**	Near threatened	No	No
Circus macrourus	**Pallid Harrier**	Near threatened	No	No
Circus maurus	**Black Harrier**	Near threatened	No	No
Eupodotis caerulescens	**Blue Korhaan**	Near threatened	No	No

Falco biarmicus	**Lanner Falcon**	Near threatened	No	No
Falco peregrinus	**Peregrine Falcon**	Near threatened	No	No
Glareola nordmanni	**Black-winged Pratincole**	Near threatened	No	No
Leptoptilos crumeniferus	**Marabou Stork**	Near threatened	No	No
Mirafra cheniana	**Melodious lark**	Near threatened	No	No
Mycteria ibis	**Yellow-billed Stork**	Near threatened	No	No
Pelecanus onocrotalus	**Great White Pelican**	Near threatened	No	No
Phoenicopterus minor	**Lesser Flamingo**	Near threatened	No	No
Phoenicopterus ruber	**Greater Flamingo**	Near threatened	No	No
Rostratula benghalensis	**Greater Painted-snipe**	Near threatened	No	No
Spizocorys sclateri	**Sclater's Lark**	Near Threatened	No	No
Sternia caspia	**Caspian Tern**	Near threatened	No	No

** Though some of the above bird species that roams over large areas may ocassionally be found at the site, the site does not appear to be a habitat of particular importance to these birds, and these birds also do not use the site as breeding area.

4.3.3 Reptiles of particular high conservation priority

Table 4.18 Threatened reptile species in North West Province and Northern Cape Province. Main Source: (Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers, 2014). No = Reptile species is not a resident on the site; Yes = Reptile species is found to be resident on the site.

Species	Threatened Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
Crocodylus niloticus Nile Crocodile	Vulnerable	No	No	No
Homopus signatus Speckled Dwarf Tortoise	Vulnerable	No	No	No
Pachydactylus goodi Good's Gecko	Vulnerable	No	No	No
Pachydactylus rangei Namib Web-footed Gecko	Critically Endangered (Regionally)	No	No	No

Table 4.19 Near threatened reptile species in North West Province and Northern Cape Province. Main Source: Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers (2014). Though *Homoroselaps dorsalis* has not yet been recorded from the North West Province, its presence in some areas or the Province is anticipated. No = Reptile species is not a resident on the site; Yes = Reptile species is found to be resident on the site.

Species	Threatened Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment

Cordylus imkeae Rooiberg Girdled Lizard	Near Threatened	No	No	No
Cordylus macropholis Large-scaled Girdled Lizard	Near Threatened	No	No	No
Goggia gemmula Richtersveld Pygmy Gecko	Near Threatened	No	No	No
Homopus boulengeri Karoo Dwarf Tortoise	Near Threatened	No	No	No
Homoroselaps dorsalis Striped Harlequin Snake	Near threatened	No	No	No
Typhlosaurus lomiae Lomi's Blind Legless Skink	Near Threatened	No	No	No

4.3.4 Amphibian species of particular high conservation priority

Table 4.20 Threatened amphibian species in Northern Cape Province. Sources: Du Preez & Carruthers (2009), Carruthers & Du Preez (2011). No = Reptile species is not a resident on the site; Yes = Reptile species is found to be resident on the site.

Species	Red Listed Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
Breviceps macrops Desert Rain Frog	Vulnerable	No	No	No

Table 4.21 Near threatened (currently least concern) amphibian species in North West Province and Northern Cape Province. No = Amphibian species is not a resident on the site; Yes = Amphibian species is found to be resident on the site.

Species	Threatened Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
Pyxicephalus adspersus Giant Bullfrog	Near threatened (Currently Least Concern)	No	No	No

4.4 ASSESSMENT OF INVERTEBRATE SPECIES OF PARTICULAR HIGH CONSERVATION PRIORITY

4.4.1 Butterflies of particular conservation priority

Table 4.22 Threatened butterfly species in North West Province, northern Northern Cape Province and Gauteng Province. Sources: Henning, Terblanche & Ball (2009), Mecenero *et al*. (2013). Invertebrates such as threatened butterfly species are often very habitat specific and residential status imply a unique ecosystem that is at stake.

Species	Threatened Status	Recorded at site during survey	Residential status at the site: Yes confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
Aloeides dentatis dentatis Roodepoort Russet	**Endangered**	No	Highly unlikely
Anthene lindae Kalahari Hairtail	**Vulnerable**	No	Unlikely
Chrysoritis aureus Golden Opal	**Endangered**	No	Highly unlikely
Chrysoritis trimeni Diamond Opal	**Vulnerable**	No	Highly unlikely
Lepidochrysops praeterita Highveld Blue	**Endangered**	No	Highly unlikely
Orachrysops mijburghi Mijburgh's Blue	**Endangered**	No	Highly unlikely

Table 4.23 Butterfly species of the Gauteng Province, North West Province and Northern Cape Province that are not threatened and not near threatened but of which are of particular conservation concern and listed as **Critically Rare/ Rare/ Data Deficient** category (Mecenero *et al.*, 2013). No = Butterfly species is unlikely to be a resident at the study area; Yes = Butterfly species is a resident at the study area.

Species	Threatened Status	Recorded at site during survey	Residential status at the site: Yes confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
Chrysoritis beaufortia charlesi Roggeveld Opal	Rare (Restricted Range)	No	Highly unlikely
Chrysoritis beaufortia stepheni Hantam Mountain Opal	Rare (Habitat Specialist)	No	Highly unlikely
Chrysoritis turneri wykehami Hantam Opal	Rare (Habitat Specialist)	No	Highly unlikely
Chrysoritis violescens Violescent Opal	Rare (Habitat Specialist)	No	Highly unlikely
Colotis celimene amina Lilac Tip	Rare (Low density)	No	Highly unlikely
Lepidochrysops jamesi claassensi Hantamsberg Nimble Blue	Rare (Habitat Specialist)	No	Highly unlikely
Lepidochrysops jamesi jamesi Karoobush Nimble Blue	Rare (Habitat Specialist)	No	Highly unlikely
Lepidochrysops mcgregori Copper-brown Nimble Blue	Rare (Habitat Specialist)	No	Highly unlikely
Lepidochrysops penningtoni Arid Nimble Blue	Data Deficient	No	Highly unlikely
Lepidochrysops procera Savanna Blue	Rare (Habitat specialist)	No	Highly unlikely

Metisella meninx Marsh Sylph	Rare (Habitat specialist)	No	Highly unlikely
Platylesches dolomitica Hilltop Hopper	Rare (low density)	No	Highly unlikely
Pseudonympha southeyi kamiesbergensis Kamiesberg Pepperbrown	Rare (Habitat Specialist)	No	Highly unlikely
Thestor calviniae Calvinia Skolly	Rare (Restricted Range)	No	Highly unlikely
Tuxentius melaena griqua Griqua Black Pie	Data Deficient	No	Highly unlikely

4.4.2 Beetles of particular conservation priority

Table 4.24 Fruit chafer species (Coleoptera: Scarabaeidae: Cetoninae) in the Gauteng Province and North-West Province which are of known high conservation priority.

Species	Threatened Status	Recorded at site during survey	Likely to be resident based on habitat assessment
Ichnestoma stobbiai	Uncertain	No	No
Trichocephala brincki	Uncertain	No	No

4.4.3 Scorpion species of particular conservation priority

Table 4.25 Rock scorpion species (Scorpiones: Ischnuridae) species that are of known high conservation priority in the Gauteng Province and North-West Province.

Species	Threatened Status	Recorded at site during survey	Likely to be resident at site based on habitat assessment
Hadogenes gracilis	Uncertain	No	No
Hadogenes gunningi	Uncertain	No	No

5 DISCUSSION

5.1 HABITAT AND VEGETATION CHARACTERISTICS

An outline of the habitat and vegetation characteristics is given in Table 4.1.

5.2 PLANT SPECIES

Extinct, threatened, near threatened and other plant species of high conservation priority in Northern Cape Province are listed in Tables 4.2 – 4.9. Protected tree species are listed in Table 4.10. Plant species listed in Schedule 1 and Schedule 2 of the Northern Cape Nature Conservation Act No. 9 of 2009 are included in Table 4.11 and 4.12. The presence or not of all the species listed in the tables was investigated during the survey. None of the Threatened and Near-threatened plant species are likely to occur on the site. One plant species, *Vachellia erioloba* (Camel Thorn) that is not threatened but listed as Protected tree species (and also Declining species) occurs at the site. In terms of a part of section 15(1) of the National Forests Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

According to Northern Cape Nature Conservation Act No. 9 of 2009 (Updated in Provincial Gazette No. 1566, December 2011 with date of commencement 1 January 2012) no person may pick a Specially Protected Plant species or Protected Plant species without a permit. The term “pick” includes “to collect, to cut, to chop off, to take, to gather, to pluck, to uproot, to break, to damage or to destroy” (NCNCA, No. 9 of 2009). None of these protected plant species were found at the site.

5.3 VERTEBRATES

5.3.1 Mammals

Table 4.13, Table 4.14 and Table 4.15 list the possible presence or absence of threatened mammal species, near threatened mammal species and mammal species of which the status is uncertain, respectively, at the site. Literature sources that were used are Friedman & Daly (2004), Skinner & Chimimba (2005) and Wilson & Reeder (2005). Since the site falls outside reserves, threatened species such as the black rhinoceros (*Diceros bicornis*) and the African wild dog (*Lycaon pictus*) are obviously not present. No smaller mammals of particular high conservation significance are likely to be found on the site as well.

5.3.2 Birds

Table 4.16 and Table 4.17 list the possible presence or absence of threatened bird species and near threatened bird species at the site. With bird species which often have a large distributional range, their presence does not imply that they are particularly dependent on a site as breeding location. Therefore the emphasis in the right hand columns of Table 4.16 and Table 4.17 are on the particular likely dependance or not of bird species on the site. Literature sources that were mainly consulted are Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007). No threat to any threatened bird species or any bird species of particular conservation importance are foreseen.

5.3.3 Reptiles

Table 4.18 and Table 4.19 list the possible presence or absence of threatened and near threatened reptile species on the site. The Atlas and Red List of Reptiles of South Africa, Lesotho and South Africa (Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers, 2014) has been used as the main source to compile the list for assessment. There appears to be no threat to any reptile species of particular high conservation importance if the site is developed.

5.3.4 Amphibians

Table 4.20 lists frog species that are threatened (vulnerable, endangered or critically endangered) in the Northern Cape according to Minter, Burger, Harrison, Braack, Bishop and Kloepfer (2004) as well as Du Preez & Carruthers

(2009). Table 4.21 lists *Pyxicephalus adspersus* (Giant Bullfrog) as near threatened (Minter *et al*., 2004; Du Preez & Carruthers, 2009). Though currently this species is listed as Least Concern (IUCN) it remains as species which is considered as of special conservation priority. There is no suitable habitat for *Pyxicephalus adspersus* (Giant Bullfrog) at the site. There appears to be no threat to any amphibian species of particular high conservation importance if the site is developed.

5.4 INVERTEBRATES

5.4.1 Butterflies

Studies about the vegetation and habitat of threatened butterfly species in South Africa showed that ecosystems with a unique combination of features are selected by these often localised threatened butterfly species (Deutschländer and Bredenkamp 1999; Edge 2002, 2005; Terblanche, Morgenthal & Cilliers 2003; Lubke, Hoare, Victor & Ketelaar 2003; Edge, Cilliers & Terblanche, 2008). Threatened butterfly species in South Africa can then be regarded as bio-indicators of rare ecosystems.

Four species of butterfly in Gauteng Province, northeastern Northern Cape Province and North West Province combined are listed as threatened in the recent butterfly conservation assessment of South Africa (Mecenero *et al*., 2013). The expected presence or not of these threatened butterfly species as well as species of high conservation priority that are not threatened, at the site (Table 4.22 and Table 4.23) follows.

5.4.1.1 Assessment of threatened butterfly species

***Aloeides dentatis dentatis (*Roodepoort Russet)**

The proposed global red list status for *Aloeides dentatis dentatis* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.,* 2013). *Aloeides dentatis dentatis* colonies are found where one of its host plants *Hermannia depressa* or *Lotononis eriantha* is present. Larval ant association is with *Lepisiota capensis* (S.F. Henning 1983; S.F. Henning & G.A. Henning 1989). The habitat requirements of *Aloeides dentatis dentatis* are complex and not fully understood yet. See Deutschländer and Bredenkamp (1999) for the description of the vegetation and habitat characteristics of one locality of *Aloeides dentatis* subsp. *dentatis* at Ruimsig, Roodepoort, Gauteng Province. There is not an ideal habitat of *Aloeides dentatis* subsp. *dentatis* on the site and it is unlikely that the butterfly is present at the site.

***Anthene lindae* (Kalahari Hairtail)**

Small but distinct butterfly species discovered by R.F. Terblanche in 1990 at the present Witsand Nature Reserve in the Northern Cape. Recent red listing and exinction risk assessments list *Anthene lindae* as Vulnerable (Henning, Terblanche & Ball, 2009; Mecenero *et al.*, 2013). The butterfly is intimately associated with *Acacia erioloba* which may prove to be the larval food plant (Terblanche, 1994; Jessnitz pers. comm). However, all the localities for this butterfly species have been found on what appears to be a unique catchment area and basins with particular high water tables on the western side of the Langberg mountain chain, Northern Cape Province (Terblanche & Taylor, 2000). According to Henning *et al.* (2009) *Anthene lindae* has up to date only been found at an ecotone between Gordonia Plains Shrubland and Olifantshoek Plains Thornveld (Mucina & Rutherford, 2006). *Anthene lindae* is not found everywhere where *Vachellia erioloba* is present (Terblanche In prep.) and based on the present knowledge and surveys, presence of the butterfly at the site is unlikely.

Chrysoritis aureus (Golden Opal/ Heidelberg Copper)

The proposed global red list status for *Chrysoritis aureus* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.,* 2013) *Chrysoritis aureus* (Golden Opal/ Heidelberg Copper) is a resident where the larval host plant, *Clutia pulchella* is present. However, the distribution of the butterfly is much more restricted than that of the larval host plant (S.F. Henning 1983; Terblanche, Morgenthal & Cilliers 2003). One of the reasons for the localised distribution of *Chrysoritis aureus* is that a specific host ant *Crematogaster liengmei* must also be present at the habitat. Fire appears to be an essential factor for the maintenance of suitable habitat (Terblanche, Morgenthal & Cilliers 2003). Research revealed that *Chrysorits aureus* (Golden Opal/ Heidelberg Copper) has very specific habitat requirements, which include rocky ridges with a steep slope and a southern aspect (Terblanche, Morgenthal & Cilliers 2003). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon is highly unlikely.

Lepidochrysops praeterita **(Highveld Blue)**

The proposed global red list status for *Lepidochrysops praeterita* according to the most recent IUCN criteria and categories is Endangered (G.A. Henning, Terblanche & Ball, 2009; Mecenero *et al.,* 2013). *Lepidochrysops praeterita* is a butterfly that occurs where the larval host plant *Ocimum obovatum* (= *Becium obovatum*) is present (Pringle, G.A. Henning & Ball, 1994), but the distribution of the butterfly is much more restricted than the distribution of the host plant. *Lepidochrysops praeterita* is found on selected rocky ridges and rocky hillsides in parts of Gauteng, the extreme northern Free State and the south-eastern Gauteng Province. No ideal habitat appears to be present for the butterfly on the site. It is unlikely that *Lepidochrysops praeterita* would be present on the site and at the footprint proposed for the development.

Orachrysops mijburghi **(Mijburgh's Blue)**

The proposed global red status for *Orachrysops mijburghi* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.,* 2013). *Orachrysops mijburghi* favours grassland depressions where specific *Indigofera* plant species occur (Terblanche & Edge 2007). The Heilbron population of *Orachrysops*

mijburghi in the Free State uses *Indigofera evansiana* as a larval host plant (Edge, 2005) while the Suikerbosrand population in Gauteng uses *Indigofera dimidiata* as a larval host plant (Terblanche & Edge 2007). There is no suitable habitat for *Orachrysops mijburghi* on the site and it is unlikely that *Orachrysops mijburghi* would be present on the site.

Conclusion on threatened butterfly species

There appears to be no threat to any threatened butterfly species if the site is developed.

5.4.1.2 Assessment of butterfly species that are not threatened but also of high conservation priority

Colotis celimene amina (Lilac tip)

Colotis celimene amina is listed as Rare (Low density) by Mecenero *et al.* (2013). In South Africa *Colotis celimene amina* is present from Pietermaritzburg in the south and northwards into parts of Kwa-Zulu Natal, Gauteng, Limpopo, Mpumalanga and the North West Provinces (Mecenero *et al.* 2013). Reasons for its rarity are poorly understood. It is highly unlikely that *Colotis celimene amina* would be present at the site.

Lepidochrysops procera (Savanna Blue)

Lepidochrysops procera is listed as Rare (Habitat specialist) by Mecenero *et al.* (2013). *Lepidochrysops procera* is endemic to South Africa and found in Gauteng, KwaZulu-Natal, Mpumalanga and North West (Mecenero *et al.,* 2013). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon at the site is highly unlikely.

Metisella meninx (Marsh Sylph)

Henning and Henning (1989) in the first South African Red Data Book of Butterflies, listed *Metisella meninx* as threatened under the former IUCN category Indeterminate. Even earlier in the 20th century Swanepoel (1953) raised concern about vanishing wetlands leading to habitat loss and loss of populations of *Metisella meninx*. According to the second South African Red Data Book of butterflies (Henning, Terblanche & Ball, 2009) the proposed global red list status of *Metisella meninx* has been Vulnerable. During a recent large scale atlassing project the *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas* (Mecenero *et al.,* 2013) it was found that more *Metisella meninx* populations are present than thought before. Based on this valid new information, the conservation status of *Metisella meninx* is now regarded as Rare (Habitat specialist) (Mecenero *et al.,* 2013). Though *Metisella meninx* is more widespread and less threatened than perceived before, it should be regarded as a localised rare habitat specialist of conservation priority, which is dependent on wetlands with suitable patches of grass at wetlands (Terblanche In prep.). Another important factor to keep in mind for the conservation of *Metisella meninx* is that based on very recent discoveries of new taxa in the group the present *Metisella meninx* is species complex consisting of at least three taxa (Terblanche In prep.,

Terblanche & Henning In prep.). The ideal habitat of *Metisella meninx* is treeless marshy areas where *Leersia hexandra* (rice grass) is abundant (Terblanche In prep.). The larval host plant of *Metisella meninx* is wild rice grass, *Leersia hexandra* (G.A. Henning & Roos, 2001). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon at the site is highly unlikely.

Platylesches dolomitica (Hilltop Hopper)

Platylesches dolomitica is listed as Rare (Low density) by Mecenero *et al.* (2013). Historically the conservation status of *Platylesches dolomitica* was proposed to be Vulnerable (Henning, Terblanche & Ball 2009). However this butterfly which is easily overlooked and has a wider distribution than percieved before. *Platylesches dolomitica* has a patchy distribution and is found on rocky ledges where *Parinari capensis* occurs, between 1300 m and 1800m (Mecenero *et al*. 2013, Dobson Pers comm.). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon at the site is highly unlikely.

5.5 Ecological Sensitivity at the site

Ecological sensitivity at the terrestrial zone of the site is medium. Ecological sensitivity at the two poorly defined narrow non-perennial streambeds and their buffer zones are medium based on their importance to connectivity of watercourses in the larger area (Figure 4). Ecological sensitivity is medium-high at the pan (wetland depression) and its buffer zone (30 m). Kindly also see Wetland Assessment report which accompanies this Ecological Habitat Survey Report.

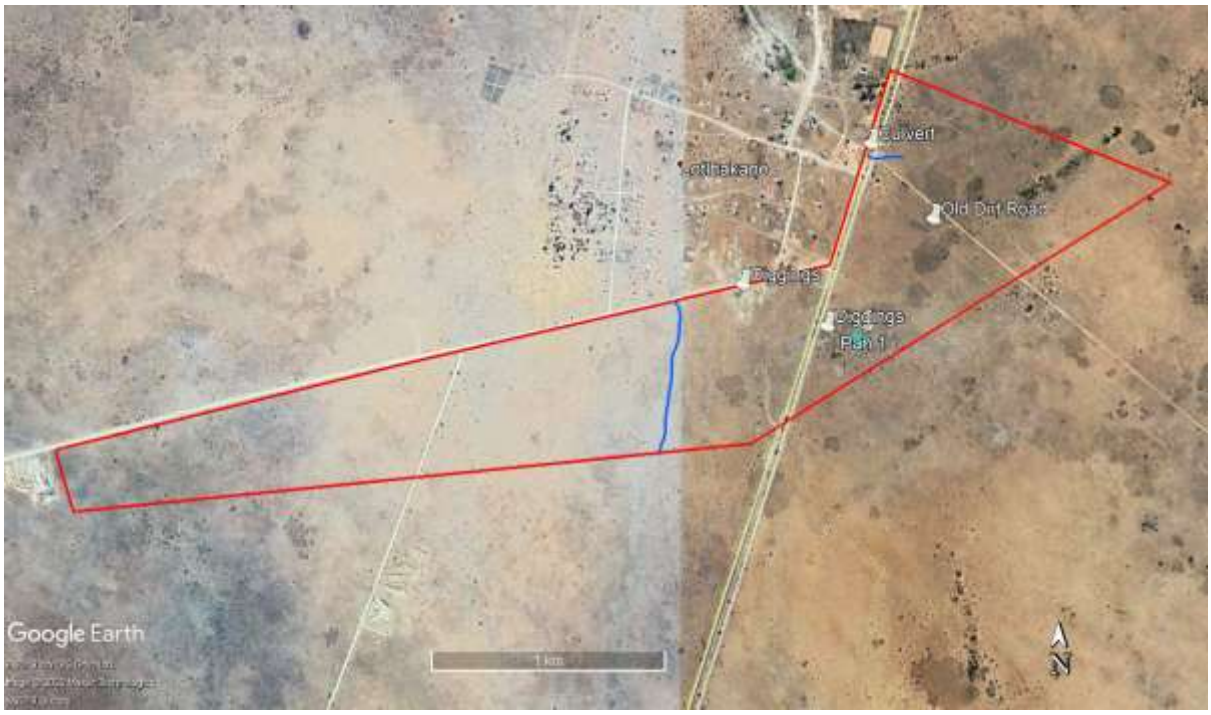

Figure 2 Indication of wetland and drainage lines at the site.

———	Light blue outline and shading	Extent of wetland depression (small pan) at the site
———	Blue outline	Drainage line

Grid references and altitudes were taken at site with a GPS Garmin E-trex 20 ® instrument. Map information were analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2020).

Figure 3 Indication of certain ecological aspects at the central-eastern and northeastern part of the site.

———	Light blue outline and shading	Extent of wetland depression (small pan) at the site
———	Blue outline	Drainage line

Grid references and altitudes were taken at site with a GPS Garmin E-trex 20 ® instrument. Map information were analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2020).

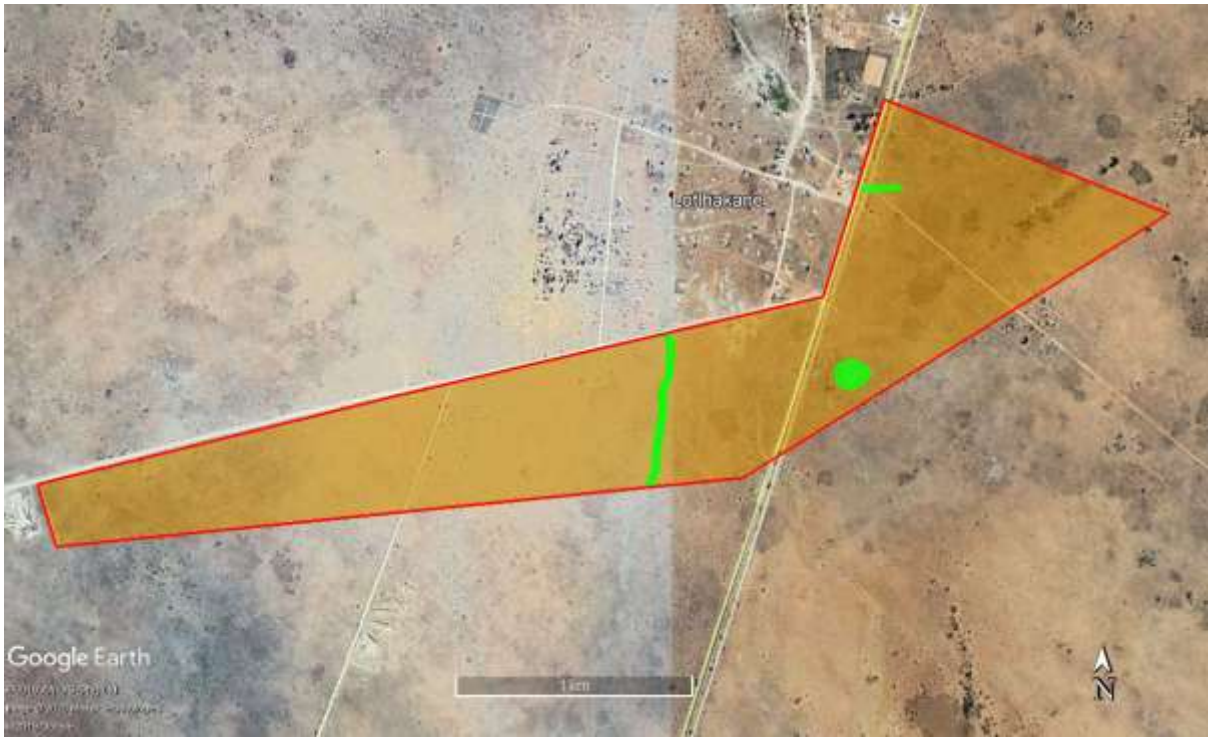

Figure 4 Indications of ecological sensitivity at the site. Ecological sensitivity of most of the site is medium, whereas the ecological sensitivity at the poorly defined drainage lines and small pan depression with their buffer zones are considered to be medium-high.

Red outline	Boundaries of the site
Orange-brown outline and shading	Medium Sensitivity
Light green outline and shading	Medium-high Sensitivity

Grid references and altitudes were taken at site with a GPS Garmin E-trex 20 ® instrument. Map information were analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2019).

6 RISKS, IMPACTS AND MITIGATION

The primary cause of loss of biological diversity is habitat degradation and loss (IUCN, 2004; Primack, 2006). Habitats of threatened plants are in danger most often due to urban developments such as is the case for the Gauteng Province (Pfab & Victor, 2002). Habitat conservation is the key to the conservation of invertebrates such as threatened butterflies (Deutschländer and Bredenkamp 1999; Edge 2002, 2005; Terblanche, Morgenthal & Cilliers 2003; Lubke, Hoare, Victor & Ketelaar 2003; Edge, Cilliers & Terblanche, 2008). Though human impacts in few cases have improved the habitat for mammalian species such as greater cane rats, that prosper in sugar cane and maize fields (Apps 2000), for many mammalian habitat specialist species, human impacts have lead to habitat loss. Some mammal species, especially many of the larger species, could adapt to a wide range of habitat types, but then need a large range. Some animals and plants are rare and occupy only one or a few specialised habitats (Primack 2006). Habitat conservation, either as large available land or as specialised habitats is therefore key to the conservation of many threatened plant species and animal species or any other species of high conservation priority (i.e. rare, near threatened species). Overall corridors and linkages may play a significant role in conservation of fauna.

Corridors are important to link ecosystems of high conservation priority. Such corridors or linkages are there to improve the chances of survival of otherwise isolated populations (Samways, 2005). How wide should corridors be? The answer to this question depends on the conservation goal and the focal species (Samways, 2005). Corridors for mammalian species are especially important for migratory species (Mwalyosi, 1991, Pullin 2002). For an African butterfly assemblage this is about 250m when the corridor is for movement as well as being a habitat source (Pryke and Samways 2003). Hill (1995) found a figure of 200m for dung beetles in tropical Australian forest. In the agricultural context, and at least for some common insects, even small corridors can play a valuable role (Samways, 2005). Much more research remains to be done to find refined answers to the width of grassland corridors in South Africa. The width of corridors will also depend on the type of development, for instance the effects of the shade of multiple story buildings will be quite different from that of small houses. Corridors have a number of advantages related to dispersal and gene flow by avoiding isolation of ecological patches. However, corridors could also have potential drawbacks, for example creating gene flow where none has occurred naturally in the past and also as reservoirs for pathogens or introduced species (Pullin, 2002). Perhault and Lomolino (2000) studied corridors and mammal community structure in an old-growth forest landscape in the United States of America and their data suggest that each corridor should be valued individually. A lot of research remains to be conducted to have a better idea of the value of corridors, but in general corridors would be of considerable value. It appears that a network of wetland corridors and rocky ridges is highly likely to be of considerable benefit in

environmental management and planning. Though proper management plans for habitats are not in place, setting aside special ecosystems is in line with the resent Biodiversity Act (2004) of the Republic of South Africa.

To summarise: In practice, as far as any developments are concerned, the key would be to prioritise and plan according to sensitive species and special ecosystems.

In the case of this study:
Terrestrial vegetation at the site is an open savanna with few trees that are taller than shrub-height. Patches of shrub-height *Diospyros lycioides* subsp. *lycioides* are present in some areas. Other indigenous tree species at the site include *Vachellia hebeclada* subsp. *hebeclada*, *Senegalia mellifera* subsp. *detinens* (Black Thorn), *Ziziphus mucronata* (Buffalo-thorn), *Tarchonanthus camphoratus* (Camphor Bush), *Grewia flava* (Velvet Raisin Bush) and *Searsia lancea* (Karee). *Vachellia erioloba* (Camel Thorn) is sparsely distributed across the site. Some indigenous shrublets, herbaceous plant species and grass species remain at the visibly degraded savanna.

Alien invasive weed species are conspicuous are hirtherto bare ground or ecologically disturbed areas. Noticeable alien invasive tree species at the site are *Prosopis glandulosa* (Mesquite), *Agave americana* and *Opuntia ficus-indica* (Prickly Pear).

Typical wetland plant species appear to be sparse at a small pan (wetland depression), Pan 1, at the site. The grass species *Cynodon dactylon* (Couch Grass) and the sedge *Scirpoides dioecus* are found at the pan at the site. Encroachment by terrestrial plant species such as the exotic *Opuntia ficus-indica* and *Vachellia hebeclada* subsp. *hebeclada* occurs at the pan (wetland depression).

Site appears trampled and overgrazed in many areas. Numerous tracks and some diggings are found at the site. Some old dirt roads at the site are deeply eroded. Numbers of free roaming goats, cattle and donkeys are likely cause of overgrazing. Site is, for large parts, surrounded by settlements, roads, scraped areas and fences. Informal dumping occurs at some parts. Various alien invasive weeds are widespread at the site.

Two poorly defined narrow non-perennial streambeds with rather indistinctive riparian zones are found at the northeastern part and the central-eastern part of the site respectively. One small pan, Pan 1, is present at the eastern part of the site.

No Threatened or Near Threatened plant or animal species appear to be present at site.

One plant species that is not threatened but listed as Protected tree species (and also Declining species) occurs at the site, *Vachellia erioloba* (Camel Thorn). In terms of a part of section 15(1) of the National Forests Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport,

export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

None of the protected plant species according to Northern Cape Nature Conservation Act No. 9 of 2009 (Updated in Provincial Gazette No. 1566, Desember 2011 with date of commencement 1 January 2012) have been found at the site.

The two poorly defined narrow non-perennial streambeds at the site are corridors of conservation importance in terms of connectivity. The small Pan 1, a wetland depression, at the site is part of a stepping stone corridor system of conservation importance.

The following potential risks, impacts and mitigation measures apply to the proposed development:

6.1 Identification of potential impacts and risks

The potential impacts identified are:

Construction Phase

- Potential impact 1: Loss of habitat owing to the removal of vegetation at the proposed footprint for development.
- Potential impact 2: Loss of sensitive species (Threatened, Near-Threatened, Rare, Declining or Protected species) during the construction phase.
- Potential impact 3: Loss of connectivity and conservation corridor networks in the landscape.
- Potential impact 4: Contamination of soil during construction in particular by hydrocarbon spills.
- Potential impact 5: Killing of vertebrate fauna during the construction phase.

Operational Phase

- Potential impact 6: An increased infestation of exotic or alien invasive plant species owing to disturbance.

6.2 Potential impacts and risks during the construction phase

Classes of impacts for this study: Very High, High, Moderate, Low, Very Low

Aspect/Activity	Clearance of vegetation at part of the site for the development
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Clearing of vegetation at the proposed development. This will entail the partial destruction of habitat of medium and low ecological sensitivity.
Status	Negative
Mitigation Required	Pan (wetland depression) and its 30 m bufferzone, is excluded from the development. Poorly defined non-perennial streambeds and their 10 m buffer zones are excluded for the development.
Impact Significance (Pre-Mitigation)	High
Impact Significance (Post-Mitigation)	Moderate
RISK	Following the mitigation measures a moderate risk of impact is expected.

Aspect/Activity	Removal of sensitive species
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Sensitive species: Loss of Threatened or Near-Threatened Plants, Mammals, Reptiles, Amphibians and Invertebrates at the proposed footprint appears to be unlikely. A protected tree species *Vachellia erioloba* (Camel Thorn) is present at the site.
Status	Negative.
Mitigation Required	Mitigation measures for Protected tree species if development is approved: • Marking or avoidance of the *Vachellia erioloba* (Camel Thorn Tree) at the site.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISK	If *Vachellia erioloba* is marked or avoided at the site the risk for any threat to sensitive species of particular conservation importance at the site is moderate.

Aspect/Activity	Fragmentation of corridors of particular conservation concern
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Small pan (wetland depression) with its buffer zone, is a corridor of considerable conservation importance.
Status	Negative
Mitigation Required	Pan (wetland depression) with its riparian zone and 30 m bufferzone, is excluded from the development. Poorly defined non-perennial streambeds and their 10 m buffer zones are excluded for the development.
Impact Significance (Pre-Mitigation)	High
Impact Significance (Post-Mitigation)	Moderate
RISK	Following mitigation, a moderate impact risk is expected.

Aspect/Activity	Contamination of soil by leaving rubble/ waste or spilling petroleum fuels or any pollutants on soil which could infiltrate the soil
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Rubble or waste could lead to infiltration of unwanted pollutants into the soil. Spilling of petroleum fuels and unwanted chemicals onto the soils that infiltrate these soils could lead to pollution of soils.
Status	Negative
Mitigation Required	Rubble or waste that could accompany the construction effort, if the development is approved, should be removed during and after construction. Measures should be taken to avoid any spills and infiltration of petroleum fuels or any chemical pollutants into the soil during construction phase.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISKS	A low risk is expected following mitigation.

Aspect/Activity	Possible disturbance, trapping, hunting and killing of vertebrates during construction phase
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	During the construction phase animal species could be disturbed, trapped, hunted or killed.
Status	Negative
Mitigation Required	If the development is approved, contractors must ensure that no animal species are disturbed, trapped, hunted or killed during the construction phase.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low

RISKS	Following mitigation, a low risk of impact is anticipated.

6.3 Potential impacts during the operational phase

Aspect/Activity	An increased infestation of exotic or alien invasive plant species owing to clearance or disturbance where the footprint took place.
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Infestation by alien invasive species could replace indigenous vegetation or potential areas where indigenous vegetation could recover. Once established combatting these alien invasive plant species may become very expensive in the long term.
Status	Negative
Mitigation Required	Continued monitoring and eradication of alien invasive plant species are imperative.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISKS	Following mitigation, a low risk is anticipated.

6.4 Risk and impact assessment summary for the Construction Phase

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)	
Clearing of vegetation	Habitat loss, loss of indigenous species	Negative	Part of site	Long-Term	Substantial	Very likely	Low	Low	Pan (wetland depression) and its 30 m buffer zone are excluded from the development. Poorly defined non-perennial streambeds and their 10 m buffer zones are excluded for the development.	High	Moderate	High
Loss of sensitive species	Loss of sensitive species	Negative	Site	Long-Term	Low (No Threatened species anticipated)	Unlikely	Not applicable	Not applicable	Loss of Threatened or Near-Threatened Plants, Mammals, Reptiles, Amphibians and Invertebrates at the proposed footprint appears to be unlikely. A Nationally Protected, but not threatened, tree species *Vachellia erioloba* (Camel Thorn) is present at the site. Marking or avoidance of *Vachellia erioloba* (Camel Thorn Tree) at the site is imperative. In the case where non-avoidance of *Vachellia erioloba* is not possible an appropriate permit for damage or removal of this tree species is to be applied for.	Moderate	Low	High

Loss of corridors of particular conservation concern	Fragmentation of landscape and loss of connectivity	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	Pan (wetland depression) with its riparian zone and 30 m bufferzone, is excluded from the development. Poorly defined non-perennial streambeds and their 10 m buffer zones are excluded for the development.	High	Moderate	High
Contamination of soil by spilling pollutants on soil which could infiltrate the soil	Soil contamination	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	Rubble and waste removal. Measures that avoid hydrocarbon (petroleum) spills to get into contact with the soil.	Moderate	Low	High
Disturbance or killing of vertebrates	Disturbance or killing of species	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	If the development is approved, contractors must ensure that no animal species are disturbed, trapped, hunted or killed during the construction phase.	Moderate	Low	High

6.7 Risk/ Impact assessment summary for the Operational Phase

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)	

Increased infestation of exotic or alien invasive plant species	Loss of habitat quality	Negative	Site	Long-Term	Substantial	Likely	Moderate	Moderate	Monitoring and eradication of alien invasive plant species. Implementation of rehabiliation plan which include the establisment of indigenous plant species.	Moderate	Low	High

6.6 Summary of risks and impacts

Terrestrial vegetation at the site is an open savanna with few trees that are taller than shrub-height. Some indigenous shrublets, herbaceous plant species and grass species remain at the visibly degraded savanna. Alien invasive weed species are conspicuous are hirtherto bare ground or ecologically disturbed areas. Noticeable alien invasive tree species at the site are *Prosopis glandulosa* (Mesquite), *Agave americana* and *Opuntia ficus-indica* (Prickly Pear). Typical wetland plant species appear to be sparse at a small pan (wetland depression), Pan 1, at the site.

Site appears trampled and overgrazed in many areas. Numerous tracks and some diggings are found at the site. Some old dirt roads at the site are deeply eroded. Numbers of free roaming goats, cattle and donkeys are likely cause of overgrazing. Site is, for large parts, surrounded by settlements, roads, scraped areas and fences. Informal dumping occurs at some parts.

No Threatened or Near Threatened plant or animal species appear to be present at site.

One plant species that is not threatened but listed as Protected tree species (and also Declining species) occurs at the site. In terms of a part of section 15(1) of the National Forests Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

None of the protected plant species according to Northern Cape Nature Conservation Act No. 9 of 2009 (Updated in Provincial Gazette No. 1566, Desember 2011 with date of commencement 1 January 2012) have been found at the site.

The small pan (wetland depression) at the site should is part of a stepping stone corridor system of conservation importance. This pan and its buffer zone should be excluded from any developments. Poorly defined non-perennial streambeds and their buffer zones are conserved.

Impacts to the Pan (Wetland Depression) at the site are anticipated to comprise a low\ moderate risk if the mitigation measures are applied. If the development is approved the surface flow and erosion at the wetland are likely to be limited. There is no distinct indication that interflow play of the wetlands would be impacted significantly by the proposed developments. The geomorphological setting and flow regime likely to be similar post development, if the development is approved according to the mitigation measures stated. Loss of any wetland animal or plant species of particular conservation importance are not expected. Following the mitigations which will be upheld and planned footprint for development all the impact risks listed above are moderate or low.

7 CONCLUSION

- Terrestrial vegetation at the site is an open savanna with few trees that are taller than shrub-height. Patches of shrub-height *Diospyros lycioides* subsp. *lycioides* are present in some areas. Other indigenous tree species at the site include *Vachellia hebeclada* subsp. *hebeclada*, *Senegalia mellifera* subsp. *detinens*, *Ziziphus mucronata, Tarchonanthus camphoratus*, *Grewia flava* and *Searsia lancea*. Vachellia erioloba (Camel Thorn) is sparsely distributed across the site. Some indigenous shrublets, herbaceous plant species and grass species remain at the visibly degraded savanna.
- Alien invasive weed species are conspicuous are hirtherto bare ground or ecologically disturbed areas. Noticeable alien invasive tree species at the site are *Prosopis glandulosa* (Mesquite), *Agave americana* and *Opuntia ficus-indica* (Prickly Pear).
- Typical wetland plant species appear to be sparse at a small pan (wetland depression), Pan 1, at the site. The grass species *Cynodon dactylon* (Couch Grass) and the sedge *Scirpoides dioecus* are found at the pan at the site. Encroachment by terrestrial plant species such as the exotic *Opuntia ficus-indica* and *Vachellia hebeclada* subsp. *hebeclada* occurs at the pan (wetland depression).
- Site appears trampled and overgrazed in many areas. Numerous tracks and some diggings are found at the site. Some old dirt roads at the site are deeply eroded. Numbers of free roaming goats, cattle and donkeys are likely cause of overgrazing. Site is, for large parts, surrounded by settlements, roads, scraped areas and fences. Informal dumping occurs at some parts.
- Two poorly defined narrow non-perennial streambeds with rather indistinctive riparian zones are found at the northeastern part and the central-eastern part of the site respectively. One small pan, Pan 1, is present at the eastern part of the site.
- No Threatened or Near Threatened plant or animal species appear to be present at site.
- None of the protected plant species according to Northern Cape Nature Conservation Act No. 9 of 2009 (Updated in Provincial Gazette No. 1566, Desember 2011 with date of commencement 1 January 2012) have been found at the site.
- One plant species that is not threatened but listed as Protected tree species (and also Declining species), Vachellia erioloba (Camel Thorn) occurs at the site. In terms of a part of section 15(1) of the National Forests Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

- If avoidance of any *Vachellia erioloba* (Camel Thorn tree) at the site is not practical, application for a permit to remove the tree would be imperative because in terms of a part of section 15(1) of the National Forests Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.
- The two poorly defined narrow non-perennial streambeds at the site are corridors of conservation importance based on their role in connectivity of watercourses in the area. The small Pan 1, a wetland depression, at the site is part of a stepping stone corridor system of conservation importance.
- The vegetation types representing the Savanna Biome at the site are Kuruman Vaalbosveld (SVk 8) Kuruman Thornveld (SVk 9). Kuruman Vaalbosveld and Kuruman Thornveld are not listed as threatened according to the National List of Threatened Ecosystems (2011).
- Ecological sensitivity at the terrestrial zone of the site is medium. Ecological sensitivity at the two poorly defined narrow non-perennial streambeds and their buffer zones are medium based on their importance to connectivity of watercourses in the larger area (Figure 4). Ecological sensitivity is medium-high at the pan (wetland depression) and its buffer zone (30 m). Kindly also see Wetland Assessment report which accompanies this Ecological Habitat Survey Report.
- Following the mitigations which will be upheld and planned footprint for development all the impact risks listed above are moderate or low.
- Establisment of exotic weeds should be monitored and exotic weeds at the site should be eradicated. A declared invader such as the mesquite tree (*Prosopis* species), should not be planted or allowed to spread from adjacent areas to the proposed footprint.

8 REFERENCES

Alexander, G. & Marais, J. 2007. A guide to the reptiles of Southern Africa. Struik, Cape Town.

Anderson, M.D. & Andersen, T.A. 2001. Too much, too quickly? Doubts about the sustainability of the camelthorn wood harvest. *African Wildlife* 55(3): 21-23.

Apps, P. 2012. Smithers' mammals of Southern Africa 4th ed: A field guide, revised and updated by Peter Apps. Struik Nature, Cape Town.

Armstrong, A.J. 1991. On the biology of the marsh owl, and some comparisons with the grass owl. *Honeyguide* 37:148-159.

Barnes, K.N. *ed*. 2000. The Eskom Red Data Book of birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. & De Villiers, M.S. (eds). 2014. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. *Suricata* 1. South African National Biodiversity Institute, Pretoria.

Boon, R. 2010. *Pooley's trees of eastern South Africa: a complete guide 2nd ed*. Flora and Fauna Publications Trust, Durban.

Branch, B. 1998. Field guide to snakes and other reptiles of southern Africa. 3rd ed. Struik, Cape Town.

Branch, B. 2008. Tortoises, Terrapins & Turtles of Africa. Struik Nature, Cape Town.

Branch, W.R. & Patterson, R.W. 1975. Notes on the ecology of the Giant Girdled Lizard, *Cordylus giganteus*. *Journal of Herpetology* 9(4): 364-366.

Bronner, G. 2011. *Mammals.* In: Picker, M. & Griffiths, C. 2011. *Alien & Invasive animals: a South African perspective.* Struik Nature, Cape Town, p 22-35.

Bromilow, C. 2010. Problem plants and alien weeds of South Africa. Briza Publications, Pretoria.

Carruthers, V. & Du Preez, 2011. Frogs and froging in southern Africa 2nd ed. Struik, Cape Town.

Chittenden, H. 2007. Roberts Bird Guide. John Voelcker Book Fund, Cape Town.

Cillié, B., Oberprieler, U. & Joubert, C. 2004. Animals of Pilanesberg: an identification guide. Game Parks Publishing, Pretoria.

Cilliers, S.S., Müller, N. & Drewes, E. 2004. Overview on urban nature conservation: situation in the western-grassland biome of South Africa. *Urban forestry and urban greening* 3: 49-62.

Coetzee, N. & Monadjem, A. 2008. *Mystromys albicaudatus*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>.

Conradie, W., Du Preez, L.H., Smith, K. & Weldon, C. 2006. Field guide to the frogs and toads of the Vredefort Dome World Heritage Site. School of Environmental Sciences and Development, Potchefstroom.

Court, D. 2010. *Succulent Flora of Southern Africa*. Struik Nature, Cape Town.

Crouch, N.R., Klopper, R.R., Burrows, J.E. & Burrows, S.M. 2011. Ferns of Southern Africa: a comprehensive guide. Struik Nature, Cape Town.

Del Hoyo, J., Elliot, J. & Sargatal, J. 1992. Handbook of the birds of the world, Vol. 1. Lynx Editions, Barcelona.

Deutschländer, M.S. & Bredenkamp, C.J. 1999. Importance of vegetation analysis in the conservation management of the endangered butterfly *Aloeides dentatis* subsp. *dentatis* (Swierstra) (Lepidoptera: Lycaenidae). *Koedoe* 42(2): 1-12.

Dippenaar-Schoeman, A.S. 2002. Baboon and trapdoor spiders in southern Africa: an identification manual. Plant Protection Research Institute Handbook No. 13. Agricultural Research Council, Pretoria.

Dippenaar-Schoeman, A.S. & Jocqué, R. 1997. African spiders: an identification manual. Plant Protection Research Institute Handbook No. 9. Agricultural Research Council, Pretoria.

Drinkwater, T.W., Bate, R. & Du Toit, H.A. 1998. A field guide for identification of maize pests in South Africa. Agricultural Research Council: Grain-crops Institute, Potchefstroom.

Du Preez, L.H. 1996. Field guide and key to the frogs and toads of the Free State. Department of Zoology and Entomology, University of the Orange Free State, Bloemfontein.

Du Preez, L.H. & Carruthers, V. 2009. A complete guide to the frogs of southern Africa. Struik Nature, Cape Town. CD with calls included.

Edge, D.A., Cilliers, S.S. & Terblanche, R.F. 2008. Vegetation associated with the occurrence of the Brenton blue butterfly. *South African Journal of Science* 104: 505 - 510.

Fahrig, L. 2003. Effects of habitat fragmentation on biodiversity. *Annual review of Ecology, Evolution and Systematics*, 34: 487 -515.

Ferguson-Lees, J. & Christie, D.A. 2001. *Raptors of the world*. Christopher Helm, London.

Filmer, M.R. 1991. Southern African spiders: an identification guide. Struik, Cape Town.

Gardiner, A.J. & Terblanche, R.F. 2010. Taxonomy, biology, biogeography, evolution and conservation of the genus *Erikssonia* Trimen (Lepidoptera: Lycaenidae). *African Entomology* 18(1): 171 – 191.

Germishuizen, G. 2003. Illustrated guide to the wildflowers of northern South Africa. Briza, Pretoria.

Germishuizen, G., Meyer, N.L. & Steenkamp (*eds*) 2006. A checklist of South African plants. Southern African Botanical Diversity Network Report No. 41. SABONET, Pretoria.

Goldblatt, P. 1986. The Moraeas of Southern Africa. Annals of Kirstenbosch Botanic Gardens, Volume 14. National Botanic Gardens, Cape Town.

Goldblatt, P. & Manning, J. 1998. Gladiolus in Southern Africa.

Henderson, L. 2001. *Alien weeds and alien invasive plants: a complete guide to the declared weeds and invaders in South Africa.* Plant Protection Research Institute Handbook No. 12. ARC: Plant Protection Research Institute, Pretoria.

Henderson, L. & Cilliers, C.J. 2002. *Invasive aquatic plants: a guide to the identification of the most important and potentially dangerous invasive aquatic and wetland plants in South Africa.* Plant Protection Research Handbook No. 16. Agricultural Research Council, Pretoria.

Henning, G.A. & Roos, P.S. 2001. Threatened butterflies of South African wetlands. *Metamorphosis* 12(1): 26-33.

Henning, G.A., Terblanche, R.F. & Ball, J.B. (eds) 2009. South African Red Data Book: butterflies. *SANBI Biodiversity Series No 13.* South African National Biodiversity Institute, Pretoria.

Henning, S.F. 1983. Biological groups within the Lycaenidae (Lepidoptera). *Journal of the Entomological Society of Southern Africa* 46(1): 65-85.

Henning, S.F. 1987. Outline of Lepidoptera conservation with special reference to ant associated Lycaenidae. *Proceedings of the first Lepidoptera conservation Symposium, Roodepoort*: *Lepidopterists' Society of southern Africa*: 5-7.

Henning, S.F. & Henning, G.A. 1989. South African Red Data Book: butterflies. *South African National Scientific Programmes Report* No. 158. CSIR, Pretoria.

Herman, P.P.J. 2002. Revision of the *Tarchonanthus camphoratus* complex (Asteraceae-Tarchonantheae) in southern Africa. *Bothalia* 32,1: 21-28.

Hernandez, R.R., Easter, S.B., Murphy-Mariscal, M.L., Maestre, F.T., Tavassoli, M., Allen, E.B., Barrows, C.W., Belnap, J., Ochoa-Hueso, R., Ravi, S. & Allen, M.F. 2014. Environmental impacts of utility-scale Solar Energy. *Renewable and Sustainable Energy Reviews*, 29: 766-779.

Hill, C.J. 1995. Conservation corridors and rainforest insects. (*In* Watt, A.D., Stork, N.E. & Hunter, M.D. (*eds.*), Forests and Insects. Chapman & Hall, London. p. 381-393.)

Hockey, P. 2011. *Birds.* In: Picker, M. & Griffiths, C. 2011. *Alien & Invasive animals: a South African perspective.* Struik Nature, Cape Town, p 36-44.

Hockey, P.A.R., Dean, W.J.R. & Ryan, P.G. (*eds.*). 2005. Roberts Birds of Southern Africa. John Voelcker Bird Book Fund, Cape Town.

Holm, E. & Marais, E. 1992. Fruit chafers of southern Africa. Ekogilde, Hartebeespoort.

IUCN. 2001. *IUCN Red List Categories and Criteria: Version 3.1*. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

IUCN. 2012. IUCN Red list of Threatened Species. Version 2012.1)

Jacobsen, W.B.G. 1983. The ferns and fern allies of Southern Africa. Butterworths, Durban.

Kemper, N.P. 2001. RVI: Riparian Vegetation Index, final report, WRC Report No. 850/3/1. Institute for Water Research, Pretoria.

Kok, J.C. 1998. Vrystaatse bome, struike en klimplante Kontak-uitgewers, Pretoria.

Kyalangalilwa, B., Boatwright, J.S., Daru, B.H., Maurin, O. & van der Bank, M. 2013. Phylogenetic position and revised classification of *Acacia* s.l. (Fabaceae: Mimosoideae) in Africa, including new combinations in *Vachellia* and *Senegalia*. *Botanical Journal of the Linnean Society* 172: 500–523.

Larsen, T.B. 1995. Butterfly biodiversity and conservation in the Afrotropical region. (*In* Pullin, A.S. *ed*. Ecology and conservation of butterflies. London: Chapman & Hall. p. 290-303.)

Liebenberg, L. 1990. A field guide to the animal tracks of Southern Africa. David Philip Publishers, Cape Town.

Leeming, J. 2003. Scorpions of southern Africa. Struik, Cape Town.

Leroy, A. & Leroy, J. 2003. Spiders of southern Africa. Struik, Cape Town.

Louw, W.J. 1951. *An ecological account of the vegetation of the Potchefstroom Area*. Botanical Survey of South Africa, Memoir No. 24. Government Printer, Pretoria.

Low, A.B. & Rebelo, A.G. (Eds.) 1996. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

Lubke, R.A., Hoare, D., Victor, J. & Ketelaar, R. 2003. The vegetation of the habitat of the Brenton Blue Butterfly, *Orachrysops niobe* (Trimen), in the Western Cape, South Africa. *South African Journal of Science* 99: 201-206.

Manning, J. 2003. Photographic guide to the wild flowers of South Africa. Briza, Pretoria. .

Manning, J. 2009. Field guide to the wild flowers of South Africa. Struik, Cape Town.

McMurtry, D., Grobler, L., Grobler, J. & Burns, S. 2008. Field guide to the orchids of northern South Africa and Swaziland. Umdaus Press, Hatfield.

Mecenero, S., Ball, J.B., Edge, D.A., Hamer, M.L., Henning, G.A., Krüger, M, Pringle, E.L., Terblanche, R.F. & Williams, M.C. 2013. *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas.* Saftronics, Johannesburg & Animal Demography Unit, Cape Town.

Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J. & Kloepfer, D. *eds.* 2004. Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. SI/MAB series 9, Smithsonian Institution, Washington DC.

Mucina, L. & Rutherford, M.C. *eds*. 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. Pretoria: South African National Biodiversity Institute.

Mucina, L., Rutherford, M.C., and Powrie, L.W. *eds*. 2005. Vegetation map of South Africa, Lesotho and Swaziland, 1:1 000 000 scale sheet maps. Pretoria: South African National Biodiversity Institute.

Munguira, M.L. 1995. Conservation of butterfly habitats and diversity in European Mediterranean countries. (*In* Pullin, A.S. *ed*. Ecology and conservation of butterflies. London: Chapman & Hall. p. 277- 289.)

New, T.R. 1993. *ed*. Conservation biology of *Lycaenidae* (butterflies). *Occasional paper of the IUCN Species Survival Commission* No. 8.

New, T.R. 1995. Butterfly conservation in Australasia – an emerging awareness and an increasing need. (*In* Pullin, A.S. *ed*. Ecology and conservation of butterflies. London: Chapman & Hall. p. 304 – 315.)

Oates, M.R. 1995. Butterfly conservation within the management of grassland habitats. (*In* Pullin, A.S. *ed*. Ecology and conservation of butterflies. London: Chapman & Hall. (p. 98-112.)

Peacock, F. 2006. Pipits of Southern Africa. Published by the author, Pretoria. www.pipits.co.za.

Pfab, M.F. 2002. Priority ranking scheme for Red Data plants in Gauteng, South Africa. *South African Journal of Botany* (68): 299-303.

Pfab, M.F. & Victor, J.E. 2002. Threatened plants of Gauteng, South Africa. *South African Journal of Botany* (68): 370-375.

Picker, M. & Griffiths, C. 2011. Alien & Invasive animals: a South African perspective. Struik Nature, Cape Town.

Picker, M., Griffiths, C. & Weaving, A. 2004. Field guide to insects of South Africa. 2nd ed. Cape Town: Struik.

Pooley, E. 1998. A field guide to wild flowers of KwaZulu-Natal and the eastern region. Natal Flora Publications Trust, Durban.

Pringle, E.L., Henning, G.A. & Ball, J.B. *eds.* 1994. Pennington's Butterflies of Southern Africa. Struik Winchester, Cape Town.

Pryke, S.R. & Samways, M.J. 2001. Width of grassland linkages for the conservation of butterflies in South African afforested areas. *Biological Conservation* 101: 85-96.

Pullin, A.S. *ed*. 1995. Ecology and conservation of butterflies. Chapman & Hall, London.

Rautenbach, I.L. 1982. The mammals of the Transvaal. Ecoplan monograph 1: 1-211.

Retief, E. & Herman, P.P.J. 1997. Plants of the northern provinces of South Africa: keys and diagnostic characteristics. Strelitzia 6. National Botanical Institute, Pretoria.

Rutherford, M.C. & Westfall, R.H. 1994. Biomes of southern Africa: An objective categorisation, 2nd ed. Memoirs of the Botanical Survey of South Africa, Vol. 63, pp. 1-94. National Botanical Institute, Pretoria.

Ryan, P. 2001. Practical Birding: A guide to birdwatching in southern Africa. Struik, Cape Town.

Samways, M.J. 2005. Insect diversity conservation. Cambridge University Press, Cambridge.

Saunders, D.A., Hobbs, R.J. & Margules, C.R. 1991. Biological consequences of ecosystem fragmentation: A review. *Conservation Biology* 5(1): 18-32.

Shackleton, R.T., le Maitre, D.C., van Wilgen, B.W. & Richardson, D.M. 2015a. The impact of invasive alien *Prosopis* species (mesquite) on native plants in different environments in South Africa. South African Journal of Botany, 97: 25-31.

Shackleton, R.T., le Maitre, D.C. & Richardson, D.M. 2015b. Stakeholder perceptions and practices regarding *Prosopis* (mesquite) invasions and management in South Africa. *Ambio: A Journal of the Human Environment*, 44: 569-581.

Shackleton, R.T., le Maitre, D.C. & Richardson, D.M. 2015c. *Prosopis* invasions in South Africa: Population structures and impacts on native tree population stability. *Journal of Arid Environments*, 114: 70 – 78.

Skelton, P. 2001. A complete guide to the freshwater fishes of Southern Africa. Struik, Cape Town.

Skelton, P. & Weyl, O. 2011. *Fishes.* In: Picker, M. & Griffiths, C. 2011. *Alien & Invasive animals: a South African perspective.* Struik Nature, Cape Town, p 36-44.

Skinner, J.D. & Chimimba, C.T. 2005. The mammals of the southern African subregion. Cambridge University Press, Cape Town.

Sliwa, A. 2008. *Felis nigripes*. In: IUCN 2012. IUCN Red List of Threatened Species.

Smit, N. 2008. Field guide to the *Acacias* of South Africa. Briza, Pretoria.

Smithers, R.H.N. 1986. South African Red Data Book: Terrestrial mammals. *South African National Scientific Programmes Report* No. 125. CSIR, Pretoria.

South Africa. 2004. National Environmental Management: Biodiversity Act No. 10 of 2004. Government Printer, Pretoria.
Stuart, C. & Stuart, T. 2006. Field guide to the larger mammals of Africa 3rd ed. Struik Nature, Cape Town.

Stuart, C. & Stuart, T. 2013. A field guide to the tracks and signs of Southern, Central and East African wildlife 4th ed. Struik Nature, Cape Town.

Tarboton, W. & Erasmus, R. 1998. Owls and owling in southern Africa. Struik, Cape Town.

Taylor, J.C., Janse Van Vuuren, M.S. & Pieterse , A.J.H. 2007. The application and testing of diatom-based indices in the Vaal and Wilge Rivers, South Africa. *Water SA* 33(1): 51-59.

Terblanche, R.F. & Edge, D.A. 2007. The first record of an *Orachrysops* in Gauteng. *Metamorphosis* 18(4): 131-141.

Terblanche, R.F. 1994. The little hairtail from the Kalahari. *Metamorphosis* 5(4): 173-174.

Terblanche, R.F., Morgenthal, T.L. & Cilliers, S.S. 2003. The vegetation of three localities of the threatened butterfly species *Chrysoritis aureus* (Lepidoptera: Lycaenidae). *Koedoe* 46(1): 73-90.

Terblanche, R.F. & Taylor, J.C. 2000. Notes on the buttterflies of Witsand – a unique terrestrial island in the Northern Cape Province, South Africa – with special reference to two RED DATA BOOK butterfly species. *Metamorphosis* 11(3): 122-131.

Terblanche, R.F. & Van Hamburg, H. 2003. The taxonomy, biogeography and conservation of the myrmecophilous *Chrysoritis* butterflies (Lepidoptera: Lycaenidae) in South Africa. *Koedoe* 46(2): 65-81.

Terblanche, R.F. & Van Hamburg, H. 2004. The application of life history information to the conservation management of *Chrysoritis* butterflies (Lepidoptera: Lycaenidae) in South Africa. *Koedoe* 47(1): 55-65.

Thomas, C.D. 1995. Ecology and conservation of butterfly metapopulations in the fragmented British landscape. (*In* Pullin, A.S. *ed*. Ecology and conservation of butterflies. London: Chapman & Hall. p. 46-64.)

Van den Berg, J. & Drinkwater, T.W. 1998. Field guide to identification of sorghum pests in South Africa. Agricultural Research Council: Grain-crops Institute, Potchefstroom.

Van Ginkel, C.E., Glen, R.P., Gordon-Gray, K.D., Cilliers, C.J., Muasya, M. & van Deventer, P.P. 2011. Easy identification of some South African Wetland Plants. WRC Report No TT 479/10. Water Research Commission, Gezina.

Van Jaarsveld, E.J. 2006. The Southern African *Plectranthus* and the art of turning shade to glade.

Van Oudtshoorn, F. 2012. Guide to grasses of southern Africa, 3rd ed. Briza, Pretoria.

Van Wyk, B. 2000. A photographic guide to wild flowers of South Africa. Struik, Cape Town.

Van Wyk, B. & Malan, S. 1998. Field Guide to the Wild Flowers of the Highveld. Struik, Cape Town.

Van Wyk, A.E. & Smith, G.F. 2001. Regions of floristic endemism in Southern Africa: a review with emphasis on succulents, Umdaus Press, Pretoria.

Van Wyk, B.E. & Smith, G.F. 2014. Guide to the aloes of South Africa. 3rd ed. Briza, Pretoria.

Van Wyk, B. & Van Wyk, P. 2013. Field guide to trees of Southern Africa 2nd ed. Struik Nature, Cape Town.

Walker, C. 1996. Signs of the Wild. 5th ed. Struik, Cape Town.

Warren, M.S. 1995. Managing local microclimates for the high brown fritillary, *Argynnis adipe*. (*In* Pullin, A.S. *ed*. Ecology and conservation of butterflies. London: Chapman & Hall.)

Watt, A.D., Stork, N.E. & Hunter, M.D. (*eds*.), Forests and Insects. London: Chapman & Hall. (p. 381-393.)

APPENDIX 1

Plant species that have been recorded at the site.

Plant species are listed alphabetically under life forms that are generally recognizable.
Plant species marked with an asterisk (*) are exotic.
Sources: Germishuizen (2003), Manning (2003), Manning (2009), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Malan (1998), Van Wyk & Van Wyk (2013), Crouch, Klopper, Burrows & Burrows (2011), Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), McMurtry, Grobler, Grobler & Burns (2008), Smit (2008), Van Ginkel *et al*. (2011), Van Jaarsveld (2006), Van Wyk & Smith (2003).

TAXON	COMMON NAMES	FAMILY
ANGIOSPERMAE: MONOCOTYLEDONS		
**** Agave americana***		AGAVACEAE
Albuca setosa	Fibrous Slime Lily	HYACINTHACEAE
Aristida adscensionis	Annual Three-awn	POACEAE
Aristida canescens	Pale Three-awn	POACEAE
Aristida diffusa		POACEAE
Aristida congesta	Three-awn	POACEAE
Bulbine narcissifolia		ASPHODELACEAE
Cenchrus ciliaris	Foxtail Buffalo Grass	POACEAE

Cynodon dactylon	Couch Grass	POACEAE
Digitaria eriantha	Common Finger Grass	POACEAE
Elionurus muticus	Wire Grass	POACEAE
Enneapogon cenchroides	Nine-awned Grass	POACEAE
Eragrostis curvula	Weeping Love Grass	POACEAE
Eragrostis echinochloidea	Tick Grass	POACEAE
Eragrostis lehmanniana	Lehmann's Love Grass	POACEAE
Eragrostis superba	Saw-toothed Love Grass	POACEAE
Heteropogon contortus	Spear Grass	POACEAE
Melinis repens	Natal Red Top	POACEAE
Scirpoides dioecus		CYPERACEAE
Setaria verticillata	Bur Bristle Grass	POACEAE
Tragus racemosa	Carrot-seed Grass	POACEAE
ANGIOSPERMS: DICOTYLEDONS		
Acrotome inflata		LAMIACEAE
**** Alternanthera pungens***	Paper Thorn	AMARANTHACEAE
Alternanthera sessilis		AMARANTHACEAE
**** Amaranthus deflexus***	Perrenial Pigweed	AMARANTHACEAE
Amaranthus thunbergii		AMARANTHACEAE
**** Amaranthus viridus***	Slender Amaranth	AMARANTHACEAE
**** Argemone ochroleuca***	White-flowered Mexican poppy	PAPAVERACEAE
**** Atriplex semibaccata***	Australian Salt Bush	AMARANTHACEAE
Barleria macrostegia		ACANTHACEAE
Berkheya onopordifolia var. ***onopordifolia***		ASTERACEAE
**** Bidens bipinnata***	Spanish blackjack	ASTERACEAE
**** Bidens pilosa***	Common blackjack	ASTERACEAE
**** Capsella bursa-pastoris***	Shepherd's Purse	BRASSICACEAE
Chamaesyce hirta	Red Milkweed	EUPHORBIACEAE
Chamaesyce inaequilatera	Smooth Creeping Milkweed	EUPHORBIACEAE
**** Chamaesyce prostrata***	Hairy Creeping Milkweed	EUPHORBIACEAE
**** Chenopodium album***	White Goosefoot	CHENOPODIACEAE
**** Chenopodium ambrosioides***	Wormseed Goosefoot	CHENOPODIACEAE
**** Chenopodium carinatum***	Green Goosefoot	CHENOPODIACEAE

Chrysocoma ciliata	Bitterbush	ASTERACEAE
Cleome monophylla	Single-leaved Spindle Pod	BRASSICACEAE/ CAPPARACEAE
**** Convolvulus arvensis***	Field Bindweed	CONVOLVULACEAE
Convolvulus sagittatus		CONVOLVULACEAE
Corchorus asplenifolius		MALVACEAE
**** Datura ferox***	Large Thorn-apple	SOLANACEAE
**** Datura stramonium***	Common Thorn-apple	SOLANACEAE
Diospyros lycioides subsp***. lycioides***		EBENACEAE
Emex australis	Spiny Emex	POLYGONACEAE
Elephantorrhiza elephantina	Eland's Bean	FABACEAE
Felicia muricata		ASTERACEAE
**** Galinsoga parviflora***	Small-flowered quickweed	ASTERACEAE
Gazania krebsiana subsp. ***krebsiana***		ASTERACEAE
Gnidia polycephala		THYMELAEACEAE
**** Gomphrena celosioides***	Bachelor's Button	AMARANTHACEAE
Grewia flava	Wild Raisin	MALVACEAE
Helichrysum argyrosphaerum		ASTERACEAE
Hermannia tomentosa		MALVACEAE
Hertia pallens		ASTERACEAE
Indigofera daleoides		FABACEAE
**** Lactuca serriola***	Wild Lettuce	ASTERACEAE
Lycium horridum		SOLANACEAE
Lycium hirsutum		SOLANACEAE
**** Nicotiana glauca***		SOLANACEAE
Nidorella anomala		ASTERACEAE
Opuntia ficus-indica	Prickly Pear	CACTACEAE
Pentzia calcarea		ASTERACEAE
Pentzia globosa		ASTERACEAE
Pollichia campestris	Waxberry	ILLECEBRACEAE
**** Prosopis glandulosa***	Mesquite	FABACEAE
**** Schkuhria pinnata***	Dwarf Marigold	ASTERACEAE
Searsia lancea	Karree	ANACARDIACEAE
Senecio coronatus	Sybossie	ASTERACEAE

Senecio consanguineus	Starvation Senecio	ASTERACEAE
Senegalia mellifera subsp. ***detinens***	Black Thorn	FABACEAE
Senna italica	Wild Senna	CAESALPINIACEAE
**** Sonchus oleraceus***	Sowthistle	ASTERACEAE
Stachys spathulata		LAMIACEAE
Tarchonanthus camphoratus	Wild Camphor Bush	ASTERACEAE
Teucrium trifidum		LAMIACEAE
Thesium sp.		SANTALACEAE
Tribulus terrestris	Devil's Thorn	ZYGOPHYLLACEAE
Vachellia erioloba	Camel Thorn	MIMOSACEAE
Vachellia hebeclada* subsp. *hebeclada	Candle Thorn	MIMOSACEAE
Vachellia tortilis* subsp. *heteracantha	Umbrella Thorn	MIMOSACEAE
**** Verbena aristigera***	Fine-leaved Verbena	VERBENACEAE
**** Verbesina encelioides***	Wild Sunflower	ASTERACEAE
Waltheria indica		MALVACEAE
**** Xanthium spinosum***	Spiny Cocklebur	ASTERACEAE
**** Xanthium strumarium***	Large Cocklebur	ASTERACEAE
Ziziphus mucronata	Buffalo-thorn	RHAMNACEAE