

ECOLOGICAL FAUNA AND FLORA HABITAT SURVEY

A Portion of the Remaining Extent of Portion 399, on Portion 450 and Portion 451 of the farm Waterkloof 305 JQ

North West Province



Shoots of indigenous *Buddleja salviifolia* at the riparian zone at the site.
Photo: Reinier F. Terblanche.

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1 INTRODUCTION

An ecological habitat survey is required for a Portion of the Remaining Extent of Portion 399, on Portion 450 and Portion 451 of the farm Waterkloof 305JQ, about 8 km south of the centre of Rustenburg in the North West Province, South Africa (elsewhere referred to as the site). Survey focused on the possibility that threatened fauna or flora known to occur in North West Province are likely to occur within the proposed development. Species of known high conservation priority that do not qualify for threatened status 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 or foodplants 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

- Surveys 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 a Portion of the Remaining Extent of Portion 399, on Portion 450 and Portion 451 of the farm Waterkloof 305 JQ, about 8 km south of the centre of Rustenburg, North West Province, South Africa. Site is situated at the Savanna Biome which is represented by Moot Plains Bushveld (Mucina & Rutherford, 2006). A brief overview of the vegetation types, serve as an outline of the ecological context of the site, follows.

SVcb 8 Moot Plains Bushveld

In South Africa Moot Plains Bushveld is found in North-West and Gauteng Provinces. Main belt of this vegetation type occurs immediately south of the Magaliesberg from the Selons River Valley in the West through Maanhaarrand, filling the valley bottom of the Magalies River, proceeding east of the Hartebeestpoort Dam between the Magaliesberg and Daspoort mountain ranges to Pretoria. It also occurs as a narrow belt immediately north of the Magaliesberg from Rustenburg in the west to just east of the Crocodile River in the east; also south of the Swartruggens-Zeerust line. Altitude at this vegetation type is typically about 1050-1450 m.

Vegetation and landscape features comprise open to closed, low, often thorny savanna dominated by various species of *Acacia* in the bottomlands and plains as well as woodlands of varying height and density on the lower hillsides. Herbaceous layer is dominated by grasses (Mucina & Rutherford, 2009).

Geology and soils at the Moot Plains Vegetation type are clastic sediments and minor carbonates and volcanics of the Pretoria Group (including the Silverton Formation) and some Malmani dolomites in the west, all of the Transvaal Supergroup (Vaalian). There is also some contribution from mafic Bushveld intrusives. Soils often stony with colluvial clay-loam but varied, including red-yellow apedal freely drained, dystrophic and eutrophic catenas, vertic and melanic clays, and some less typical Glenrosa and Mispah forms. Land types Ae, Ba, Ea, Bc, Ac and less typically Fb (Mucina & Rutherford, 2006).

Climate: Summer rainfall with very dry winters. Mean annual precipitation (MAP) form about 550 mm in the west to about 700 mm in the east. Frost frequent in winter. Mean monthly maximum and minimum temperatures for Pretoria-Pur 33.6°C and -3.6°C for January and June respectively (Mucina & Rutherford, 2006).

Important taxa: Small trees: *Acacia nilotica*, *Acacia tortilis* subsp. *heteracantha*, *Searsia lancea*. Tall shrubs: *Buddleja saligna*, *Euclea undulata*, *Olea europaea* subsp. *africana*, *Grewia occidentalis*, *Gymnosporia polyacantha*, *Mystroxyton aethiopicum* subsp. *burkeanum*. Low shrubs: *Aptosimum elongatum*, *Felicia fascicularis*, *Lantana rugosa*, *Teucrium trifidum*. Succulent shrub: *Kalanchoe paniculata*. Woody Climber: *Jasminum breviflorum*. Herbaceous climber: *Lotononis bainesii*. Graminoids: *Heteropogon contortus*, *Setaria sphacelata*, *Themeda triandra*, *Aristida congesta*, *Chloris virgata*, *Cynodon dactylon*, *Sporobolus nitens*, *Tragus racemosus*. Herbs: *Achyroopsis avicularis*, *Corchorus asplenifolius*, *Evolvulus alsinoides*, *Helichrysum nudifolium*, *Helichrysum undulatum*, *Hermannia depressa*, *Osteospermum muricatum*, *Phyllanthus maderaspatensis* (Mucina & Rutherford, 2006).

Note: Not all of the above listed plant species for the vegetation types occur at the site in the study area.

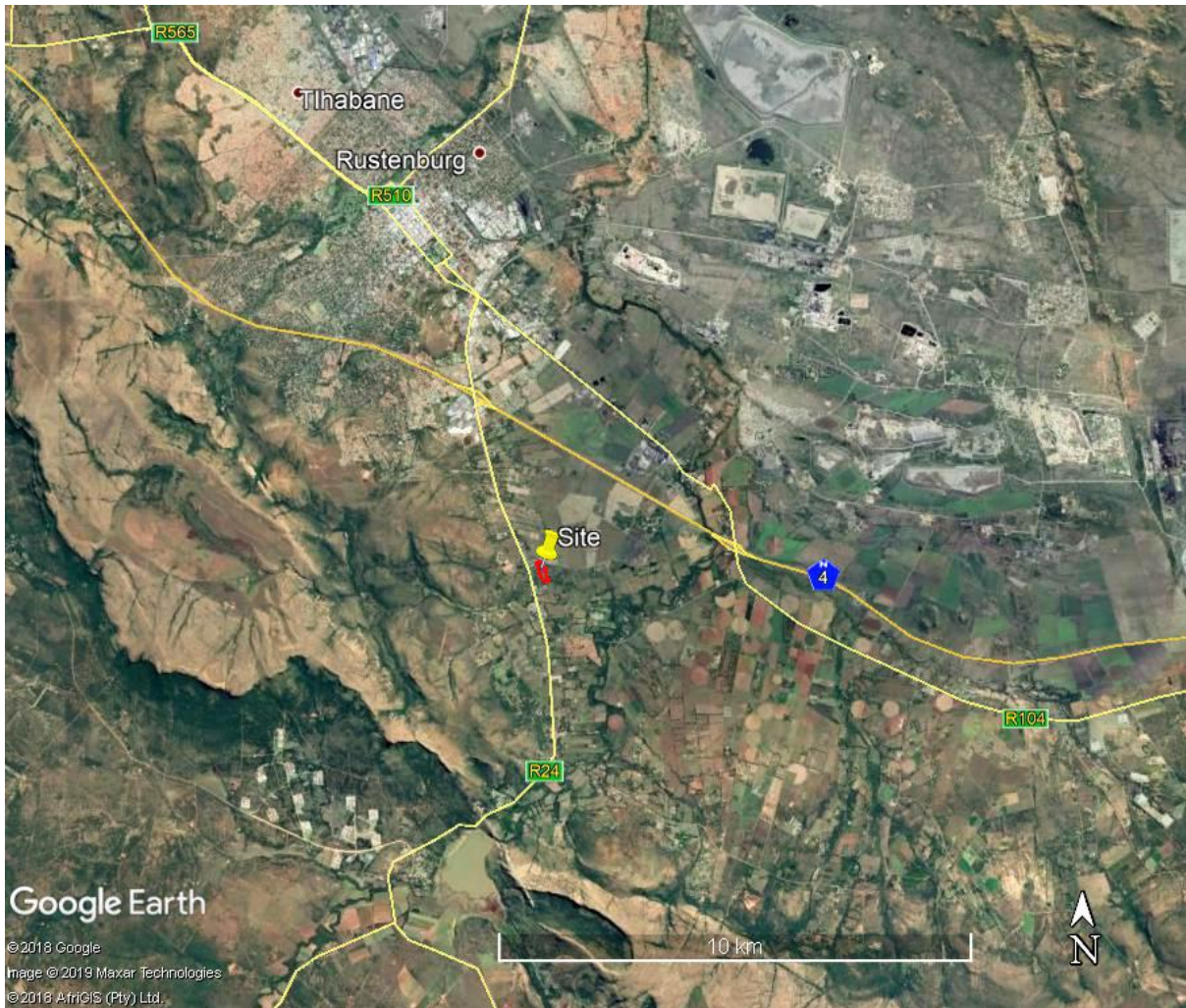


Figure 1 Map with an indication of the location of the site.

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, 2019).

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 by R.F. Terblanche during August 2019 were conducted to note key elements of habitats on the site, relevant to the conservation of fauna and flora. The main purpose of the site visits was ultimately to serve as a habitat survey that concentrated on the possible presence or not of threatened species and other species of high conservation priority.

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

3.1 HABITAT CHARACTERISTICS AND VEGETATION

The habitat was investigated by noting habitat structure (rockiness, slope, plant structure/ physiognomy) 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 Boon (2010), 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 (1999), Van Wyk (2000), Van Wyk & Smith (2001), Van Wyk & Smith (2003), Van Wyk & Malan (1998) and Van Wyk & Van Wyk (1997). 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 spoor and signs. Trapping was not done since it proved not necessary in the case of this study.

Habitat characteristics were also surveyed to note potential occurrences of mammals. 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 need 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. 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, Morghental & 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 is on a habitat survey.

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 *Ichneostoma* 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. Surveys were conducted during August

2019 which includes a sub-optimal time of the year to find signs of animals such as invertebrates, signs of habitat sensitive plant species and vertebrate animal species high conservation priority. Weather conditions during the surveys were favourable for recording fauna and flora. The focus of the 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	The area proposed for the development is on gentle to moderate slopes.
Rockiness	No rocky ridges are present.
Presence of wetlands	No wetlands appear to be present at the footprint proposed for the development. A narrow non-perennial river is present at the southern limits of the site.
Vegetation	<p>Terrestrial vegetation at most of the site is a woodland with conspicuous presence of exotic trees. Extensive covers of <i>Pinus</i> species are in particular conspicuous at the site. Alien invasive tree species such as <i>Melia azedarach</i> are widespread at the site. Some indigenous tree species such as <i>Dombeya rotundifolia</i>, <i>Vachellia karroo</i>, <i>Ziziphus mucronata</i>, <i>Faurea saligna</i> and <i>Searsia lancea</i> are conserved at the site. Conspicuous exotic weeds at the site are <i>Flaveria bidentis</i>, <i>Tagetes minuta</i> (Khaki Weed), <i>Bidens bipinnata</i> (Black Jack), <i>Conyza bonariensis</i> (Flea Bane) and <i>Datura</i> (Thorn-apples) as well as shrubs such as <i>Solanum mauritianum</i> (Bugweed).</p> <p>Riparian vegetation at the site is ecologically disturbed but contains a number of indigenous plant species. The reed species <i>Phragmites mauritianus</i>, the grass <i>Imperata cylindrica</i>, the shrub <i>Buddleja salviifolia</i> as well as the tree species <i>Vachellia karroo</i> and <i>Combretum erythrophyllum</i> are all part of the indigenous component of the riparian vegetation at the site. Some bush encroachment by <i>Asparagus larinicus</i> occur along the riparian zone. Alien invasive <i>Melia azedarach</i> is also present at the riparian zone as well as exotic herbaceous species such as <i>Rumex crispus</i>.</p>
Signs of disturbances	Large parts of the site have buildings, associated roads, associated gardens and conspicuous cover of exotic plant species including <i>Pinus</i> species, <i>Melia azedarach</i> (<i>Syringa</i>) and <i>Solanum mauritianum</i> (Bugweed). Excavations have taken place at some areas at the site in the past.
Connectivity	Non-perennial river at the southern part of the site is a corridor of particular conservation concern.



Photo 1 Extensive covers of exotic *Pinus* species are present at the site.
Photo: R.F. Terblanche.



Photo 2 Section of the riparian zone at the site where some small indigenous *Combreton erythrophyllum* (River Bushwillow) trees are present.

Photo: R.F. Terblanche



Photo 3 Narrow active channel at the site.

Photo: R.F. Terblanche.



Photo 4 Soil auger and part of riparian zone at the site. Reddish-brown stems in the picture are those of young alien invasive *Melia azedarach* (*Syringa*) trees.
Photo: R.F. Terblanche



Photo 5 Soil sample at the riparian zone in close proximity of the narrow active channel (non-perennial river) at the site.
Photo: R.F. Terblanche.



Photo 6 Soil sample near the edge of the riparian zone at the site.
Photo: R.F. Terblanche



Photo 7 Indigenous reed species, *Phragmites mauritianus*, at the site.
Photo: R.F. Terblanche.



Photo 8 Indigenous grass species, *Imperata cylindrica*, at the riparian zone at the site.
Photo: R.F. Terblanche



Photo 9 Shoots of indigenous small tree, *Buddleja salviifolia*, at the site.
Photo: R.F. Terblanche.



Photo 10 Alien invasive weed *Datura stramonium* at the site.
Photo: R.F. Terblanche

4.2 ASSESSMENT OF PLANT SPECIES OF PARTICULAR CONSERVATION PRIORITY

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 which are listed in the **Critically Endangered** category. 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
<i>Brachystelma canum</i>	Critically Endangered	No
<i>Brachystelma gracillimum</i>	Critically Endangered	No

Table 4.3 Threatened plant species of the North West Province which are listed in the **Endangered** category. 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
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<i>Aloe peglerae</i>	Endangered	No
<i>Brachystelma discoideum</i>	Endangered	No

Table 4.4 Threatened plant species of the North West Province which are listed in the **Vulnerable** category. 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
<i>Brachycorythis conica</i> subsp. <i>transvaalensis</i>	Vulnerable	No
<i>Brachystelma incanum</i>	Vulnerable	No
<i>Ceropegia decidua</i> subsp. <i>pretoriensis</i>	Vulnerable	No
<i>Ceropegia stentiae</i>	Vulnerable	No
<i>Ledebouria atrobrunnea</i>	Vulnerable	No
<i>Marsilea farinosa</i>	Vulnerable	No
<i>Melolobium subspicatum</i>	Vulnerable	No
<i>Prunus africana</i>	Vulnerable	No
<i>Rennera stellata</i>	Vulnerable	No
<i>Searsia maricoan</i>	Vulnerable	No

Table 4.5 Near Threatened plant species of the North West 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
<i>Adromischus umbraticola</i> subsp. <i>umbraticola</i>	Near Threatened	No
<i>Ceropegia turricula</i>	Near Threatened	No
<i>Cineraria austrotransvaalensis</i>	Near Threatened	No
<i>Cleome conrathii</i>	Near Threatened	No
<i>Delosperma leendertziae</i>	Near Threatened	No
<i>Drimia sanguinea</i>	Near Threatened	No
<i>Elaeodendron transvaalense</i>	Near Threatened	No
<i>Kniphofia typhoides</i>	Near Threatened	No
<i>Lithops leslei</i> subsp. <i>leslei</i>	Near Threatened	No
<i>Nerine gracilis</i>	Near Threatened	No
<i>Sporobolus oxyphyllus</i>	Near Threatened	No
<i>Stenostelma umbelluliferum</i>	Near Threatened	No

Table 4.6 Plant species of the North West 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
<i>Gladiolus filiformis</i>	Critically Rare	No

Table 4.7 Plant species of the North West 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
<i>Brachystelma dimorphum</i> subsp. <i>gratum</i>	Rare	No
<i>Ceropegia insignis</i>	Rare	No
<i>Frithia pulchra</i>	Rare	No
<i>Gnaphalium nelsonii</i>	Rare	No
<i>Habenaria culveri</i>	Rare	No

Table 4.8 Plant species of the North West 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
<i>Boophone disticha</i>	Declining	No
<i>Crinum bulbispermum</i>	Declining	No
<i>Crinum macowanii</i>	Declining	No
<i>Drimia altissima</i>	Declining	No
<i>Eucomis autumnalis</i>	Declining	No
<i>Gunnera perpensa</i>	Declining	No
<i>Hypoxis hemerocallidea</i>	Declining	No
<i>Ilex mitis</i>	Declining	No
<i>Pelargonium sidoides</i>	Declining	No
<i>Vachellia erioloba</i>	Declining	No

4.2.2 Plant species of particular conservation concern: protected species

Table 4.9 Tree species of the North West Province which are listed as **Protected Species** under the National Forests Act No. 84 of 1998, Section 15(1). 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
<i>Boscia albitrunca</i> (Sheppard's tree)	Protected	No
<i>Sclerocarya birrea</i> (Marula)	Protected	No
<i>Vachellia erioloba</i> (Camel Thorn Tree)	Protected	No

4.3 ASSESSMENT OF VERTEBRATE SPECIES OF PARTICULAR HIGH CONSERVATION PRIORITY

4.3.1 Mammals of particular high conservation priority

Table 4.10 Threatened mammal species of the North West 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	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Chrysoxalax villosus</i> Rough-haired golden mole	Vulnerable	No	No
<i>Cloeotis percivali</i> Short-eared Trident Bat	Vulnerable/ Near-threatened	No	No
<i>Diceros bicornis</i> Black rhinoceros	Critically Endangered	No	No
<i>Lycaon pictus</i> African wild dog	Endangered	No	No
<i>Loxodonta africana</i> African elephant	Vulnerable	No	No
<i>Mystromys albicaudatus</i> White-tailed mouse	Endangered	No	No
<i>Neamblysomus julianae</i> Juliana's Golden Mole	Critically Endangered	No	No
<i>Panthera leo</i> Lion	Vulnerable	No	No
<i>Rhinolophus blasii</i> Blasi's Horseshoe Bat	Vulnerable	No	No



Table 4.11 Near threatened mammal species known to occur in the North West 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 to be found based on habitat assessment
<i>Ceratotherium simum</i> White Rhinoceros	Near threatened	No	No
<i>Manis temminckii</i> Ground Pangolin	Near threatened	No	No

Table 4.12 Data deficient (or uncertain) mammal species of the North West 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
<i>Myosorex varius</i> Forest shrew	Uncertain	No	No

4.3.2 Birds of particular high conservation priority

Table 4.13 Threatened bird species of the North West 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
<i>Aegypius tracheliotos</i>	Lappet-faced Vulture	Vulnerable	No	No
<i>Anthropoides paradiseus</i>	Blue Crane	Vulnerable	No	No
<i>Aquila rapax</i>	Tawny Eagle	Vulnerable	No	No
<i>Ardeotis kori</i>	Kori Bustard	Vulnerable	No	No
<i>Balearica regulorum</i>	Grey Crowned Crane (Mahem)	Vulnerable	No	No
<i>Botaurus stellaris</i>	Eurasian Bittern	Critically Endangered	No	No
<i>Circus ranivorus</i>	African Marsh- Harrier	Vulnerable	No	No
<i>Crex crex</i>	Corn Crake	Vulnerable	No	No
<i>Eupodotis senegalensis</i>	White-bellied Korhaan	Vulnerable	No	No

<i>Falco naumanni</i>	Lesser Kestrel	Vulnerable	No	No
<i>Geronticus calvus</i>	Southern Bald Ibis	Vulnerable	No	No
<i>Gorsachius leuconotus</i>	White-backed Night-heron	Vulnerable	No	No
<i>Gypaetus barbatus</i>	Bearded Vulture	Endangered	No	No
<i>Gyps africanus</i>	White-backed Vulture	Vulnerable	No	No
<i>Gyps coprotheres</i>	Cape Vulture	Vulnerable	No	No
<i>Pelecanus rufescens</i>	Pink-backed Pelican	Vulnerable	No	No
<i>Polemaetus bellicosus</i>	Martial Eagle	Vulnerable	No	No
<i>Rhynchops flavirostris</i>	African Skimmer	Endangered	No	No
<i>Sagittarius serpentarius</i>	Secretarybird	Vulnerable	No	No
<i>Sarothrura ayresi</i>	White-winged Flufftail	Critically Endangered	No	No
<i>Tyto capensis</i>	African Grass-Owl	Vulnerable	No	No

* Though some of the above bird species that roams over large areas may occasionally 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 4.14 Near threatened bird species of the North West 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
<i>Certhilauda chuana</i>	Short-clawed Lark	Near threatened	No	No
<i>Charadrius pallidus</i>	Chestnut-banded Plover	Near threatened	No	No
<i>Ciconia nigra</i>	Black Stork	Near threatened	No	No
<i>Circus macrourus</i>	Pallid Harrier	Near threatened	No	No
<i>Eupodotis caerulescens</i>	Blue Korhaan	Near threatened	No	No
<i>Falco biarmicus</i>	Lanner Falcon	Near threatened	No	No
<i>Falco peregrinus</i>	Peregrine Falcon	Near threatened	No	No
<i>Glareola nordmanni</i>	Black-winged Pratincole	Near threatened	No	No
<i>Leptoptilos crumeniferus</i>	Marabou Stork	Near threatened	No	No
<i>Mirafra cheniana</i>	Melodious lark	Near threatened	No	No
<i>Mycteria ibis</i>	Yellow-billed Stork	Near threatened	No	No
<i>Phoenicopterus minor</i>	Lesser Flamingo	Near threatened	No	No

<i>Phoenicopterus ruber</i>	Greater Flamingo	Near threatened	No	No
<i>Rostratula benghalensis</i>	Greater Painted-snipe	Near threatened	No	No
<i>Sterna caspia</i>	Caspian Tern	Near threatened	No	No

* Though some of the above bird species that roams over large areas may occasionally 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

The following tables list possible presence or absence of threatened reptile or near threatened reptile species in the study area. 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.

Table 4.15 Threatened reptile species in North West 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
<i>Crocodylus niloticus</i> Nile Crocodile	Vulnerable	No	No	No

Table 4.16 Near threatened reptile species in North West 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
<i>Homoroselaps dorsalis</i> Striped Harlequin Snake	Near threatened	No	No	No

4.3.4 Amphibian species of particular high conservation priority

Table 4.17 Near threatened amphibian species in North West 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
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				habitat assessment
<i>Pyxicephalus adspersus</i> Giant Bullfrog	Least Concern (IUCN) Remains a species of particular conservation concern.	No	No	No

4.4 ASSESSMENT OF INVERTEBRATE SPECIES OF PARTICULAR HIGH CONSERVATION PRIORITY

4.4.1 Butterflies of particular conservation priority

Table 4.18 Threatened butterfly species in North West 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
<i>Aloeides dentatis dentatis</i> Roodepoort Copper	Endangered	No	Highly unlikely
<i>Chrysoritis aureus</i> Golden Copper	Endangered	No	Highly unlikely
<i>Lepidochrysops praeterita</i> Highveld Blue	Endangered	No	Highly unlikely
<i>Orachrysops mijburghi</i> Mijburgh's Blue	Endangered	No	Highly unlikely

Table 4.19 Butterfly species of the North West Province and Gauteng Province that are not threatened and not near threatened but of which are of particular conservation concern and listed in the **Rare** 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
<i>Colotis celimene amina</i> Lilac Tip	Rare (Low density)	No	Unlikely
<i>Lepidochrysops procera</i> Savanna Blue	Rare (Habitat specialist)	No	Highly unlikely
<i>Metisella meninx</i> Marsh Sylph	Rare (Habitat specialist)	No	Highly unlikely
<i>Platylesches dolomitica</i>	Rare (low density)	No	Highly unlikely

Hilltop Hopper

4.4.2 Beetles of particular conservation priority

Table 4.20 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
<i>Ichneustoma stobbiai</i>	Uncertain	No	No
<i>Trichocephala brincki</i>	Uncertain	No	No

4.4.3 Scorpion species of particular conservation priority

Table 4.21 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
<i>Hadogenes gracilis</i>	Uncertain	No	No
<i>Hadogenes gunningi</i>	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 North West Province are listed in Tables 4.2 – 4.8. Protected tree species are listed in Table 4.9. The presence or not of all the species listed in the tables were investigated during the survey. None of the Threatened, Near Threatened plant species or any other plant species of particular conservation concern appear to be present at the site.

5.3 VERTEBRATES

5.3.1 Mammals

Table 4.10, Table 4.11 and Table 4.12 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 4.13 and Table 4.14 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 4.12 and Table 4.13 are on the particular likely dependence 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 4.15 and Table 4.16 list the possible presence or absence of threatened and near threatened reptile species on the site. The Southern African Reptile Conservation Assessment (SARCA) was launched in May 2005 (Branch, Tolley, Cunningham, Bauer, Alexander, Harrison, Turner & Bates, 2006). Its primary aim is to produce a conservation assessment for reptiles of South Africa, Lesotho and Swaziland within a four year period, ending 2009 (Branch *et al.*, 2006). Therefore a full up-dated conservation assessment of reptiles, taking into account the recent IUCN (2001) criteria, will only be available in the near future. While the conservation statuses of reptile species are under revision Alexander & Marais (2007) as well as Tolley & Burger 2007) give useful indications of possible red listings in the near future. There appears to be no threat to any reptile species of particular high conservation importance if the site is developed.

5.3.4 Amphibians

No frog species that occur in the North West are listed as Threatened species (Vulnerable, Endangered or Critically Endangered) or Near Threatened species according to IUCN Amphibian Specialist Group (2013). Table 4.17 lists *Ptychocheilus adspersus* (Giant Bullfrog) as Least Concern globally. According to the Biodiversity Management Directorate of GDARD (Gauteng Department of Agriculture and Rural Development) (2014) there are no amphibians in Gauteng that qualify for red listed status (red listed here indicates a category of special conservation concern such as threatened or near threatened). Suitable habitat for Giant Bullfrog at site appears to be absent.

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 (Deutshländer and Bredenkamp 1999; Edge 2005; Terblanche, Morgenthal & Cilliers 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 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 4.18 and Table 4.19) follows.

5.4.1.1 Assessment of threatened butterfly species

***Aloeides dentatis dentatis* (Roodepoort Copper)**

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.

***Chrysothrix aureus* (Golden Opal/ Heidelberg Copper)**

The proposed global red list status for *Chrysothrix aureus* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2013) *Chrysothrix aureus* (Golden Opal/ Heidelberg Copper) is a resident where the larval host plant, *Clusia 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 *Chrysothrix 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 *Chrysothrix 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.* In press.). Reasons for its rarity are poorly understood. It is highly unlikely that *Colotis celimene amina* would be resident 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 perceived 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.

5.4.2 Fruit chafer beetles

Table 4.20 lists the fruit chafer beetle species (Coleoptera: Scarabaeidae: Cetoniinae) that are of known high conservation priority in the North West Province. No *Ichnestoma stobbiai* or *Trichocephala brincki* were found during the surveys. There appears to be no suitable habitat for *Ichnestoma stobbiai* or *Trichocephala brincki* at the site. There appears to be no threat to any of the fruit chafer beetles of particular high conservation priority if the site were developed.

5.4.3 Scorpions

Table 4.21 lists the rock scorpion species (Scorpiones: Ischnuridae) that are of known high conservation priority in the North West Province. None of these rock scorpions have been found at the site and the habitat does not appear to be optimal.

5.5 Ecological Sensitivity at the site

Ecological sensitivity at most of the terrestrial zone at the site is low (for the developed areas) or medium (for the remainder). Ecological sensitivity at the non-perennial river is high because though it is disturbed and do not appear to contain threatened animal or plant species, it remains a very important conservation corridor and is also part of a River Freshwater Ecosystem Priority Area (River FEPA) (Nel *et al.*, 2011) (Figure 4).

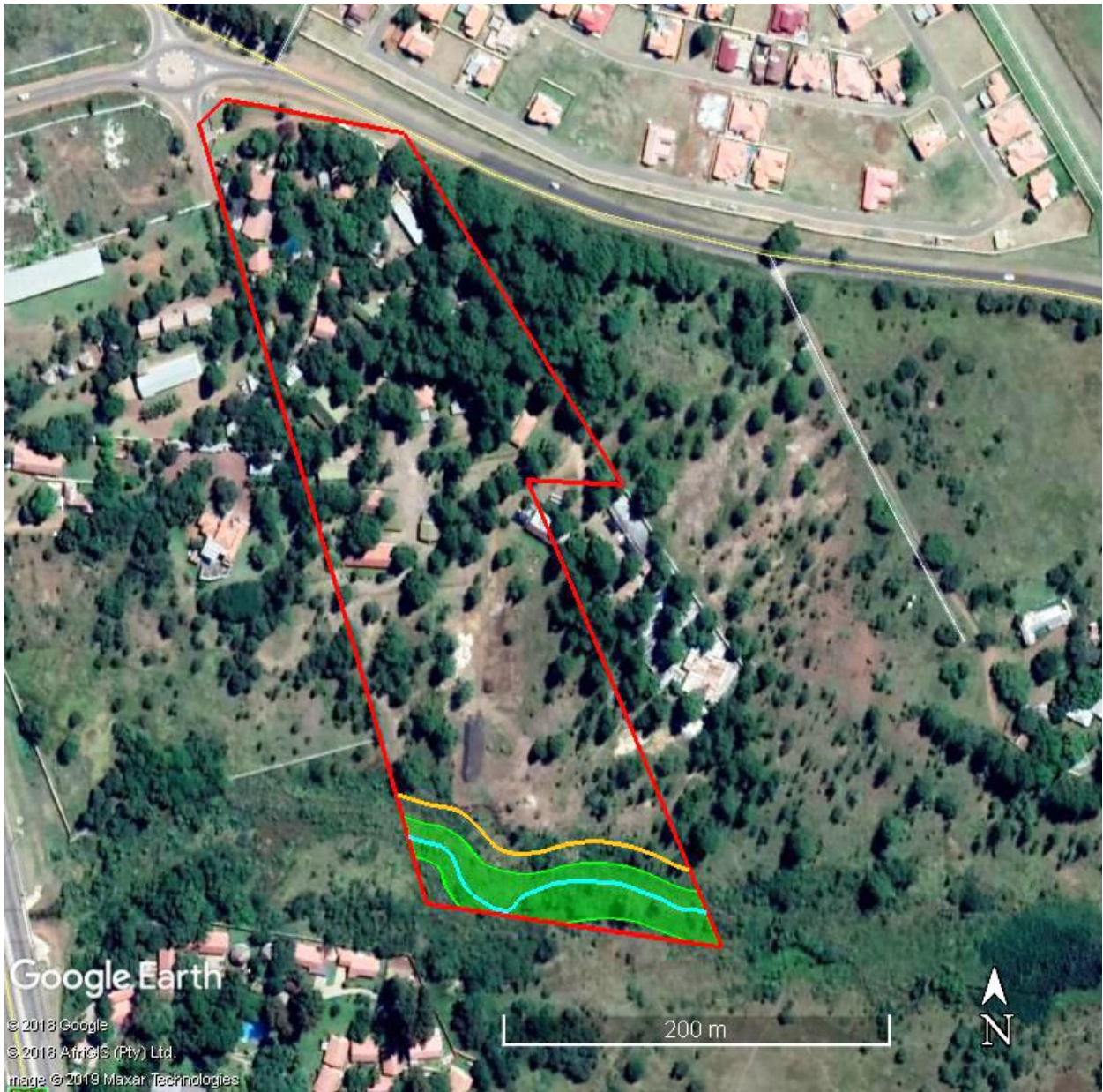


Figure 2 Indication of non-perennial river (active channel, riparian zone, buffer zone) at the site.




- | | | |
|---|---------------------------|-------------------------------------|
|  | Light blue outline | Route of active channel at the site |
|  | Green outline and shading | Riparian zone |
|  | Orange outline | Outer edge of buffer zone |



Figure 3 Indication of non-perennial river (active channel, riparian zone, buffer zone) at the site.








- | | | |
|---|---------------------------|-------------------------------------|
|  | Light blue outline | Route of active channel at the site |
|  | Green outline and shading | Riparian zone |
|  | Orange outline | Outer edge of buffer zone |



Figure 4 Indication of ecological sensitivity at the site.

- | | | |
|---|----------------------------------|------------------------|
|  | Red outline | Boundaries of the site |
|  | Light yellow outline and shading | Low Sensitivity |
|  | Orange outline and shading | Medium Sensitivity |
|  | Green outline and shading | High Sensitivity |

6 RISKS, IMPACTS AND MITIGATION

Background:

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; Edge, Cilliers & Terblanche, 2008). Furthermore, corridors and linkages may play a significant role in insect conservation (Pryke & Samways, 2003, Samways, 2005).

Urbanisation is a major additional influence on the loss of natural areas (Rutherford & Westfall 1994). In the South Africa the pressure to develop areas are high since its infrastructure allows for improvement of human well-being. Urban nature conservation issues in South Africa are overshadowed by the goal to improve human well-being, which focuses on aspects such as poverty, equity, redistribution of wealth and wealth creation (Cilliers, Müller & Drewes 2004). Nevertheless, the conservation of habitats is the key to invertebrate conservation, especially for those threatened species that are very habitat specific. This is also true for any detailed planning of corridors and buffer zones for invertebrates. Though proper management plans for habitats are not in place, setting aside special ecosystems is in line with the recent Biodiversity Act (2004) of the Republic of South Africa.

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). 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.

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

In the case of this study:

Large parts of the site have buildings, associated roads, associated gardens and conspicuous cover of exotic plant species including *Pinus* species, *Melia azedarach* (Syringa) and *Solanum mauritianum* (Bugweed). Excavations have taken place at some areas at the site in the past.

A non-perennial river, including its narrow active channel and riparian zone, is present at the site. Riparian vegetation at the site is ecologically disturbed but contains a number of indigenous plant species. The reed species *Phragmites mauritianus*, the grass *Imperata cylindrica*, the shrub *Buddleja salviifolia* as well as the tree species *Vachellia karroo* and *Combretum erythrophyllum* are all part of the indigenous component of the riparian vegetation at the site. Some bush encroachment by *Asparagus lariginus* occur along the riparian zone. Alien invasive *Melia azedarach* is also present at the riparian zone as well as exotic herbaceous species such as *Rumex crispus*.

Wetlands and rocky ridges appear to be absent at the site.

No Threatened or Near Threatened plant or animal species or any other plant and animal species of particular conservation concern appear to be resident at the site.

There is little scope for most of the site to be a corridor of particular conservation importance with the exception of the narrow watercourse. The non-perennial river, including its riparian zone and buffer zone, should be viewed as important part of linked conservation corridor in the larger area. This watercourse, the Waterkloofspruit, is part of a River FEPA (Freshwater Ecosystem Priority Area) (Nel *et al.*, 2011).

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 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 or low ecological sensitivity.
Status	Negative
Mitigation Required	Active channel and riparian zone with bufferzone are excluded from the development.
Impact Significance (Pre-Mitigation)	High
Impact Significance (Post-Mitigation)	Moderate
RISK	Following the mitigation measures a low risk of impact is expected.

Aspect/Activity	Removal of sensitive species
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Sensitive species: Presence of Threatened or Near-Threatened Plants, Mammals, Reptiles, Amphibians and Invertebrates or any other plant or animal species of particular conservation concern, at the site appear to be unlikely.
Status	Neutral.
Mitigation Required	No particular mitigation measures at the site apply for threatened species.
Impact Significance (Pre-Mitigation)	Low
Impact Significance (Post-Mitigation)	Low
RISK	Risks of impacts to sensitive species of particular conservation concern at the site appears to be low.

Aspect/Activity	Fragmentation of corridors of particular conservation concern
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	While there is little scope for most of the site to be part of a corridor of particular conservation importance, the narrow active channel and riparian zone should be viewed as an important conservation corridor in the larger area.
Status	Negative
Mitigation Required	Active channel and riparian zone with bufferzone are excluded from the development.
Impact Significance (Pre-Mitigation)	High
Impact Significance (Post-Mitigation)	Low
RISK	Following mitigation measures, a low 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 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 takes 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. It is in particular declared alien invasive species such as <i>Melia azedarach</i> (Syringa), <i>Solanum mauritianum</i> (Bugweed) or alien invasive Australian <i>Acacia</i> species (Australian Wattles) that should not be allowed to establish. Once established these 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. It is in particular declared alien invasive species such as <i>Melia azedarach</i> (Syringa), <i>Solanum mauritianum</i> (Bugweed) and alien invasive Australian <i>Acacia</i> species (Australian wattles) that should not be allowed to establish.
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	Keep disturbance to less sensitive area. Avoid watercourse and buffer zone.	High	Moderate	High
Loss of sensitive species	Loss of sensitive species (Note no Threatened species or Near-threatened species)	Neutral	Site	Long-Term	Very low (No species anticipated)	Unlikely	Not applicable	Not applicable	Not applicable at the site.	Low	Low	High
Loss of corridors of particular conservation concern	Fragmentation of landscape and loss of connectivity	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	Demarcate and avoid watercourse and buffer zone.	High	Low	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

6.5 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	Moderate	Low	High

6.5 Summary of risks and impacts

Large parts of the site have buildings, associated roads, associated gardens and conspicuous cover of exotic plant species including *Pinus* species, *Melia azedarach* (Syringa) and *Solanum mauritianum* (Bugweed). Excavations have taken place at some areas at the site in the past.

A non-perennial river, including its narrow active channel and riparian zone, is present at the site. Riparian vegetation at the site is ecologically disturbed but contains a number of indigenous plant species. The reed species *Phragmites mauritianus*, the grass *Imperata cylindrica*, the shrub *Buddleja salviifolia* as well as the tree species *Vachellia karroo* and *Combretum erythrophyllum* are all part of the indigenous component of the riparian vegetation at the site. Some bush encroachment by *Asparagus laricinus* occur along the riparian zone. Alien invasive *Melia azedarach* is also present at the riparian zone as well as exotic herbaceous species such as *Rumex crispus*.

Wetlands and rocky ridges appear to be absent at the site.

No Threatened or Near Threatened plant or animal species or any other plant and animal species of particular conservation concern appear to be resident at the site.

There is little scope for most of the site to be a corridor of particular conservation importance with the exception of the narrow watercourse. The non-perennial river, including its riparian zone and buffer zone, should be viewed as important part of linked conservation corridor in the larger area. This watercourse, the Waterkloofspruit, is part of a River FEPA (Freshwater Ecosystem Priority Area) (Nel *et al.*, 2011).

Ecological sensitivity at most of the terrestrial zone at the site is low and medium. Ecological sensitivity at the non-perennial river is high because of its importance as a conservation corridor and being part of a River FEPA.

The non-perennial river (with active channel, riparian zone and buffer zone) is regarded as an important conservation corridor in the larger area. Risks and possible impacts to the watercourses if the buffer zone is upheld, are not expected to be significant because excessive surface flow and erosion are not anticipated. There is no distinct indication that interflow plays an important role in the maintenance of the watercourse. The geomorphological setting and flow regime will not be impacted. Loss of any wetland animal or plant species 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

- The site consists of a large part that has been developed in the past and a remaining ecologically disturbed terrestrial zone as well as an ecologically disturbed riparian zone. Large parts of the site have buildings, associated roads, associated gardens and conspicuous cover of exotic plant species including *Pinus* species, *Melia azedarach* (*Syringa*) and *Solanum mauritianum* (Bugweed). Excavations have taken place at some areas at the site in the past.
- A non-perennial river, including its narrow active channel and riparian zone, is present at the site. Riparian vegetation at the site is ecologically disturbed but contains a number of indigenous plant species such as *Phragmites mauritianus*, *Imperata cylindrica*, *Buddleja salviifolia*, *Vachellia karroo* and *Combretum erythrophyllum*. Alien invasive *Melia azedarach* is also present at the riparian zone as well as exotic herbaceous species such as *Rumex crispus*.
- Site is part of the Crocodile (West) and Marico Water Management Area (WMA 3). The site is part of a River Freshwater Ecosystem Priority Area (River FEPA) (Nel *et al.*, 2011a, 2011b). The stream network in the catchment therefore need to be managed in a way that maintains a good condition of the river reach (Nel *et al.*, 2011). The River FEPA status also means that it is important to apply clearing of invasive alien plants and/or rehabilitation of river banks.
- No wetlands appear to be present at the site.
- No rocky ridges are present at the site.
- Savanna at the site is represented by the Moot Plains Bushveld vegetation type which is not listed as a threatened ecosystem (National List of Threatened Ecosystems, 2011).
- No Threatened or Near Threatened plant or animal species or any other plant or animal species of particular conservation concern appear to be resident at the site.
- There is little scope for most of the site to be part of a corridor of particular conservation importance with the exception of the non-perennial river with its riparian and buffer zone at the site.
- The non-perennial river, including its riparian zone and buffer zone, should be viewed as an important conservation corridor in the larger area. Given the likely absence of sensitive species as well as the location, setting and current ecological status of the site a 10 m buffer zone from the edge of the riparian zone is strongly recommended as a practical buffer zone for the conservation of the non-perennial river and riparian zone at the site.
- Ecological sensitivity at most of the terrestrial zone at the site is low and medium. Ecological sensitivity at the non-perennial river is high because of its importance as a conservation corridor and being part of a River FEPA.

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ANNEXURE 1: Plants

List of plant species recorded at the site.

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
GYMNOSPERMAE: CONNIFERS		
<i>Pinus species</i>	Pines	PINACEAE
ANGIOSPERMAE: MONOCOTYLEDONS		
<i>Albuca setosa</i>	Fibrous Slime Lily	HYACINTHACEAE
<i>Aristida adscensionis</i>	Annual Three-awn	POACEAE
<i>Aristida canescens</i>	Pale Three-awn	POACEAE
<i>Aristida congesta</i>	Three-awn	POACEAE
<i>Asparagus laricinus</i>	Common Wild Asparagus	ASPARAGACEAE
<i>Bulbine narcissifolia</i>		ASPHODELACEAE
<i>Chloris virgata</i>	Feather-top Chloris	POACEAE
<i>Commelina africana</i>		COMMELINACEAE
<i>Cynodon dactylon</i>	Couch Grass	POACEAE
<i>Digitaria eriantha</i>	Common Finger Grass	POACEAE
<i>Eleusine coracana</i>	Goose Grass	POACEAE
<i>Eragrostis curvula</i>	Weeping Love Grass	POACEAE
<i>Eragrostis lehmanniana</i>	Lehmann's Love Grass	POACEAE
<i>Heteropogon contortus</i>	Spear Grass	POACEAE
<i>Imperata cylindrica</i>	Cotton Wool Grass	POACEAE
<i>Melinis repens</i>	Natal Red Top	POACEAE
<i>Panicum maximum</i>		POACEAE
<i>Phragmites mauritianus</i>	Reed	POACEAE
<i>Pogonarthria squarrosa</i>	Herringbone Grass	POACEAE

<i>* Sorghum halepense</i>	Johnson Grass	POACEAE
<i>Themeda triandra</i>	Red Grass	POACEAE
<i>Urochloa panicoides</i>	Herringbone Grass	POACEAE
<i>Urochloa mosambicensis</i>	Bushveld Signal Grass	POACEAE
ANGIOSPERMS: DICOTYLEDONS		
<i>* Alternanthera pungens</i>	Duwweltjie	AMARANTHACEAE
<i>Alternanthera sessilis</i>		AMARANTHACEAE
<i>* Amaranthus deflexus</i>	Perrenial Pigweed	AMARANTHACEAE
<i>* Argemone ochroleuca</i>	White-flowered Mexican poppy	PAPAVERACEAE
<i>Berkheya radula</i>		ASTERACEAE
<i>* Bidens bipinnata</i>	Spanish blackjack	ASTERACEAE
<i>* Bidens pilosa</i>	Common blackjack	ASTERACEAE
<i>Buddleja salviifolia</i>	Sagewood	BUDDLEJACEAE
<i>Chamaecrista mimosoides</i>	Fishbone Cassia	CAESALPINIACEAE
<i>Chamaesyce hirta</i>	Red Milkweed	EUPHORBIACEAE
<i>Chamaesyce inaequilatera</i>	Smooth Creeping Milkweed	EUPHORBIACEAE
<i>* Chamaesyce prostrata</i>	Hairy Creeping Milkweed	EUPHORBIACEAE
<i>* Chenopodium album</i>	White Goosefoot	CHENOPODIACEAE
<i>Combretum erythrophyllum</i>	River Bushwillow	COMBRETACEAE
<i>* Convolvulus arvensis</i>	Field Bindweed	CONVOLVULACEAE
<i>Convolvulus sagittatus</i>		CONVOLVULACEAE
<i>* Conyza bonariensis</i>	Fleabane	ASTERACEAE
<i>Conyza podocephala</i>		ASTERACEAE
<i>Corchorus asplenifolius</i>		MALVACEAE
<i>* Datura ferox</i>	Large Thorn-apple	SOLANACEAE
<i>* Datura stramonium</i>	Common Thorn-apple	SOLANACEAE
<i>Dichrostachys cinerea</i>	Sicklebush	FABACEAE
<i>Dombeya rotundifolia</i>	Wildpear	PENTAPETACEAE
<i>Gazania krebsiana</i> subsp. <i>krebsiana</i>		ASTERACEAE
<i>Gerbera viridifolia</i> subsp. <i>viridifolia</i>		ASTERACEAE
<i>Gymnosporia buxifolia</i>	Spikethorn	CELASTRACEAE
<i>Gomphocarpus fruticosus</i>	Milkweed	APOCYNACEAE

* <i>Gomphrena celosioides</i>	Bachelor's Button	AMARANTHACEAE
* <i>Eucalyptus camaldulensis</i>	River Red Gum	MYRTACEAE
<i>Faurea saligna</i>	Boekenhout	PROTEACEAE
<i>Felicia muricata</i>		ASTERACEAE
* <i>Hibiscus trionum</i>	Bladder hibiscus	MALVACEAE
* <i>Jacaranda mimosifolia</i>	Jacaranda	BOGNONIACEAE
<i>Limeum viscosum</i>		MOLLUGINACEAE
* <i>Ludwigia adscendens</i>	Willowherb	ONAGRACEAE
* <i>Malva parviflora</i>	Small Mallow	MALVACEAE
* <i>Medicago laciniata</i>	Little Burweed	FABACEAE
* <i>Melia azedarach</i>	Seringa	MELIACEAE
* <i>Melilotus albus</i>	Bokhara Clover	FABACEAE
<i>Monsonia angustifolia</i>	Crane's Bill	GERANIACEAE
<i>Nidorella anomala</i>		ASTERACEAE
* <i>Opuntia ficus-indica</i>	Sweet Prickly Pear	CACTACEAE
* <i>Oxalis corniculata</i>	Creeping Sorrel	OXALIDACEAE
<i>Pentarrhinum inspidum</i>	African Heartvine	APOCYNACEAE
<i>Persicaria species</i>	Knotweed	POLYGONACEAE
* <i>Plantago lanceolata</i>	Narrow-leaved plantain	PLANTAGINACEAE
* <i>Portulaca oleracea</i>	Purslane	POLYGONACEAE
* <i>Richardia brasiliensis</i>	Mexican Richardia	RUBIACEAE
* <i>Rumex crispus</i>	Curly Dock	POLYGONACEAE
* <i>Schkuhria pinnata</i>	Dwarf Marigold	ASTERACEAE
<i>Searsia lancea</i>	Karree	ANACARDIACEAE
<i>Searsia leptodictya</i>	Mountain Karee	ANACARDIACEAE
<i>Senecio coronatus</i>	Sybossie	ASTERACEAE
<i>Senecio consanguineus</i>	Starvation Senecio	ASTERACEAE
* <i>Solanum mauritianum</i>	Bugweed	SOLANACEAE
<i>Solanum panduriforme</i>	Poison Apple	SOLANACEAE
* <i>Tagetes minuta</i>	Khakiweed	ASTERACEAE
<i>Teucrium trifidum</i>		LAMIACEAE
<i>Thesium</i> sp.		SANTALACEAE
<i>Tipuana tipu</i>	Tipu Tree	FABACEAE

<i>Tribulus terrestris</i>	Devil's Thorn	ZYGOPHYLLACEAE
<i>Vachellia karroo</i>	Sweet Thorn	FABACEAE
<i>Vachellia tortilis</i> subsp. <i>heteracantha</i>	Umbrella Thorn	FABACEAE
* <i>Verbena aristigera</i>	Fine-leaved Verbena	VERBENACEAE
* <i>Verbena bonariensis</i>	Purple top	VERBENACEAE
<i>Ziziphus mucronata</i>	Buffalo-thorn	RHAMNACEAE