# Ecological Assessment for the proposed construction of a 90MW PV Solar Park on a portion of the farm Weltevreden 746-LS, Polokwane Local Municipality, Limpopo

Prepared by

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Commissioned by

**PHAKANANI ENVIRONMENTAL**

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To Phakanani Environmental

We have the pleasure in submitting herewith our report as requested and as per your correspondence and appointment in October 2017. This study has been carried out in accordance with regulations stated in *DEAT (2005) Guideline 3: General Guide to the Environmental Impact Assessment Regulations, 2005, Integrated Environmental Management Guideline Series, Department of Environmental Affairs and Tourism (DEAT), Pretoria.*

The aim of this report was to:

1. Identify detrimental environmental impacts brought about by the proposed construction of a 90MW PV Solar Park project and associated infrastructure.
2. Provide the client with a description of the potential status of threatened species and habitats that could be potentially suitable for their presence in the survey area.
3. Provide an overall description of the biological diversity on the survey area.
4. Provide a detailed description of the ecological status of the survey area.
5. Provide recommendations for the long term management of the survey area.

Habitat is suitable for the presence of eight species of conservation concern in the survey area. This does not include avifauna, as this is addressed in a separate report. One of these species was directly observed during the survey period, namely the TOPS registered scorpion *Opistophthalmus glabrifrons*. The eight species are tabled below:

| Taxonomic group | Critically endangered | Endangered | Threatened | Near threatened | Vulnerable |
|---|---|---|---|---|---|
| Plantae | 2 | 1 | | 1 | |
| Mammalia | | | | 1 | 1 |
| Arachnida | | | 1 | | |
| Reptilia | | | | | |
| Amphibia | | | 1 | | |

Two mammals of conservation concern are listed for the grid reference 2329 CD. Brown hyena (*Parahyaena brunnea*) should not be considered as resident but may transit the survey area for occasional foraging. It is unlikely that they occur in the survey area, as no tracks or scats were been observed. Although habitat is suitable for the presence of Juliana's golden mole (*Neamblysomus julianae*), the species was not observed, nor was any mole activity detected.

Two plants, *Euphorbia clivicola* and *E. groenewaldii* are listed as *Critically Endangered* (http://posa.sanbi.org). However, no specimens of either species were observed during the survey. Although *Euphorbia clivicola* and *E. groenewaldii* are listed to occur in the grid reference, 2329CD, no suitable habitat was observed in the survey area.

*Euphorbia clivicola* survives in only two populations, 38 km apart: one in Percy Fyfe Nature Reserve southwest of Polokwane and the other in an urban area on the outskirts of Polokwane (Pfab & Witkowski 1998). Fewer than ten individuals of the Percy Fyfe population currently exist, mainly because game trample and overgraze the area. This survey area constitutes an unfavourable habitat

as these plants grow in a veld type known as “sour bushveld derived from white quartzite stones” (Dyer 1951).

*E. groenewaldii* occurs in isolated populations in the peri-urban (semi-rural) areas of Ga Mothiba and Dalmada. Although this plant is endemic to the Polokwane area it is most unlikely that any population exists in the survey area. These human settlements lie well to the north and north-east of the site, respectively. Moreover, they grow on rocky outcrops, in between rocks, and on small granite hills. These hills and rocky outcrops are more reminiscent of the Mamabolo Mountain Bushveld (SVcb24) (Mucina & Rutherford 2006), which occurs on main isolated hills and small mountains embedded within the Polokwane Plateau. No such habitats (granite hills and/ or rocky outcrops) occur in the survey area, although one rocky outcrop just outside the south western boundary of the survey area.

Urban expansion, quarrying, and trampling and over-grazing by cattle are important contributing factors to the decline in the distribution range of *E*. *groenewaldii*. These activities have continued in and adjacent to the survey area for some time, which has caused habitat modification, and transformation of the survey area.

One *Endangered* plant *Ledebouria crispa* (http://posa.sanbi.org) is listed to occur in the grid reference, 2329CD, however it almost certainly does not occur within the boundaries of the survey site. This species is highly localized and known from only a few locations in the hills east of the city of Polokwane. It occurs on rocky ridges where it is usually found between schist rocks sometimes hidden under vegetation. Such habitat does not occur in the survey area.

The *Near Threatened* species *Adenia fruticosa* does not occur in the survey area although it is listed for the grid 2329CD. It occupies a range Strydpoort Mountains southwards to Ohrigstad and the Steelpoort River Valley. It occurs in habitats characterised by arid woodland, rocky outcrops, slopes and sandy flats, on dolomite, granite and quartzite. Such habitats are not found in the area.

The TOPS listed scorpion *Opistophthalmus glabrifrons* was observed in the survey area. The small size of invertebrates relative to mammals enables them to adapt better to habitat modification. There is also a sufficient food resource (mainly insects) in the survey area on which scorpions can survive. Dispersal to new suitable habitats should not be as much of a challenge at this micro-ecological scale, as it would for much larger vertebrates.

Concerted efforts to locate the protected frog *Pixicephalus adspersus* were unsuccessful. Little rain had fallen by at the time the survey was conducted, which might have contributed to no bullfrogs being present. Furthermore, the only area of the survey site in which they could occur is the transformed vegetation unit (unit 2), which contains man-made dams. Man-made wetlands (such as these dams) do contribute to creating habitats to aquatic taxa that inhabit these ecosystems, where natural pans have been destroyed. However, these dams are overrun by alien invasives and very shallow due to silt deposition from the nearby silicon smelter, thus creating unfavourable conditions for *P*. *adspersus* in which to survive. No reptiles of conservation concern occur within the boundaries of the survey area.

Approximately 85% of the survey area (unit 1) is comprised of Polokwane Plateau Bushveld that remains in a largely natural condition. This vegetation unit is considered as Least Concern, however only 2% is statutorily conserved and approximately one third of Polokwane Plateau Bushveld is considered as degraded. Unit 1 land is used mainly for cattle grazing by local communities. There are however few signs of overgrazing and relatively few alien invasive plants occur in unit 1 of the survey area. Soil erosion in unit one is minimal. The property is fenced; however, access can easily be obtained through holes in this fence line or by simply climbing over dilapidated sections. Signs of snaring were evident towards the northeast of the survey area, where rural communities reside.

Ninety-five percent of the survey area is located within a CBA1. The survey area is located adjacent to a mine to the south-west and a silicon smelter to the east. For this reason, a small portion of the site has been transformed from Polokwane Plateau Bushveld into an artificial wetland, which is heavily invaded by alien plant species. The remainder of the site is considered to be a CBA2. The urgent environmental issue on the property is the proliferation of exotic tree species in unit 2. The removal of these species should be considered a high priority. Soil erosion is prominent in this area. As long as the mining and smelting activities are practised on neighbouring properties, it is highly unlikely that this portion of the survey site will be restored to the original vegetation type.

LDEDET considers CBA 1's to be irreplaceable and necessary to meet conservation targets. CBA 2's are considered as best design sites required to meet biodiversity targets. The survey area has been assigned a high conservation priority by LDEDET because it's a buffer zone to a protected area, namely the Polokwane Nature Reserve.

There is however limited connectivity between the survey area and the Polokwane Nature Reserve. The connection point between the survey area and the reserve is comprised of severely degraded mining areas, a smeltering plant, Silicon Road and habitat that has been transformed by the seepage of mine water into the survey area as well as invasion by exotic species. Nevertheless, despite the survey area being encircled by public roads to the west, agricultural holdings to the south and east, urbanised areas to the north and mines to the west, there is a degree connectivity with other natural stands of Polokwane Plateau Bushveld. These stands of natural vegetation indirectly connect the survey area to Polokwane Nature Reserve. A decision on whether the proposed development should be approved will depend on LDEDET priorities. The question at hand will be whether the provincial demand for clean energy should be prioritised over the necessity to maintain a natural buffer zone surrounding a small municipal reserve.

# CONTENTS

# BIODIVERSITY AND SUSTAINABLE DEVELOPMENT

Biodiversity is the variability among living organisms on earth, including the variability within and between species and within and between ecosystems. The biodiversity of Limpopo province is under constant threat from human settlement and societal development. Natural land is being degraded and transformed by the rapid expansion of human settlements as well as the establishment of mines, manufacturing plants, storage dams, transport and agricultural infrastructure. The loss, fragmentation and degradation of natural habitat through urbanisation and exponential human population growth, represent the greatest threats to biodiversity in Limpopo province.

Sustainable development is an evolving concept, which is continually being redefined and reinterpreted and should form the basis of the planning processes of new developments. Reducing the burden of environmental impacts is necessary if development is to become sustainable. The process of planning new developments should be based on scientific, ecological principles and used as a planning tool to promote sustainable development by integrating environmental considerations into a wide range of proposed actions. Development proposals should not undermine critical resource and ecological functions. These proposals should improve the way environmental resources are utilised as well as the well-being, lifestyle and livelihood of the communities who depend on them.

According to NWDCE (2008) sustainable development refers to “the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations”. It rests on three namely economic viability, social equity and ecological integrity (Figure 4.). To ensure that sustainable development is achieved it is critical that government has strategies and policies in place that dictate the rate of consumption of non-renewable and renewable resources, thereby ensuring ecosystem integrity whilst still providing the necessary services to humans.


**Figure 1.** The three pillars on which sustainable utilisation and therefore economic viability rests.

Any strategy aimed at ensuring sustainable development must, according to the European Commission (1993), focus on maintaining overall quality of life (for all living organisms), guarantee continued access to these natural resources and avoid permanent damage to ecosystems. The European commission further stresses three important elements of such programmes:

1. Preventative action should be preferable to remedial measures;
2. Environmental damage should be restored at the source and;
3. The transgressor should pay the cost of corrective measures taken to protect/restore the environment.

Although the Department of Environmental Affairs and Tourism (DEAT) has developed a national Framework to improve communication between organs of state and the public and to provide sufficient information for decision-making for development, it is important that each province define their own set of priorities to ensure sustainable development and utilisation of its natural resources. From a national perspective, Section 24 of the constitution of RSA enshrines the right to - The Environment. Everyone has the right:

1. to an environment that is not harmful to their health or well-being; and

2. to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that
   a) prevent pollution and ecological degradation;
   b) promote conservation; and
   c) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

3. Sustainable development requires the consideration of all relevant factors including the following:
   a) That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimized and remedied;
   b) that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimized and remedied;
   c) that the disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or where it cannot be altogether avoided, is minimized and remedied;
   d) that waste is avoided, or where it cannot be altogether avoided, minimized and reused or recycled where possible and otherwise disposed of in a responsible manner;
   e) that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
   f) that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardized;
   g) that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
   h) that negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimized and remedied.

# PROJECT BACKGROUND AND STUDY AREA

Jeka Resources (Pty) Ltd has appointed Phakanani Environmental to undertake an EIA process for the proposed construction of a 90MW PV solar park project and associated infrastructure on a portion of the farm Weltevreden 746-LS, within the Polokwane Local Municipality, Limpopo.

The proposed project triggers the following activities:

- Activities 11 and 29 (ii) in GN R.327 under Listing Notice 1;
- Activities 1 and 15 in GN R.325 under Listing Notice 2; and
- Activities 4 and 12 GN R.324 under Listing Notice 3.

On the 6th of October 2017 Phakanani Environmental requested an ecological survey of the property to gauge what environmental impacts may result from these construction activities. This ecological survey has been carried out with a special focus on:

1. providing the client with a detailed description of the ecological status of the survey area;
2. identifying potential species of conservation concern and habitat that could be potentially suitable for their presence in the areas where developments are to take place on the Farm Weltevreden 746-LS, in the Polokwane Local Municipality.

This will include:

1. a vegetation assessment
2. preparation of a plant species list
3. preparation of faunal species list for species observed and those likely to occur in the study area
4. an environmental sensitivity map
5. a description of impacts on fauna and flora
6. recommendations for long-term management of natural areas.

**Location of the study area:** The Farm Weltevreden 746-LS is located about 8 km from Polokwane city centre, in Limpopo (Figure 2). The site is accessible via a road that leads to the Polokwane Game Reserve and Silicon Smelter, which turns off the R71 road. The construction of a solar park will take place within a Critical Biodiversity Area 1 (CBA 1) as per the Limpopo Conservation Plan (refer to figure 3).

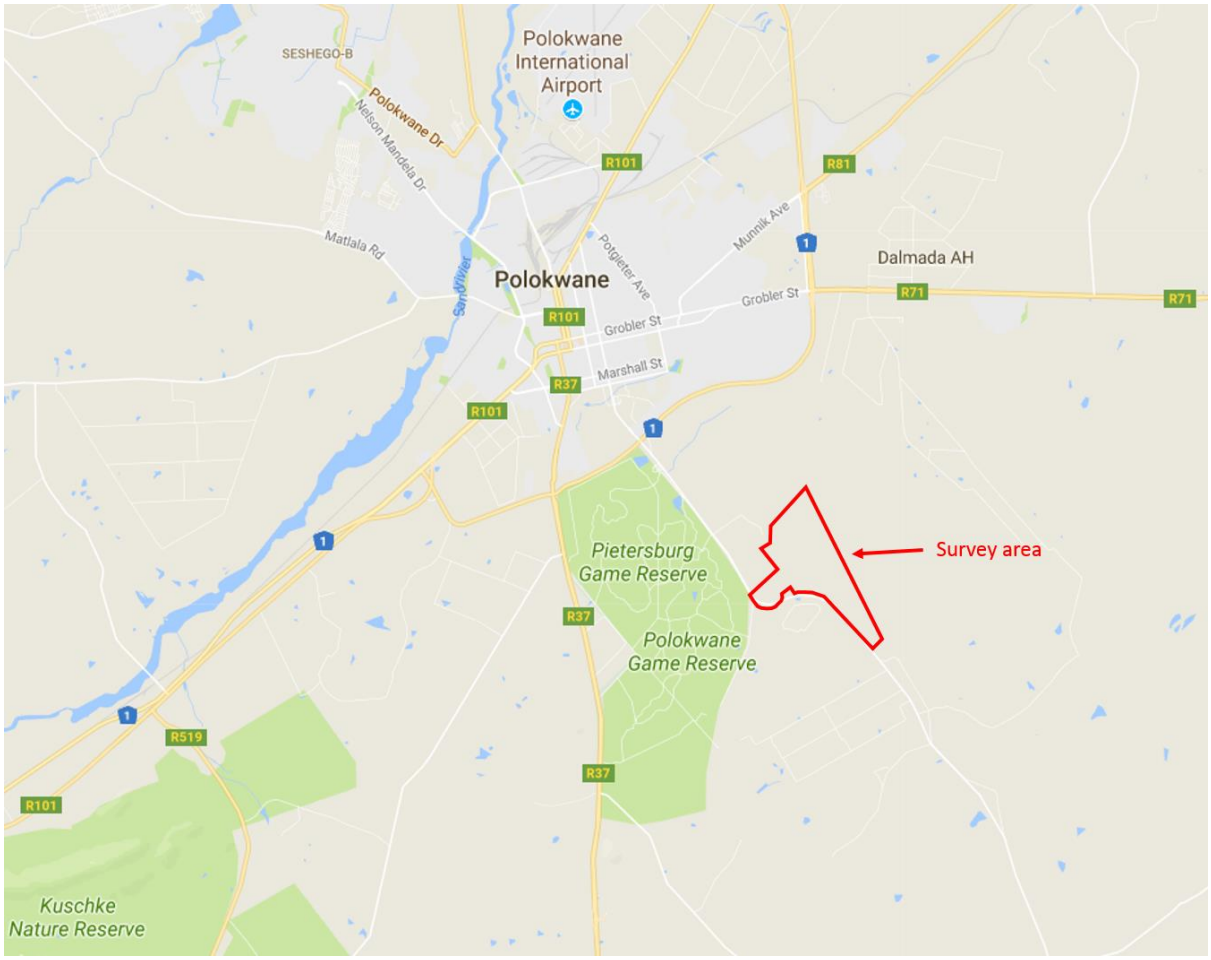


**Figure 2.** The location of the survey area.

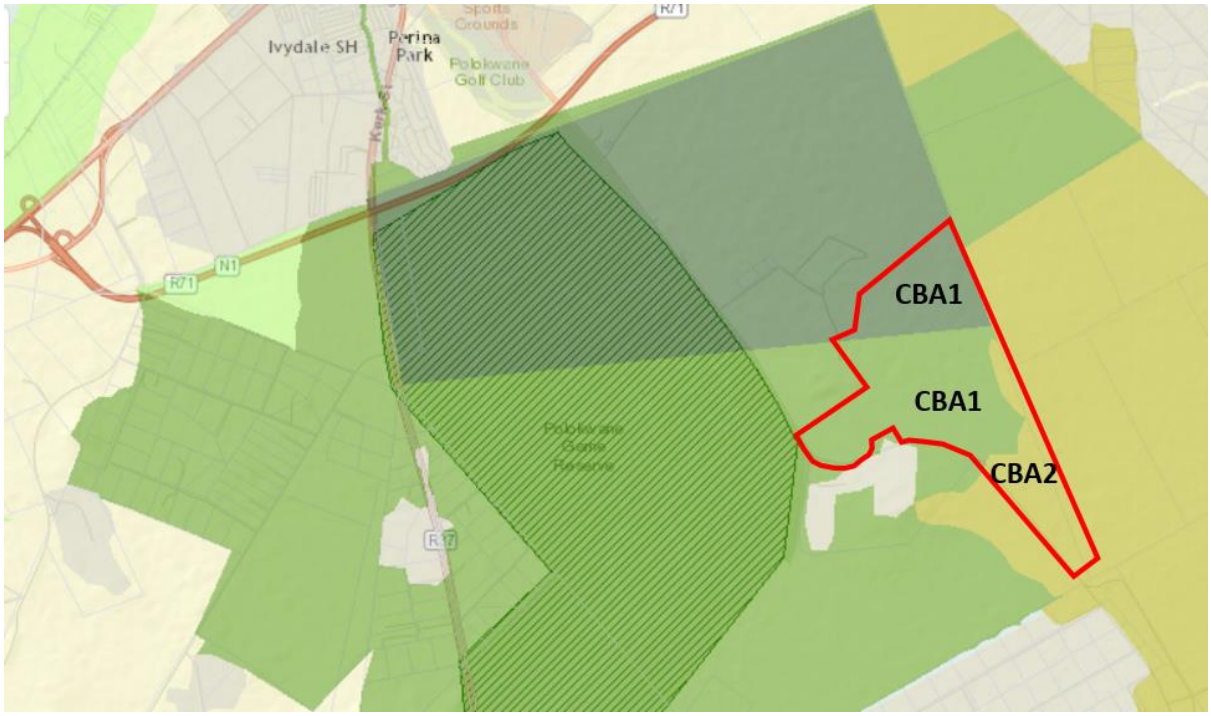


**Figure 3.** Location of the proposed development area within the Limpopo Conservation Plan.

**Duration of survey:** The site visit was carried out on 15th, 16th and 17th October 2017 soon after the first spring rains were recorded for the area. The site visit was performed by Cornel du Toit. Vincent van der Merwe visited the survey area on the 13th October 2017. The purpose of these site visits was to become acquainted with the development area, to document faunal and plant diversity and to investigate the possibility of species of conservation concern or sensitive habitat being impacted by listed activities on the site. Invertebrate and plant diversity documented during the survey was limited by the fact that the site visits took place shortly after the first summer rains.

**Conditions during survey:** Conditions for an ecological survey were satisfactory. The study area had received some early summer rainfall prior to the site visit. Temperatures exceeded 25°C during the site visit and it was sunny with no cloud cover during the sampling effort. Invertebrate activity was low due to the survey period (early summer). Few plant species were flowering and identification was sometimes challenging. Follow up site visits after good summer rains would be preferable to enable a more complete list of plant and invertebrate species to be recorded.

**Topography and land use:** The survey area is a moderately undulating plain that slopes downwards in a south westerly direction, at about 1100m above sea level (a.s.l.). The majority of the Farm Weltevreden 746-LS is used to graze cattle, except for the south western portion, which is wedged between a silicon smelter and a mining site. Several drainage ponds were built in this section and mine dumps flank this area to the west. Thus, economic activities take place in the larger, relatively natural portion of the survey area, away from the smelter and mine. These economic activities include only subsistence cattle farming. Most of the anthropogenic disturbance is concentrated in the south-western section, where the vast majority of the site has been transformed by alien invasives and dam building activities. This resulted in the transformation of the Polokwane Plateau Bushveld that is the only vegetation type on the Farm Weltevreden 746-LS. The exotic trees *Eucalyptus* spp. and *Melia azedarach* have become established in this portion of the survey area. Elements of Polokwane Plateau Bushveld have persisted away from the dams and dense eucalypt stands.

**Geology and soils:** Migmatites and gneisses of the Hout River Gneiss and the Turfloop Granite are dominant. Some ultra-mafic and mafic metavolcanics, quartzite and chloride schists of the Pietersburg group are present. Soils are variable (freely drained soils) with Mispah and Glenrosa soil forms. (Mucina & Rutherford 2006).

**Climate:** Summer rainfall with very dry winters. Mean Annual Precipitation is approximately 400mm per year in the northwest to about 600mm where it borders the foot of mountains to the east. The highest monthly rainfall is recorded in December and January. Almost no precipitation occurs in winter. Mean Annual Temperature is 16.9 ºC. Frost is fairly infrequent. The survey area has low climatic variation due to the homogenous nature of the study site.

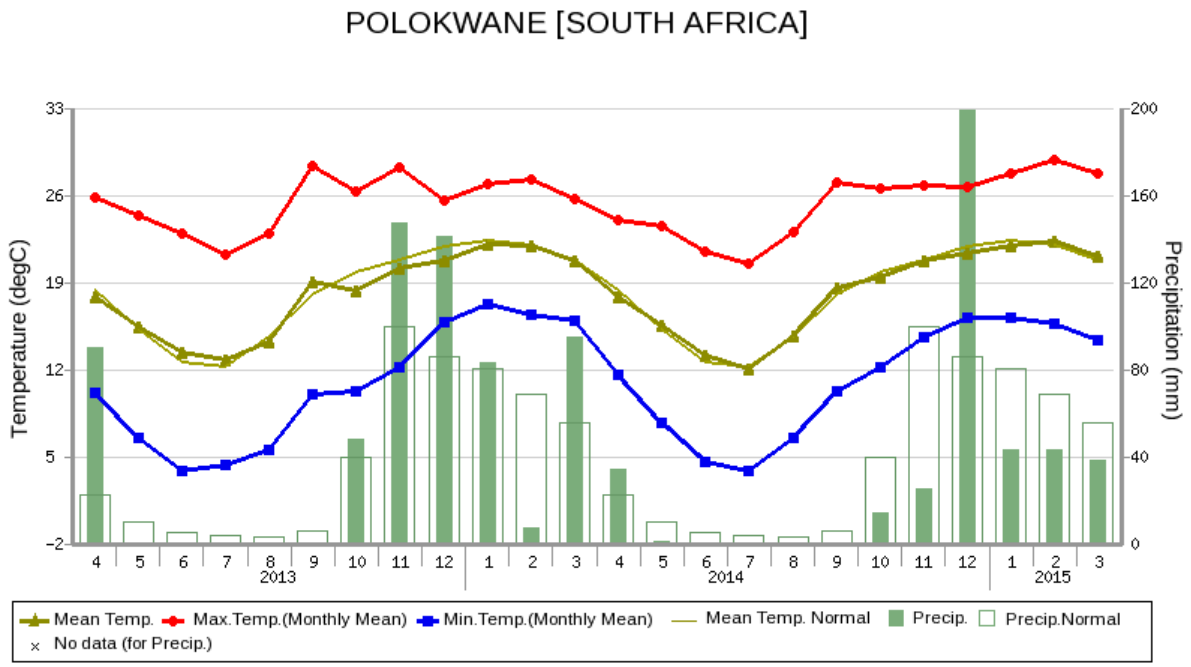


**Figure 4.** Climate data values for the survey area.

**Picture 1.** The majority of the survey area is comprised of natural vegetation that has not been heavily impacted by human activities.

# VEGETATION OF THE SURVEY AREA

This chapter provides a general overview of the vegetation observed in the survey area with reference to the different plant communities present, their species composition, and diversity. Initial information for this chapter was obtained from published scientific literature and was supplemented by data collected during the site visit.

**Vegetation types:** Vegetation is the most physical representation of the environment. Each plant community possesses its own specific plant species composition and structure, which is the result of the environmental conditions of its habitat (climate, geology, topography, soil, drainage, water regime, etc.). This total physical environment of an area is therefore manifested in the plant species composition, named the vegetation or plant community of the area. These plant communities may, however, also be influenced by historical land use activities, and management of the area. The ecological integrity of each plant community, with regards to providing habitats for animals, carrying capacity, resilience to anthropogenic modification (e.g. agricultural practices), and stochastic events (such as flood and drought) is a direct result of the combined influence of environmental factors and past management practices. The habitat and environmental conditions influence ecological succession, species composition and distribution, of the plant communities. Each plant community (ecosystem) also has its own specific conservation potential, need and status. A thorough inventory of the plant communities and their associated habitats will therefore provide information on the conservation status of an area.

**Methodology:** The Braun-Blanquet survey technique to describe plant communities as ecological units was used for this study. It allows for the mapping of vegetation and the comparison of the data with similar studies in the area. The study area was delineated into different vegetation units using an aerial photograph and then surveyed on foot. Sampling plots were placed out on a stratified random basis to represent all the different vegetation units. Within each plot all the species present were identified and listed and their canopy cover estimated. Environmental data such as rockiness, slope and aspect were also listed.

**Data recorded:** A list of all plant species present, including trees, shrubs, grasses, forbs, geophytes and succulents were compiled. All identifiable plant species were listed. Notes were additionally made of any other features that might have an ecological influence.

**Data processing:** Vegetation data were classified to identify, describe and map vegetation types. Descriptions of the plant communities include the tree, shrub and herbaceous layers. The conservation priority of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the Polokwane area.

The following four conservation priority categories were used for each vegetation unit / plant community:

**High:** Area with high species richness and habitat diversity; presence of viable populations of red data plant species OR suitable habitat for such species; presence of unique habitats; less than 5% pioneer/alien plant species present. These areas are ecologically valuable and important for ecosystem functioning. This land should be conserved and managed and is not suitable for development purposes.

**Medium-high:** An area with a relatively natural species composition; not a threatened or unique ecosystem; moderate species and habitat diversity; between 5-20% pioneer/alien plant species present; that would need moderate to low financial input to rehabilitate to an improved condition; and where low density development could be considered under exceptional conditions with limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation are maintained**.**

**Low-medium:** Area with relatively natural vegetation, though a common vegetation type; moderate to low species and habitat diversity; previously or currently degraded or in secondary successional phase; between 20-50% pioneer and/or alien plant species; low ecosystem functioning; low rehabilitation potential.

**Low:** A totally degraded and transformed area with a low habitat diversity and ecosystem functioning; no viable populations of natural plants; >50% pioneer and/or alien plant species present; very low habitat uniqueness; whose recovery potential is extremely low; and on which development could be supported with little to no impact on the natural vegetation / ecosystem.

The following **Agricultural Potential** categories were utilised:

**High:** The deep loamy soil has a high potential for cultivation of crops.

**Medium:** The shallow soil has a medium potential for cultivation of crops.

**Low:** The shallow, rocky soil has little or no potential for cultivation of crops, and can be used for grazing only.

The survey area is located within the Savanna Biome of southern Africa and specifically within the Central Bushveld (SVcb) (Mucina & Rutherford 2006). A bioregion is a composite terrestrial unit that is defined on the basis of broadly similar biotic and physical features. The vegetation of the location where the solar park will be built, is classified as Polokwane Plateau Bushveld (SVcb23) (Mucina & Rutherford 2006). This vegetation unit was previously classified as Pietersburg Plateau Grassveld (50%) (VT 67) by Acocks (1953); and Mixed Bushveld (88%) (LR 18) by Low & Rebelo (1996).

Polokwane Plateau Bushveld is currently listed as least threatened (as from remote sensing data). About 2% is statutorily conserved in mainly three nature reserves. While the conservation target is 19%, almost 17% of this vegetation unit is considered as being transformed. Land transformation is caused mainly by cultivation practices (10%) and 6% results from the expansion of human settlements (urban and rural) (Musina & Rutherford 2006). Recent urban expansion occurred in the north western parts; and rural human settlements are burgeoning in a densely concentrated region in the east of this vegetation unit. Erosion potential is high to moderate (Mucina & Rutherford 2006).

Alien invasive plants grow in scattered populations in some regions of this unit. Plants of concern include the species: *Agave* spp., *Jacaranda mimosifolia*, *Melia azedarach*, *Opuntia ficus-indica*, and *Rhicinus communis*.

Two vegetation types were identified during the survey:

1. Polokwane Plateau Bushveld
2. Transformed Marsh Zone

**Figure 5**. Large amounts of litter and building rubble have been dumped along Silicon Road, on the southern boundary of the survey area.

1.Polokwane Plateau Bushveld

| | | | |
|---|---|---|---|
| **Mapping unit** | 1 | **Tree cover** | >10% |
| **Soil** | Soils variable. Glenrosa and Mispah soil forms | **Shrub cover** | <5% |
| **Rock cover** | Low | **Herb cover** | <5% |
| **Topography** | Slightly undulating plain. About 1100m a.s.l. | **Grass cover** | >80% |
| **Status:** | The vegetation unit is largely natural although some areas are invaded by alien plant species and low levels of over grazing by cattle | | |
| **Ground cover of site:** | 65% | | |
| **Need for rehabilitation:** | Removal of exotic vegetation, implement adequate measures to prevent erosion. Litter removal. | | |
| **Agricultural potential:** | Low | | |
| **Conservation priority:** | Medium-High | | |

This vegetation unit comprises of a moderately undulating plain with short open tree layer with a well-developed grass layer and a grass plain with occasional trees. Vegetation unit 1 covers most of the survey site, except for a small area in the south-western portion. Although this unit is largely naturally intact, some anthropogenic disturbances are evident. These disturbances include (1) the establishment of roads and other agricultural infrastructure (cattle feeding troughs), (2) the erection of power lines, (3) dumping of litter, and (4) invasion by alien and invasive species. Low levels of over grazing by cattle are evident. Although alien and invasive species were observed, the level of invasion by these species is relatively low.

Four plant species of conservation interest occur in the vegetation type:

- Critically endangered: *Euphorbia clivicola* and *E. groenewaldii*. However, these species are very unlikely to occur on the study site due to the fact that few rocky areas are located in the area earmarked for development. Mamabolo Mountain Bushveld, located immediately south east of the survey area may constitute suitable habitat.

- Endangered: *Ledebouria crispa*
- Near Threatened: *Adenia fruticosa*

None of the above mentioned species were observed in this unit during the survey.

Table 1. Plant species identified in unit 1 during the survey (invasive species bolded).

| Trees | Shrubs | Graminoids | Climbers | Herbs |
|---|---|---|---|---|
| *Acacia caffra* | *Lippia javanica* | *Panicum maximum* | *Rubia petiolaris* | *Hypoxis hemerocallidea* |
| *Acacia karroo* | *Seersia pyroides* | *Aristida congesta* | *Asparagus africanus* | *Eulophia petersii* |
| *Acacia tortilis* | *Triumfetta pilosa* | *Hyparrhenia hirta* | | *Felicia mossamedensis* |
| *Acacia rehmanniana* | *Anthospermum rigidum* | *Eragrostis curvula* | | *Aloe greatheadii* |
| *Acacia permixta* | *Gymnosporia glaucophylla* | *Themeda triandra* | | ***Bidens pilosa*** |
| *Aloe marlothii* | *Senecio burchelli* | *Cymbopogon excavates* | | ***Tagetes minuta*** |
| *Ziziphus mucronata* | *Solanum panduriforme* | *Cynodon dactylon* | | |
| *Combretum molle* | *Helichrysum spp.* | *Digitaria diagonalis* | | |
| *Seersia lancea* | ***Opuntia stricta*** | ***Eragrostic curvula*** | | |
| *Gymnosporia senegalensis* | ***Ricinus communis*** | ***Urchloa mosambicensis*** | | |
| *Diospyros lycioides* | ***Seriphium plumosum*** | ***Sporobolus africanus*** | | |
| *Euclea crispa* | | ***Sorghum bicolor*** | | |
| *Ehritia rigida* | | | | |
| *Dombeya rotundifolia* | | | | |
| *Peltophorum africanum* | | | | |
| *Dichrostachys cinerea* | | | | |
| ***Melia azedarach*** | | | | |
| ***Agave sisalana*** | | | | |
| ***Cereus jamarca*** | | | | |

**Conclusion:**

- Despite anthropogenic disturbance, this vegetation unit remains in a relatively natural condition.
- This vegetation type is classified as Least Threatened.
- Indirectly, there is a degree of connectivity with larger portions of Polokwane Plateau Bushveld to the South of the survey area, where it is separated from the Polokwane Nature Reserve by two fences and the Silicon Road.
- This unit is regarded as having **Medium-High conservation value**.

## 2. Transformed Marsh Zone

| | | | |
|---|---|---|---|
| **Mapping unit** | 2 | **Tree cover** | ±60% |
| **Soil** | Soils variable. Glenrosa and Mispah soil forms | **Shrub cover** | ±10% |
| **Rock cover** | <5% | **Herb cover** | ±10% |
| **Topography** | Moderately undulating marshy area, about 1100m a.s.l. | **Grass cover** | ±20% |
| **Status:** | Transformed marshy area characterised by man-made dams that are filled by mine seepage water and severely invaded by alien plant species. | | |
| **Ground cover of site:** | >90% | | |
| **Need for rehabilitation:** | Removal of alien invasive plant species. | | |
| **Agricultural potential:** | Low | | |
| **Conservation priority:** | Low | | |

This vegetation unit was formerly comprised of Polokwane Plateau Bushveld. Due to its proximity to a silicon smelter and an adjacent mine the area had become completely transformed by the construction of man-made dams and rubble heaps. Alien invasive plants, mainly *Eucalyptus* sp., abound in this unit. These factors have facilitated the transition of Polokwane Plateau Bushveld into a transformed marsh vegetation. The restoration of this unit back to Polokwane Plateau Bushveld is unlikely. However, the regulation of the water levels in the ponds (dams) and eradication of all alien and invasive plants should go a long way in restoring some of the ecological integrity of the unit. This unit has a relatively low species richness. No plant species of conservation concern were observed.

Table 2. Plant species identified in unit 2 during the survey (invasive species bolded).

| Trees | Shrubs | Graminoids | Climbers | Herbs |
|---|---|---|---|---|
| *Acacia tortilis* | *Gymnosporia senegalensis* | *Themeda triandra* | | *Hypoxis hemerocallidea* |
| *Acacia rhemanniana* | *Diospyros lycioides* | *Panicum maximum* | | *Aloe greatheadii* |
| *Acacia caffra* | *Lippia javanica* | *Hyparrhena hirta* | | *Typha capensis* |
| *Combretum molle* | *Seersia pyroides* | *Eragrostis gummiflua* | | *Cyperus spp.* |
| ***Melia azedarach*** | | | | ***Bidens pilosa*** |
| ***Eucalyptus*** spp. | | | | |

**Conclusion:**

- This unit is in a transformed state and very few elements of the original Polokwane Plateau Bushveld remain.
- Alien vegetation is abundant in this south-western corner of this unit, outcompeting indigenous woody vegetation. These alien elements should be cleared and the area rehabilitated as a high priority.
- The artificial wetland areas provide habitat for a large variety of bird, insect and amphibian species. For this reason, the artificial wetland areas should not be considered for development.
- This unit is currently a mosaic of transformed marshland and Polokwane Plateau Bushveld. It should be regarded as having **low-medium conservation value** because it is invaded by alien plant species, mainly *Eucalyptus* spp.

**Picture 2.** Portions of unit two are comprised of artificial dams that have been heavily invaded by *Typha capensis.*

**Picture 3.** Transformed marshy area with a large and dense *Eucalyptus* stand.

**Picture 4.** One of the artificial dams with exotic vegetation.

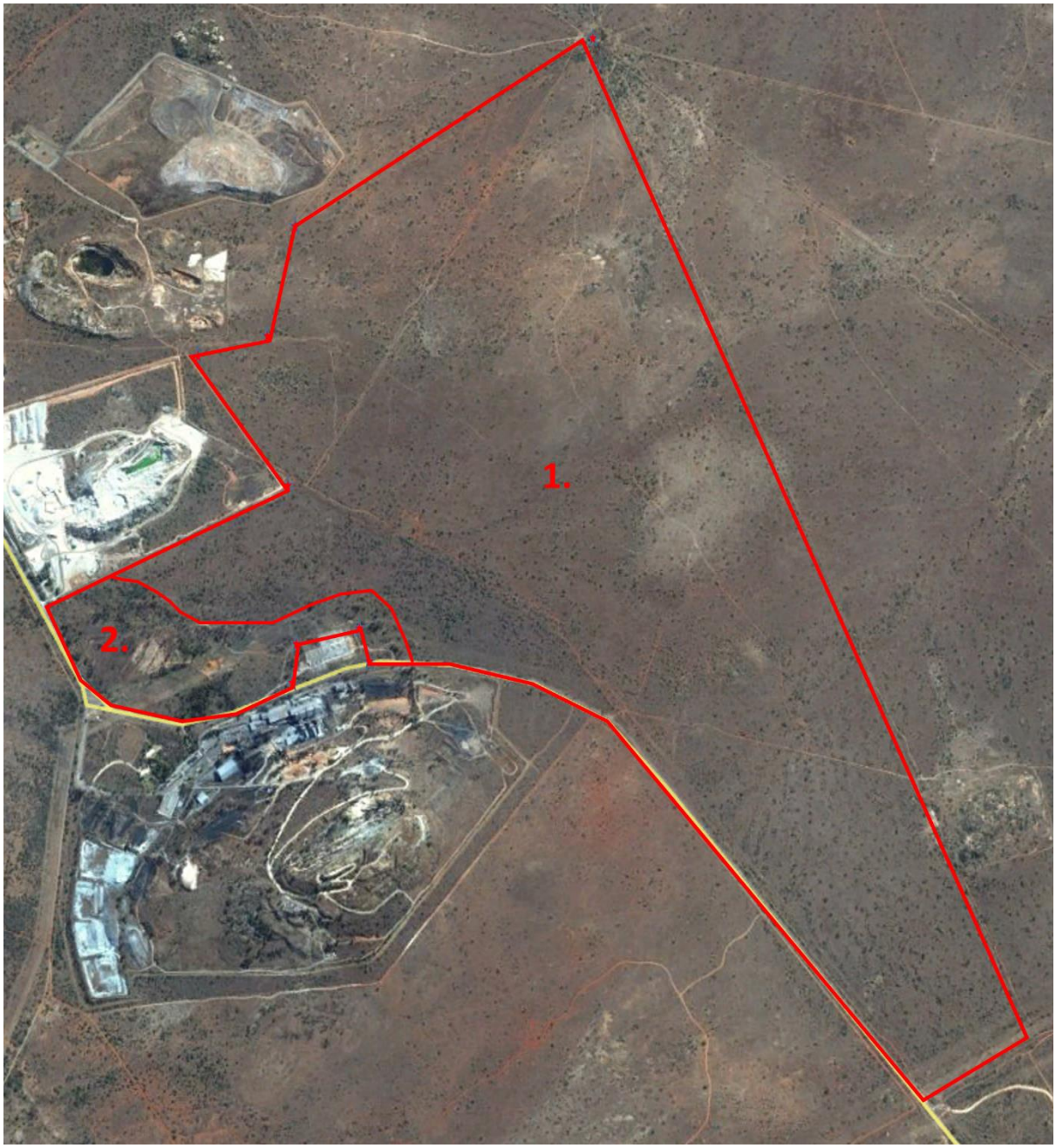


**Figure 4.** Map indicating the different vegetation units in the survey area namely (1) Polokwane Plateau Bushveld, (2) Transformed Marsh Zone.

# MAMMALS OF THE SURVEY AREA

**Small mammals:** Most small mammals are primary consumers and represent the primary prey items of many carnivores, including raptors and medium-sized mammals. They are abundant in many ecosystems and serve many important ecological roles in terms of influencing their prey and their predators. Sherman live trapping was the core survey method utilised.

Sherman traps were deployed along selected transects. Traps were placed near to features such as logs, burrows, rock piles, termite mounds, the base of trees, runways around burrows and almost always in an area that provided cover from weather (e.g. under shrubs, in tall grass). Traps were permanently marked or recorded with a GPS so that they could be relocated with ease. Bait was comprised of dry oats mixed with peanut butter and golden syrup.

A nocturnal survey was carried out on the 15th October 2017. Only one bat species could be identified, however several ground dwelling mammals were either directly observed or heard.

**Medium and large mammals:** For larger mammals visual encounters of the actual animal as well as spoor or tracks, scat, foraging marks were noted and used for species identification. Evidence of the presence of 9 mammal species was observed in the survey area, although habitat is suitable for a number of other species. Many of the large herbivores that occur in the neighbouring Polokwane Nature Reserve, do not occur in the survey area. This is due to cattle grazing the area (competition), probable due to poaching for subsistence, and the modified and degraded state of the environment.

Table 3. Mammal species occurring */or likely to occur in the survey area.

| Family | Common name | Genus | Species | Conservation status |
|---|---|---|---|---|
| Bovidae | Steenbok | *Raphicerus* | *campestris* | Least concern |
| Bovidae | Bush Duiker* | *Sylvicapra* | *grimmia* | Least concern |
| Bovidae | Bushbuck | *Tragelaphus* | *scriptus* | Least concern |
| Bovidae | Greater Kudu* | *Tragelaphus* | *strepsiceros* | Least concern |
| Canidae | Black-backed Jackal* | *Canis* | *mesomelas* | Least concern |
| Cercopithecidae | Vervet Monkey* | *Cercopithecus* | *pygerythrus* | Least concern |
| Chrysochloridae | Juliana's Golden Mole | *Neamblysomus* | *julianae* | Least concern |
| Herpestidae | Marsh Mongoose | *Atilax* | *paludinosus* | Least concern |
| Herpestidae | Slender Mongoose* | *Herpestes* | *sanguineus* | Least concern |
| Hyaenidae | Brown Hyena | *Hyaena* | *brunnea* | Least concern |
| Hystricidae | Cape Porcupine* | *Hystrix* | *africaeaustralis* | Least concern |
| Pedetidae | South African Spring Hare* | *Pedetes* | *capensis* | Least concern |
| Sciuridae | Smith's Bush Squirrel* | *Paraxerus* | *cepapi* | Least concern |
| Suidae | Common Wart-hog | *Phacochoerus* | *africanus* | Least concern |
| Vespertilionidae | Cape Serotine* | *Neoromicia* | *capensis* | Least concern |

Table 4. Red listed mammal species likely to occur within the survey area.

| Family | Common name | Genus | Species | Conservation status |
|---|---|---|---|---|
| Hyaenidae | Brown hyena | *Hyaena* | *brunnea* | Near Threatened |
| Chrysochloridae | Juliana's golden mole | *Neamblysomus* | *julianae* | Vulnerable |

# REPTILES OF THE SURVEY AREA

**Introduction:** Most current knowledge of the reptiles of Limpopo is based on a survey performed by N.H.G Jacobsen (1989) providing a detailed account of all reptiles in the then Transvaal province. This survey resulted in descriptions of life histories, habitat requirements, the conservation status and maps of known distributions. Jacobsen's (1989) survey revealed that 154 reptile species occur in Limpopo Province including 86 species that are threatened mainly due to habitat destruction and habitat fragmentation. This survey focused on species that are largely restricted to Limpopo province. Reptile lists require intensive surveys conducted over several years. Reptiles are extremely secretive and are difficult to observe even during intensive field surveys conducted over several seasons.

**Methods**

**Visual encounter surveys:** This method entails actively searching suitable habitat components including turning over logs and loosely embedded rocks, searching crevices in rocks and bark and replacing all surface objects after examining the ground beneath. Logs, termite mounds and other substrates are not torn apart to minimize disturbance to important habitat elements in the sample unit. Observers note only presence of individuals or signs, and identify the detection to the most specific taxonomic level possible. Specimens are only captured when necessary to confirm identification. The detection of rare species should be documented by taking a picture of the individual, being careful to display diagnostic characters of the species. Voucher specimens may be required to confirm identification of rare species that are difficult to identify. No spotlight surveys were undertaken during nocturnal hours.

**Pitfall and funnel traps:** Pitfall traps are commonly used sampling techniques that are highly effective at surveying herpetofaunal communities. The use of pitfall traps is likely to substantially increase to number of amphibian, invertebrate and reptile species detected. They can be successfully used to detect a broad array of species although arboreal species and species with good climbing/jumping ability are often missed. Many different configurations of pitfall arrays have been used in reptile studies; the pitfall array described here is suitable for most sites.

Each pitfall trap array consisted of six pitfall traps and six funnel traps set in a triangular pattern and connected by 5m long drift fences. Drift fences are effective at increasing capture rates in pitfall traps. Two arrays were established in vegetation units one and two. These arrays were set up in randomly selected areas that were considered representative of the unit and easily accessible for monitoring.

No reptiles of conservation concern occur or were observed in the survey area. Information on the reptiles that occur in the grid reference 2329 was obtained from the ADU. Although not all these species are likely to occur in the survey area. The list is representable of the general region, including Polokwane Game Reserve and Kuschke Nature Reserve.

Table 5. Reptile species occurring/or likely to occur in the survey area.

| Family | Genus | Species | Common name | Red list category |
|---|---|---|---|---|
| Agamidae | *Agama* | *aculeata* | Distant's Ground Agama | Least Concern (SARCA 2014) |
| Chamaeleonidae | *Chamaeleo* | *dilepis* | Common Flap-neck Chameleon | Least Concern (SARCA 2014) |
| Colubridae | *Dasypeltis* | *scabra* | Rhombic Egg-eater | Least Concern (SARCA 2014) |
| Colubridae | *Philothamnus* | *semivariegatus* | Spotted Bush Snake | Least Concern (SARCA 2014) |
| Cordylidae | *Cordylus* | *vittifer* | Common Girdled Lizard | Least Concern (SARCA 2014) |
| Cordylidae | *Platysaurus* | *intermedius* | Common Flat Lizard | Least Concern (SARCA 2014) |
| Elapidae | *Naja* | *mossambica* | Mozambique Spitting Cobra | Least Concern (SARCA 2014) |
| Gekkonidae | *Chondrodactylus* | *turneri* | Turner's Gecko | Least Concern (SARCA 2014) |
| Gekkonidae | *Hemidactylus* | *mabouia* | Common Tropical House Gecko | Least Concern (SARCA 2014) |
| Gekkonidae | *Lygodactylus* | *capensis* | Common Dwarf Gecko | Least Concern (SARCA 2014) |
| Lacertidae | *Nucras* | *holubi* | Holub's Sandveld Lizard | Least Concern (SARCA 2014) |
| Lamprophiidae | *Aparallactus* | *capensis* | Black-headed Centipede-eater | Least Concern (SARCA 2014) |
| Lamprophiidae | *Atractaspis* | *duerdeni* | Duerden's Stiletto Snake | Least Concern (SARCA 2014) |
| Lamprophiidae | *Boaedon* | *capensis* | Brown House Snake | Least Concern (SARCA 2014) |
| Lamprophiidae | *Lycophidion* | *capense* | Cape Wolf Snake | Least Concern (SARCA 2014) |
| Lamprophiidae | *Prosymna* | *bivittata* | Two-striped Shovel-snout | Least Concern (SARCA 2014) |
| Lamprophiidae | *Psammophis* | *brevirostris* | Short-snouted Grass Snake | Least Concern (SARCA 2014) |
| Lamprophiidae | *Psammophylax* | *tritaeniatus* | Striped Grass Snake | Least Concern (SARCA 2014) |
| Lamprophiidae | *Pseudaspis* | *cana* | Mole Snake | Least Concern (SARCA 2014) |
| Pythonidae | *Python* | *natalensis* | Southern African Python | Least Concern (SARCA 2014) |
| Scincidae | *Trachylepis* | *punctatissima* | Speckled Rock Skink | Least Concern (SARCA 2014) |
| Testudinidae | *Stigmochelys* | *pardalis* | Leopard Tortoise | Least Concern (SARCA 2014) |
| Typhlopidae | *Afrotyphlops* | *schlegelii* | Schlegel's Beaked Blind Snake | Least Concern (SARCA 2014) |
| Typhlopidae | *Rhinotyphlops* | *lalandei* | Delalande's Beaked Blind Snake | Least Concern (SARCA 2014) |
| Varanidae | *Varanus* | *albigularis* | Rock Monitor | Least Concern (SARCA 2014) |
| Viperidae | *Bitis* | *arietans* | Puff Adder | Least Concern (SARCA 2014) |

# AMPHIBIANS OF THE SURVEY AREA

**Introduction:** Global amphibian diversity has declined dramatically in recent decades. Amphibians are considerably more threatened than both mammals and birds, although comparisons with other taxa are confounded by a shortage of reliable data. Although habitat loss has played a significant role in this decline, recent research has focused on the effects of environmental contaminants, UV-B irradiation, emerging diseases, introduction of alien species, direct exploitation and climate change.

Evidence for a countrywide decline in frog populations in South Africa is lacking. Among the threats faced by amphibians in southern Africa, the most frequently implicated is habitat destruction resulting from wetland drainage, afforestation, crop farming, invasive alien vegetation, and urbanisation. Like other animals, amphibians are also susceptible to viruses, fungi as well as parasitic infections by protozoans and various helminths. Most frogs are intimately associated with wetlands. Although no amphibians were recorded during the survey, most amphibian diversity in the survey area should be located close to the transformed marshy area.

Amphibians are an important component of South Africa's exceptional biodiversity and are worthy of both research and conservation effort. The fact that most amphibians have a semi-permeable skin makes then particularly vulnerable to pollutants and other environmental stresses. Frogs especially are useful environmental bio-monitors and act as an early warning system for the quality of the environment.

**Methods:** Several survey methods can be employed to obtain amphibian species inventories. These include visual encounter surveys (VES) of the terrestrial and aquatic habitats, diurnal road surveys for live and road-killed specimens, and anuran call surveys at selected breeding habitats (diurnal. However, it is preferable to carry out amphibian survey after a rainfall event. A concerted effort as made to locate specimens of *Pixicephalus adspersus*, a Near Threatened species well known to occur in the vicinity of the survey area. No specimens were observed.

Table 6. Amphibian species occurring/likely to occur in the survey area.

| Family | Genus | Species | Common name | Red list category |
|---|---|---|---|---|
| Breviceptidae | *Breviceps* | *adspersus* | Bushveld Rain Frog | Least Concern |
| Bufonidae | *Schismaderma* | *carens* | Red Toad | Least Concern |
| Bufonidae | *Sclerophrys* | *garmani* | Olive Toad | Least Concern |
| Bufonidae | *Sclerophrys* | *gutturalis* | Guttural Toad | Least Concern |
| Hyperoliidae | *Hyperolius* | *marmoratus* | Painted Reed Frog | Least Concern |
| Hyperoliidae | *Kassina* | *senegalensis* | Bubbling Kassina | Least Concern |
| Microhylidae | *Phrynomantis* | *bifasciatus* | Banded Rubber Frog | Least Concern |
| Pipidae | *Xenopus* | *laevis* | Common Platanna | Least Concern |
| Pyxicephalidae | *Cacosternum* | *boettgeri* | Common Caco | Least Concern |
| Pyxicephalidae | *Pyxicephalus* | *adspersus* | Giant Bull Frog | Near Threatened |
| Pyxicephalidae | *Tomopterna* | *tandyi* | Tandy's Sand Frog | Least Concern |

# INVERTEBRATE DIVERSITY OF THE SURVEY AREA

**Introduction**: Invertebrates dominate terrestrial and freshwater ecosystems, with insects being the most speciose class, comprising more than 75% of all known species in the Animal Kingdom. Insects, myriapods and arachnids form part of the diverse and essential natural processes that sustain biological systems. The insect-plant interaction is the most common biotic interaction on Earth, and indeed, our present ecosystems would not function without these invertebrates. The worldwide Red List of Threatened Species (http://www.iucnredlist.org/) contains approximately 560 insects. This is a meagre 7% of the faunal list, which when one considers that insects make up over 70% of the world's fauna, is tremendously biased. In a study carried out by Black and Vaughn (2003), it was noted that of the world's insects, very few groups have been assessed on a worldwide scale. Approximately 10% of Swallowtail butterflies, for example, are considered globally threatened. Based on a mathematical model, McKinney (2003), predicted that 10% of all butterflies were threatened strongly contrasting the 1% currently listed. At National levels, figures between 10% and 34% are given for the number of threatened indigenous insect species, suggesting that the overall number of threatened insect species could be in excess of 100, 000. Globally countries such as Australia, France, Spain, the United States and South Africa have among the highest numbers of threatened invertebrates. This is however, more a reflection of the effort made by these countries to assess their biodiversity and hence distinguish those that are threatened rather than a true overall indication.

Invertebrates have an enormous functional value because of the numerous individuals and the great intra - and interspecific variety. The ecological importance of this great variety of invertebrates makes them valuable to assess disturbances or environmental impacts. A sound knowledge of arthropods is crucial to the conservation and management of ecosystems because a skewed focus only on the larger organisms will misrepresent ecosystem dynamics. The lack of human appreciation of the importance of invertebrates and their general disregard and dislike, coupled to the fact that only about 7-10% of insects are scientifically described, must be overcome to realistically conserve biodiversity.

**Methodology:** Invertebrates were sampled using active and passive methods. Active methods entail collection by an individual using various kinds of equipment, while passive methods involve specialised types of traps at specific sites in the field, which are visited at given time intervals.

**Passive collection**

- Pitfall traps
    - Ten pitfall traps were placed ten meters apart, in a single transect in units 1 and 2.

The pitfall traps were baited with rotting fruit as well as fresh cattle dung. The plastic buckets used for traps had a 1000 mL capacity and were 11 cm in diameter and 12 cm deep. All the traps were sunk into the ground so that the buckets' rims were level with the soil surface. Buckets were filled to about one fifth their volumes with a solution of liquid soap and water to immobilise trapped invertebrates. Trap contents were collected 24 hours after the traps had been set. Only insects and arachnids were

collected from the traps. Specimens of interest were preserved in absolute ethanol and transported to the laboratory for identification. Morphospecies were identified to order level and family level where possible.

**Active collection**

- Sweepnetting

*Ad hoc* sweepnetting was carried out in randomly chosen sites throughout the survey. An insect net with a diameter of 40 cm were used for collecting insects and arachnids. Where necessary, insects and arachnids from the samples were preserved in absolute ethanol and transported to the laboratory for identification. Morphospecies were identified to order level and family level where possible.

- Physical searches

Physical ground and rock searches were undertaken in order to identify arachnids, scorpions and various insects which take refuge underground in burrows or under rocks. Data recorded and red data species

A list of all identifiable insects and arachnids caught or seen on the site was compiled and is documented below:

## Class Insecta

**Dragonflies and damselflies**

**Order Odonata**

**Suborder Anisoptera**

Family Gomphidae

*Ceratogomphus pictus*

No Odonatan species of conservation concern were observed in the survey area. All members of this order are excellent flyers. All adults are day flying and predatory. The order has a strong association with water as all immature odonatan's are aquatic. Most specimens were observed in close vicinity to the transformed marsh zone. Approximately 160 species occur in southern Africa. There are no Odonatan species of conservation concern recorded for Limpopo.

**Cockroaches**

**Order Blattodea**

Family Blaberidae

*Bantua* spp.

*Derocalymma* sp.

There are no cockroach species of conservation concern recorded for Limpopo. This order of nocturnal insects feed on a wide range of foodstuffs. All 6 known families occur in the southern Africa and members of 1 family were observed in the survey area.

**Termites**

**Order Isoptera**

Family Termitidae

*Trinervitermes* sp.

*Odontotermes* sp.

*Macrotermes* sp.

There are no termite species of conservation concern recorded for Limpopo. These social insects live in mounds where there is a division of labour amongst the four castes (morphological). The King and Queen casts are the primary reproductives whilst workers can be either male or female but are sterile. Soldiers are exclusively male. A fifth caste includes flying termites which are secondary reproductives that may go on to build new termitaria and eventually become primary reproductives. Termites have significant ecological importance in that they are responsible for aeration of soils and recycling of nutrients in soil.

**Mantids**

**Order Mantodea**

Family Mantidae

*Sphodromantis gastrica*

*Miomantis* sp.

Family Empusidae

*Empusa guttula*

There are no mantid species of conservation concern recorded for Limpopo. Members of this order are all vicious predators. Several colourful mimics resembling flowers were observed on the site. A number of species were recorded whilst sweepnetting. Of the approximately 1 800 described species, 185 occur in southern Africa.

**Earwigs**

**Order Dermaptera**

Family Labiduridae

*Labidura riparia*

*Euborellia annulipes*

Family Forficulidae

There are no earwig species of conservation concern recorded for Limpopo. All members of this order have terminal forceps. Females exhibit brood care by tending their eggs. Flightless earwig species were observed in leaf litter where they feeding on decaying organic matter. Of the 1 800 described species, approximately 50 occur in southern Africa.

**Crickets, Grasshoppers and Locusts**

**Order Orthoptera**

Family Anostostomatidae

*Onosandrus* sp.

*Libanasidus vittatus*

Family Bradyporidae

*Acanthoplus* sp.

Family Tettigoniidae

*Eurycorypha* sp.

*Phaneroptera* sp.

*Clonia* sp.

Family Gryllidae

*Acanthogryllus fortipes*

*Gryllus bimaculatus*

*Platygryllus* sp.

*Oecanthus* sp.

Family Gryllotalpidae

*Gryllotalpa africana*

Family Pyrgomorphidae

*Phymateus viridipens*

*Phymateus leprosus*

*Dictyophorus spumans*

*Zonocerus elegans*

Family Acrididae

*Cyrtacanthacris* sp.

*Acanthacris ruficornis*

*Gastrimargus* sp.

*Heteracris* sp.

*Orthoctha* sp.

*Acrotylus* sp.

*Catantops* sp.

There are no orthopterans of conservation concern recorded for Limpopo. This order is of major economic importance and includes many pest species, some of which were observed in the survey area. All members have legs adapted for jumping and produce sounds. Numerous species were observed whilst sweepnetting.

**Bugs**

**Order Hemiptera**

Family Miridae

*Deroeocoris* sp.

Family Tingidae

Family Reduviidae

*Acanthaspis* sp.

*Ectrichodia crux*
*Glymmatophora* sp.
*Oncocephalus* sp.
*Rhinocoris* sp.
*Petalochirus* sp.
*Reduvius* sp.
Family Aradidae
Family Coreidae
*Petalocnemis* sp.
*Anolplocnemis* sp.
*Cletus* sp.
*Homoeoceris* sp.
*Holopterna* sp.
Family Pyrrhocoridae
*Dysdercus intermedius*
*Scantius fosteri*
Family Lygaeidae
*Oncopeltus* sp.
*Spilostethus* sp.
Family Scutelleridae
*Calidea dregii*
Family Pentatomidae
*Coenomorpha* sp.
*Aspongopus* sp.
*Cuara rufventris*
*Dalsira costalis*
Family Cercopidae
*Ptyelus* sp.
*Locris* sp.
Family Cicadidae
Family Cicadellidae
Family Aphididae
*Aphis gossypii*
Family Coccidae
*Ceroplastes* sp.

There are no Hemipteran species of conservation concern recorded for Limpopo. Hemiptera is the most important order of insects from an agricultural perspective. There are also numerous species that have medical and veterinary importance. All members of this order have piercing (sucking) mouthparts. From a behavioural and morphological perspective, there is no order that displays more diversity. Sexual dimorphism is pronounced in many species.

**Thrips**

**Order Thysanoptera**

There are no thrip species of conservation concern recorded for Limpopo. Thrips are a very large, diverse and common group, but attract little attention because of their small size. Species are difficult to distinguish from one another without the aid of a microscope. Some species are pests of cultivated plants whilst others are important pollinators. Reproduction can be sexual or parthenogenetic. Of the 4 500 known species, approximately 230 occur in southern Africa.

**Lacewings and Antlions**

**Order Neuroptera**

Family Chrysopidae

*Chrysoperla* sp.

*Chrysemosa jeanneli*

Family Myrmeleontidae

*Centoclisis* sp.

There are no Neuropteran species of conservation concern recorded for Limpopo. All larvae of this order are predators whilst adults can be predatory or herbivorous, some being important pollinators. Neuropteran biomass is thought to rival mammalian biomass in more arid areas of southern Africa such as the Kalahari. The order is well represented in southern Africa by 13 of the 16 known families, with 383 species.

**Beetles**

**Order Coleoptera**

Family Carabidae

*Thermophilum homoplatum*

*Caminara* sp.

*Tefflus* sp.

*Craspedophorus* sp.

Family Histeridae

Family Staphylinidae

Family Scarabaeidae

Subfamily Cetoniinae

*Pachnoda sinuata*

*Cyrtothyrea marginalis*

*Leucocelis* sp.

Subfamily Melolonthinae

*Adoretus* sp.

*Hypopholis* sp.

Subfamily Scarabaeinae

*Onitis alexis*
*Sisyphus* sp.
*Scarabaeus* sp.
Subfamily Aphodiinae
*Aphodius* sp.
Family Buprestidae
*Sphenoptera* sp.
*Acmaeodera* sp.
Family Elateridae
Family Bostrichidae
Family Melyridae
Family Coccinellidae
Subfamily Coccinellinae
*Cheilomenes lunata*
Family Tenebrionidae
*Anomalipus elephas*
*Gonocephalum simplex*
Family Meloidae
*Mylabris oculata*
Family Cerambycidae
*Ceroplesis thunbergi*
*Philematium natalense*
*Macrotoma palmata*
Family Chrysomelidae
*Chrysolina* sp.
*Plagiodera* sp.
Family Curculionidae
*Hypolixus* sp.
*Sciobius* sp.
*Protostrophus* sp.

No beetles of conservation concern were observed on the site. Beetles are the largest order of living organisms with an estimated 370 000 spp. worldwide. Beetles vary greatly in size, shape, habits and biological requirements. They have no obvious character to which their success can be attributed. Approximately 18 000 species have been described in southern Africa. Numerous species were observed in the survey area.

**Flies**

**Order Diptera**

Family Tipulidae
*Nephrotoma* sp.

*Tipula* sp.
Family Psychodidae
Family Asilidae
*Gonioscelis* sp.
*Lasiocnemis* sp.
*Philodicus* sp.
Family Bombylidae
*Notolomatia* sp.
Family Syrphidae
Family Muscidae
*Musca domestica*
*Lispe* sp.
Family Sarcophagidae
*Sarcophaga* sp.
Family Tachinidae

There are no Dipteran species of conservation concern recorded for Limpopo. From a medical point of view this is the most important insect order. Flies are also important from a veterinary and agricultural point of view. Flies are important from an ecological point of view as they responsible from 70 to 80% of carcass breakdown. Approximately 16 000 species are known in the Afrotropical region.

**Moths and Butterflies**

**Order Lepidoptera**

Family Psychidae
Family Geometridae
Family Arctiidae
Family Noctuidae
*Cyligramma latona*
Family Nymphalidae
Family Lycaenidae
Subfamily Lycaeninae
Family Pieridae
Subfamily Pierinae
Family Papilionidae
Subfamily Papilioninae
*Papilio demodocus*
Family Hesperiidae

No moths or butterflies of conservation concern were observed on the site. Lepidoptera is very large order that has close association with flowering plants. Lepidoptera contains the highest number of

endangered species in South Africa relative to other orders. There is no simple distinction between moths and butterflies. All adult members of this order have coiled mouthparts. These are reduced in a few species where adults do not feed. Many moth species are pests on agricultural products and have economic importance.

**Sawflies, Wasps, Bees & Ants**

**Order Hymenoptera**

**Suborder Apocrita**

Family Ichneumonidae

*Theronia* sp.

Family Braconidae

*Archibracon servillei*

Family Chrysididae

Family Mutilidae

Family Pompilidae

*Tachypompilus* sp.

*Batozonellus* sp.

Family Vespidae

*Polistes* sp.

*Belonogaster* sp.

Family Apidae

*Xylocopa* sp.

*Apis mellifera*

Family Formicidae

There are no wasp, bee or ant species of conservation concern recorded for Limpopo. Hymenoptera is the youngest order in evolutionary terms. It is also a very diverse order including solitary, social and parasitic species. Many members of this order have a well-developed sting. A common characteristic across this order is haplodiploidy where males are haploid and have half the genetic composition of females. Males inherit all their genetics from their mother. Of the 198 000 known species worldwide, over 6000 are known from southern Africa.

## Spiders and scorpions

## Class Arachnida

**Scorpions**

**Order Scorpiones**

Family Buthidae

*Uroplectes triangulifer*

Family Scorpionidae

*Opistopthalmus glabrifrons*

*Opistopthalmus glabrifrons*, a TOPS listed species, was observed in the survey area. Of the 1 500 known species, approximately 130 are known from southern Africa. On average 6 species occur in a localized area. Only two species were observed during the survey although some species may have missed during the sampling effort. Scorpions spend 92 to 97% of their time inactive. With such high levels of inertia, some species are thought to be able to live without food for more than a year.

**Spiders**

**Order Aranaea**

Family Araneidae

Subfamily Araneinae

*Caerostris* sp.

*Larinia* sp.

*Nephila senegalensis*

Family Tetragnathidae

Subfamily Nephilinae

*Nephila* sp.

Family Uloboridae

Subfamily Uloborinae

Family Eresidae

Subfamily Eresinae

*Gandanameno* sp.

*Dresserus* sp.

Family Agelenidae

*Olorunia* sp.

Family Pholicidae

*Pholcus* sp.

*Smeringopus* sp.

Family Lycosidae

*Geolycosa* sp.

*Lycosa* sp.

Family Salticide

*Slaticus* sp.

*Portia* sp.

Family Thomsidae

*Thomsius* sp.

No TOPS listed spider species was observed whilst lifting rocks on the site. Approximately 40 000 species of spider have been described to date however it is estimated that this figure represents approximately 30% of total spider diversity worldwide. With the exception of ticks (Acari) and scorpions (Scorpiones), Arachnids have been poorly studied in southern Africa. Ticks and scorpions are better known due to their medical and veterinary importance.

**Picture 5.** Both vegetation units are traversed by road networks and powerline infrastructure.

**Picture 6.** The burrowing hole of an aardvark

# RECOMMENDATIONS

The following standard mitigatory measures are recommended for future developments in the survey area. These recommendations are important because the survey area contains sensitive habitat types and uncontrolled development in or around these habitats is expected to impact significantly on their associated Red Data species, populations, assemblages or communities. Sensitive habitats include:

**Vegetation unit 1**

Polokwane Plateau Bushveld

***Reasoning***: Despite some level of anthropogenic disturbance, this unit has moderate species richness and constitutes suitable habitat for several species of conservation concern that occur in the survey area. Indirectly, there exists a corridor between Polokwane Nature Reserve and the southern boundary of the survey area through other portions of Polokwane Plateau Bushveld.

***Conservation value***: Medium-high

**Vegetation unit 2**

Transformed Marsh Zone

***Reasoning***: This vegetation unit is largely transformed and may serve as a barrier to certain species migrating between the survey area, Polokwane Nature Reserve and other, more natural, surrounding habitats. It has low species richness and is currently facilitating the spread of alien invasive plants. Numerous aquatic invertebrates, reptiles and amphibians will however use the artificial dams as habitat. Some species may however utilise this unit for moving between unit 1 and Polokwane Nature Reserve. Although unit 2 is ecologically degraded, it does constitute the only direct link between the survey area and Polokwane Nature Reserve.

***Conservation value***: Low-medium

**General mitigation measures**

Vegetation unit 2 is ecologically degraded. The Polokwane Municipality needs to take steps to remove all the alien invasive plant species and employ further restrictions and control, as specified by CARA Regulations. An ecological management plan must be generated by a suitably qualified specialist for implementation by the appropriate management authority. This ecological management must include an ongoing monitoring and eradication programme for all non-indigenous species, with specific emphasis on invasive and weedy species. Where removal of alien species may leave soil exposed, alternative indigenous species should be established to prevent any erosion. Plants growing naturally in the proposed development areas should, as far as possible, be retained and incorporated into landscaping. When additional plant species are used for landscaping, special emphasis should be focused on forage and host plants required by herbivores and pollinators present in the area and must otherwise only be limited to those indigenous to South Africa. The integrity of natural vegetation that falls outside developed areas should be preserved (as in Polokwane Nature Reserve).

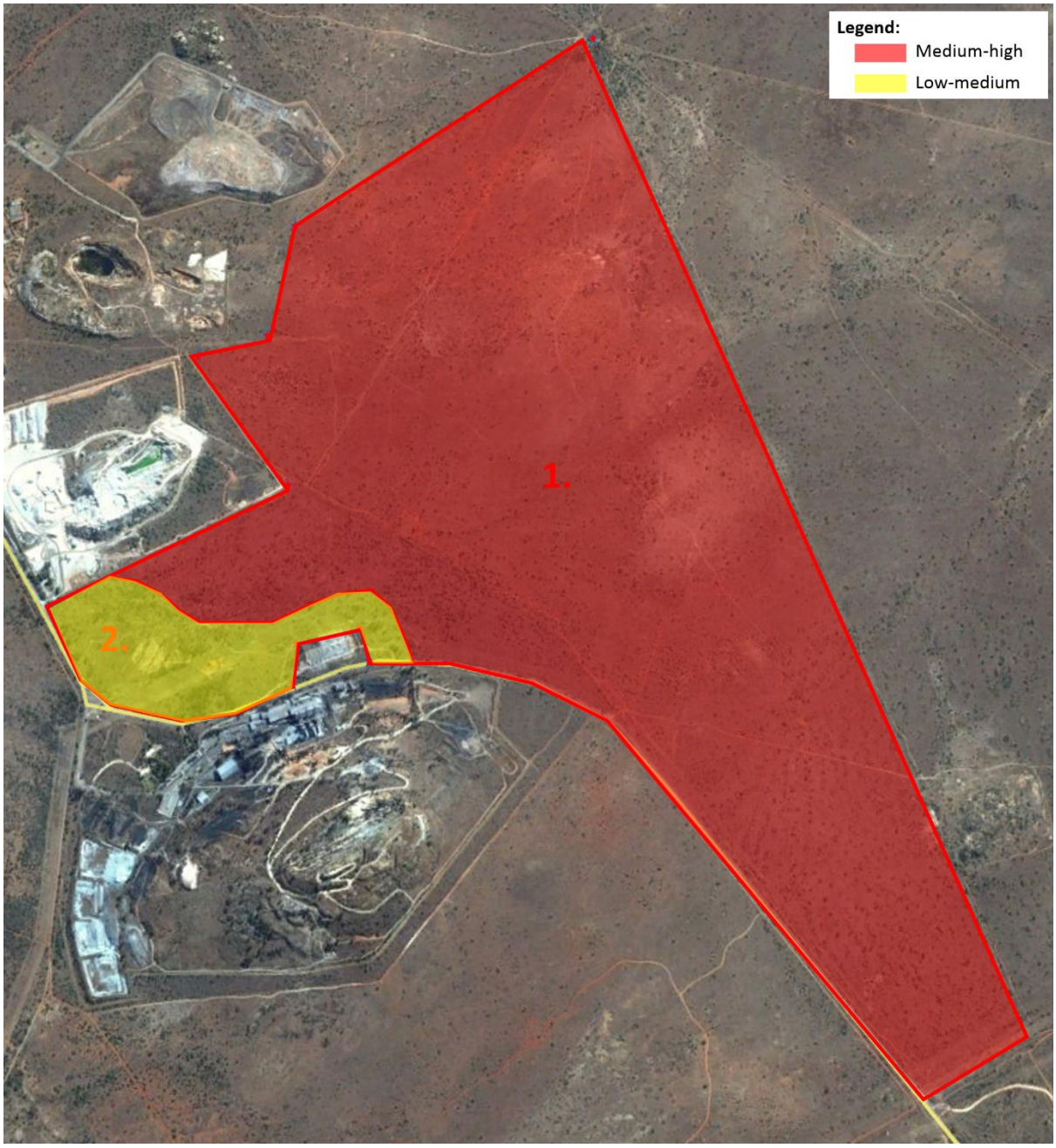


**Figure 5.** Sensitivity map of the survey area.

Any construction activities must be carefully monitored to keep disturbance to a minimum, and must be appropriately rehabilitated and managed. This entails the removal and proper disposal of all rubble and litter. All scrap materials, building rubble and rubbish accumulated during construction should be relocated to official municipal dumping grounds. Dumping of any materials in undeveloped open areas should not be allowed and this must be actively managed. Construction must preferably take place during the dry season. Temporary housing, temporary ablutions and the storing of equipment should be administered in such a manner that natural habitat is subject to as little disturbance as possible during the construction phase. A concerted effort should be made to limit construction-related impacts to natural habitat.

It is imperative that adequate erosion preventative mechanisms continue to be implemented should any further construction take place. Erosion resulting from these developments should be appropriately rehabilitated preventing further habitat deterioration. Stormwater runoff must be correctly managed during all phases of construction.

An integrated pest management programme, where the use of chemicals is considered as a last option, should be employed. However, if chemicals are used to clear invasive vegetation and weedy species or for the control of invertebrate pests, species-specific chemicals should be applied and in the recommended dosages. General spraying should be prohibited and the application of chemicals as part of a control programme should not be permitted to take place on windy days.

Outside lighting should be designed to minimize impacts, both directly on especially rare or endangered invertebrate species and indirectly by impacts on populations of prey species. All outside lighting should be directed away from sensitive areas.

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