

**TERRESTRIAL ECOLOGICAL HABITAT INTEGRITY
INVESTIGATION AS PART OF ENVIRONMENTAL IMPACT
ASSESSMENT AND AUTHORISATION PROCESS FOR THE
PROPOSED DEVELOPMENT ON DIE WILGERS EXT 83
(TUCKER SITE), GAUTENG PROVINCE**

Prepared for

Plan Associates Town and Regional Planners Inc

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Prepared by:	Scientific Terrestrial Services
Report author:	H. de Beer
Report reviewer:	E. van der Westhuizen
Report Reference:	STS 170042
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Scientific Terrestrial Services CC
CC Reg No 2005/122329/23
PO Box 751779
Gardenvue
2047
Tel: 011 616 7893
Fax: 086 724 3132
E-mail: admin@sasenvironmental.co.za



EXECUTIVE SUMMARY

Based on the findings of the assessment, it is the opinion of the ecologists that from an ecological perspective, the proposed project be considered favorably. However, all essential mitigation measures and recommendations presented in this report should be adhered to as to ensure that the impact on the receiving environment is minimized.

MANAGEMENT SUMMARY

Scientific Terrestrial Services (STS) was appointed to conduct a terrestrial ecological habitat integrity investigation as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed development on Die Wilgers Extension (Ext) 83 (Tucker Site), in Pretoria, within the Gauteng Province, henceforth referred to as the “study area” (Figures 1 & 2).

Specific outcomes required from this report include the following:

- To define the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the faunal and floral ecological resources associated with the study area;
- To conduct a Species of Conservation Concern (SCC) assessment, including potential for such species to occur within the study area. Special emphasis is placed on the identification of, or suitable habitat for *Neamblysomus julianae* (Juliana’s Golden Mole);
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and any other ecologically important features, if present; and
- To determine the environmental impacts that the proposed development may have on the terrestrial ecology associated with the study area, with emphasis on floral and faunal SCC and to develop mitigation and management measures in terms of floral and faunal SCC for all phases of the development.

Results of the Desktop Analysis

- Only one vegetation type, namely the Andesite Mountain Bushveld is present within the study area. The vegetation unit is listed as Least Threatened (Mucina and Rutherford, 2006);
- The study area does not fall within any remaining extents of a threatened ecosystem. It should be noted however that the National Threatened Ecosystem Original Extent Layer (2011) indicates that study area is situated within the Critically Endangered Bronberg Mountain Bushveld Ecosystem. This layer was however revised and areas that have undergone disturbance: agriculture, mining and urbanisation have been excluded from the Remaining Extent Layer;
- According to the Gauteng Conservation (C-Plan, 2011) the study area is situated within a Critical Biodiversity Area (CBA); and
- The study area falls within an area that is currently moderately protected (NBA, 2011).

Terrestrial Results

- A single habitat unit was identified during the field assessment, namely the Transformed Habitat Unit. The vegetation structure and composition is severely altered and comprised mainly of alien and invasive vegetation species such as *Melia azedarach*, *Eucalyptus grandis* and *Acacia mearnsii*. The study area is also no longer considered representative of the Andesite Mountain Bushveld vegetation type. This is as a result of historic and ongoing anthropogenic activities, because dumped building and household rubble was evident throughout the study area and vagrants are using the area as refuge. For this reason, the habitat unit is considered to be of low ecological sensitivity;
- The Probability of Occurrence (POC) of all South African National Biodiversity Institute (SANBI) floral SCC, as well as the Gauteng Department of Agriculture and Rural Development (GDARD) Red and Orange listed plants species listed for the Quarter Degree Square (QDS) 2528CD was calculated.



- During the field assessment none of these SCC were encountered and none of the species listed scored a POC of 60% or higher. It is therefore highly unlikely that any floral SCC will occur within the study area, due to overall lack of suitable habitat and high levels of disturbance and transformation within the study area and surrounding areas.
- High levels of historic and ongoing anthropogenic activities associated with the study area and the surrounding areas, have led to the transformation of natural faunal habitat;
- Only commonly occurring faunal species such as *Passer melanurus* (Cape Sparrow), and *Acridotheres tristis* (Common Myna), adapted to urban environments, were observed within the study area;
- No faunal SCC was observed during the field assessment. In terms of conservation, the likelihood that any such species will be encountered in or near the study area is considered low, due to the high levels of historic and ongoing anthropogenic activity and habitat transformation that has taken place within the study area and the immediate vicinity;
- The proposed development is thus deemed unlikely to pose a conservation threat to faunal species in the region.

Sensitivity

From an ecological perspective, the study area is considered to be of low ecological sensitivity, mainly as a result of the increased level of disturbance and habitat transformation within and surrounding the study area, leading to increased loss of ecological connectivity to larger open space areas in the region and the very low probability of floral or faunal SCC occurring within the study area.

Terrestrial Impact Assessment:

The tables below summarise the findings of the impact assessment, indicating the significance of the impact before mitigation takes place and the likely impact if effective management and mitigation takes place. From the tables it is evident that prior to mitigation the impacts on floral and faunal SCC are low level impacts. If effective mitigation takes place, all impacts may be reduced to very low level impacts.

A summary of the results obtained from the impact assessment for the construction phase.

Impact	Unmanaged	Managed
1: Impact on Floral Species of Conservation Concern	Low	Very-Low
2: Impact on Faunal Species of Conservation Concern	Low	Very-Low

A summary of the results obtained from the impact assessment for the operational phase.

Impact	Unmanaged	Managed
1: Impact on Floral Species of Conservation Concern	Low	Very-Low
2: Impact on Faunal Species of Conservation Concern	Low	Very-Low



DOCUMENT GUIDE

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix H
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix H
b)	A declaration that the specialist is independent	Appendix H
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1.2
cA)	An indication of the quality and age of base data used for the specialist report	Section 2.1 and 3.1
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 4.1 and 6
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1.3
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Appendix B and C
f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 4
g)	An identification of any areas to be avoided, including buffers	Section 5
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 5
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 1.3
j)	A description the findings and potential implication/s of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Section 4, 5, and 6
k)	Any mitigation measures for inclusion in the EMPr	Section 6
l)	Any conditions for inclusion in the environmental authorisation	Section 6
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 6
n)	A reasoned opinion -	Section 7
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section 7
(iA)	Regarding the acceptability of the proposed activity or activities	Section 7
(ii)	If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 6
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A



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GLOSSARY OF TERMS

Alien vegetation

Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.

Biome

A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate.

CBA (Critical Biodiversity Area)

A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges.

ESA (Ecological Support Area)

An ESA provides connectivity and important ecological processes between CBAs and is therefore important in terms of habitat conservation

IBA (Important Bird and Biodiversity Area)

The IBA Programme identifies and works to conserve a network of sites critical for the long-term survival of bird species that: are globally threatened, have a restricted range, are restricted to specific biomes/vegetation types or sites that have significant populations.

Indigenous vegetation

Vegetation occurring naturally within a defined area

RDL (Red Data listed) species

Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.

SCC (Species of Conservation Concern)

The term SCC in the context of this report refers to all RDL (Red Data) and IUCN (International Union for the Conservation of Nature) listed species as well as protected species of relevance to the project.



LIST OF ACRONYMS

BGIS	Biodiversity Geographic Information Systems
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CR	Critically Endangered
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EN	Endangered
ESA	Ecological Support Areas
EW	Extinct in the Wild
GDARD	Gauteng Department of Agriculture and Rural Development
GIS	Geographic Information System
GPS	Global Positioning System
IBA	Important Bird Area
IUCN	International Union for the Conservation of Nature
LC	Least Concern
MAP	Mean Annual Precipitation
MAPE	Mean Annual Potential for Evaporation
MASMS	Mean Annual Soil Moisture Stress
MAT	Mean Annual Temperature
MFD	Mean Frost Days
NBA	National Biodiversity Assessment (2011)
NEMA	National Environmental Management Act (Act 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NPAES	National Protected Areas Expansion Strategy
NT	Near Threatened
PES	Present Ecological State
POC	Probability of Occurrence
PRECIS	Pretoria Computer Information Systems
QDS	Quarter Degree Square (1:50,000 topographical mapping references)
RDL	Red Data List
RE	Regionally Extinct
SABAP 2	Southern African Bird Atlas 2
SACAD	South African Conservation Areas Database
SANBI	South African National Biodiversity Institute
SAPAD	South African Protected Areas Database
SCC	Species of Conservation Concern
STS	Scientific Terrestrial Services CC
TSP	Threatened Species Programme
VU	Vulnerable



1. INTRODUCTION

1.1 Background

Scientific Terrestrial Services (STS) was appointed to conduct a terrestrial ecological habitat integrity investigation as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed development on Die Wilgers Extension (Ext) 83 (Tucker Site), in Pretoria, within the Gauteng Province, henceforth referred to as the “study area” (Figures 1 & 2).

Die Wilgers Ext 83 (Tucker Site) is situated directly adjacent to the M6 Road, otherwise known as Lynwood Road, forming the northern border of the study area. The study area is situated approximately 1.94km west of Equestria, 2.11km north of Faerie Glen, and 4.79km east of Lynwood (geodesic distance).

The study area is situated within the Bronberg Ridge System, classified as a Class 2 ridge, which are ridges that have undergone very limited disturbance: more than 5% but less than 35% of their surface area has been converted to urban development, quarries and/or alien vegetation. *Neamblysomus julianae* (Juliana’s Golden Mole) is endemic to South Africa, more specifically to the Bronberg, and is listed as critically endangered. Therefore, emphasis was placed on the identification of evidence of occurrence and suitable habitat for the *N. julianae* during the field investigation.

This report, after consideration and the description of the ecological integrity within the study area must guide the Environmental Assessment Practitioner (EAP), regulatory authorities and developing proponent, by means of the presentation of results and recommendations, as to the ecological viability of the proposed development activities.



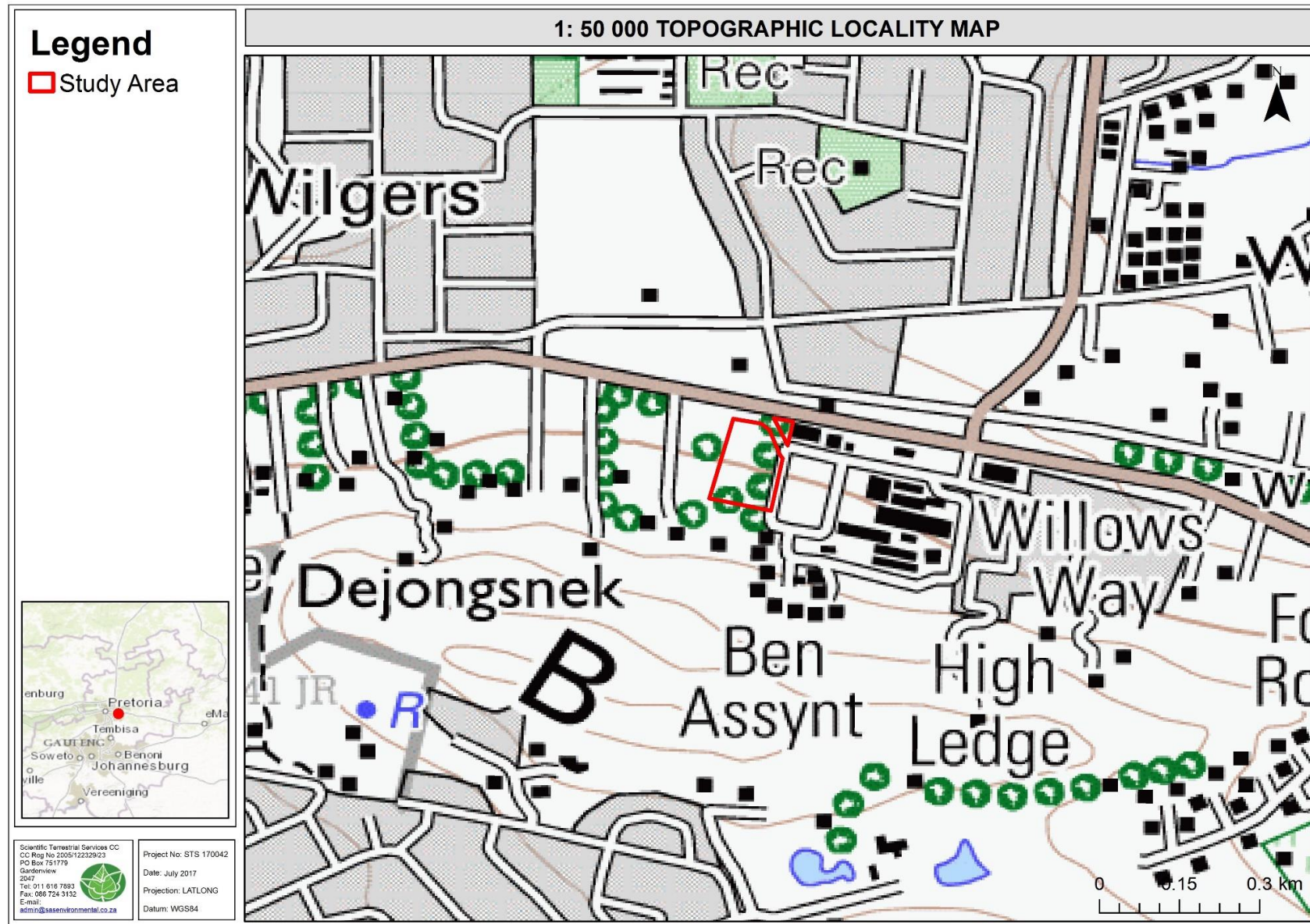


Figure 1: The study area depicted on a 1:50 000 topographical map in relation to the surrounding area.



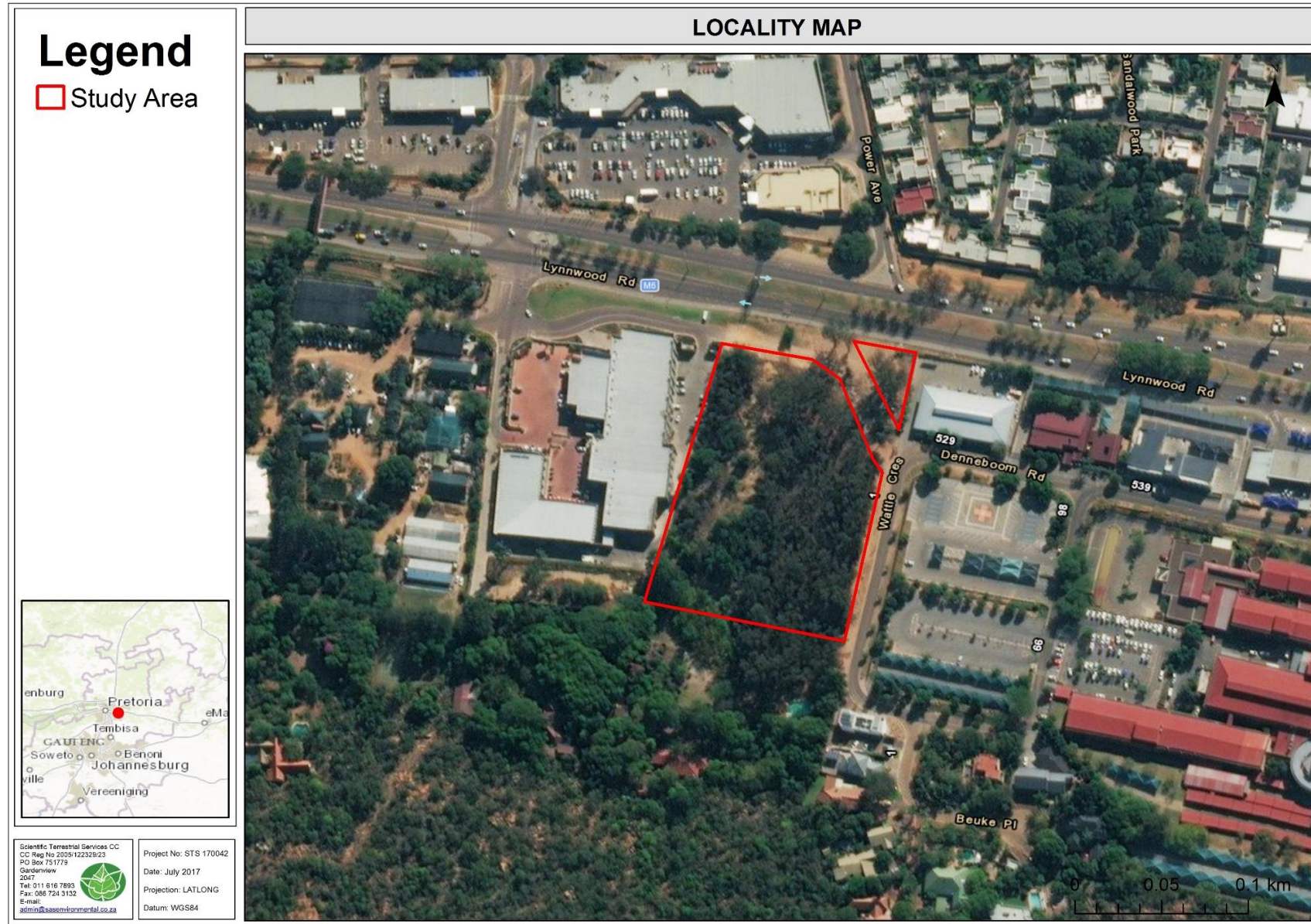


Figure 2: Digital Satellite image depicting the location of the study area in relation to surrounding areas.



1.2 Project Scope

Specific outcomes in terms of this report are outlined below:

- To define the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the faunal and floral ecological resources associated with the study area;
- To conduct a Species of Conservation Concern (SCC) assessment, including potential for such species to occur within the study area. Special emphasis is placed on the identification of, or suitable habitat for *Neamblysomus julianae* (Juliana's Golden Mole);
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and any other ecologically important features, if present; and
- To determine the environmental impacts that the proposed development may have on the terrestrial ecology associated with the study area, with emphasis on floral and faunal SCC and to develop mitigation and management measures in terms of floral and faunal SCC for all phases of the development.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The ecological assessment is confined to the study area and does not include the neighbouring and adjacent properties; these were however considered as part of the desktop assessment;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most floral and faunal communities have been accurately assessed and considered;
- Due to the nature and habits of most faunal taxa and the increased level of surrounding anthropogenic activities, it is unlikely that all species would have been observed during a site assessment of limited duration. Therefore, site observations were compared with literature studies where necessary;
- The data presented in this report are based a single site visit, undertaken on 20 July 2017 (Winter). A more accurate assessment would require that assessments take place in all seasons of the year. However, on-site data was significantly augmented with all available desktop data, local knowledge of the area and studies which have been conducted in the surrounding areas and the findings of this assessment are considered to be an accurate reflection of the ecological characteristics of the study area.



1.4 Legislative Requirements

The following legislative requirements were considered during the assessment:

- National Environmental Management Act (NEMA) (Act 107 of 1998);
- National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004);
and
- The Conservation of Agricultural Resources Act (CARA, Act 43 of 1983).

The following documentation was also considered:

- GDARD Requirements for Biodiversity Assessments Version 3 (GDARD, 2014).

Details of each of the above, as they pertain to this study, are provided in Appendix A of this report.

2. ASSESSMENT APPROACH

2.1 General Approach

In order to accurately determine the PES and EIS of the habitats within the study area and capture comprehensive data with respect to the terrestrial ecology, the following method of assessment was used:

- Maps, aerial photographs and digital satellite images were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. The results of this analysis were then used to focus the field work on specific areas of concern and to identify areas where target specific investigations were required;
- A literature review with respect to habitats, vegetation types and species distribution was conducted;
- Relevant databases considered during the assessment included the South African National Biodiversity Institute (SANBI) Threatened Species Programme (TSP), the Gauteng Conservation Plan Version 3.3 (C-Plan; 2011), Mucina and Rutherford (2012), National Biodiversity Assessment (NBA, 2011), Important Bird and Biodiversity Areas (IBA, 2015) in conjunction with the South African Bird Atlas Project (SABAP2), International Union for Conservation of Nature Red List (IUCN, 2017) and Pretoria National Herbarium Computer Information Systems (PRECIS, 2009);
- An on-site assessment of the study area was conducted on 20 July 2017 (Winter) in order to confirm the assumptions made during consultation of the maps and to



determine the ecological status of the study area. The entire study area was assessed in order to identify the occurrence of the dominant floral and faunal species and habitat diversities;

- Specific methodologies for the assessment, in terms of field work and data analysis of faunal and floral ecological assemblages are presented in Appendices B and C; and
- For the methodologies relating to the impact assessment and development of mitigation measures, please refer to Appendix D of this report.

2.2 Sensitivity Mapping

All the ecological features within the study area were considered and sensitive areas were delineated with the use of a GPS. A Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps.

3. RESULTS OF THE DESKTOP ANALYSIS

3.1 Conservation Characteristics of the study area

The following table contains data accessed as part of the desktop assessment. It is important to note, that although all data sources used provide useful and often verifiable high quality data, the various databases do not always provide an entirely accurate indication of the study area's actual biodiversity characteristics.



Table 1: Summary of the conservation characteristics for the study area.

Details of the study area in terms of Mucina & Rutherford (2012)		Detail of the study area in terms of the Gauteng Conservation Plan (C-Plan V3.3, 2011)	
Biome	The study area falls within the Savanna biome.	Critical Biodiversity Area (CBA) (Figure 5)	The entire study area is situated within a CBA. The CBA is considered an irreplaceable area, for red listed plant and mammal habitat and for primary vegetation. A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges (GDARD, 2014a).
Bioregion	The study area is situated within the Central Bushveld Bioregion.		
Vegetation Type	The study area falls within the Andesite Mountain Bushveld vegetation type.		
Conservation details pertaining to the study area (Various databases)		Ecological Support Area (ESA)	The closest ESA to the study area is approximately 90m west. An ESA provides connectivity and important ecological processes between CBAs and is therefore important in terms of habitat conservation (GDARD, 2014a).
NBA (2011)	The study area falls within an area that is currently moderately protected. Moderately protected areas are areas where < 100% of the biodiversity target protection level is met in formal A or B protected areas as per the Protected Areas Act.		
National Threatened Ecosystems (2011)	The study area does not fall within any remaining extents of a threatened ecosystem. It should be noted however that the National Threatened Ecosystem Original Extent Layer (2011) indicates that study area is situated within the Critically Endangered Bronberg Mountain Bushveld Ecosystem. This layer was however revised and areas that have undergone disturbance: agriculture, mining and urbanisation have been excluded from the Remaining Extent Layer. It is important to note that while the original extent of each listed ecosystem has been mapped, a basic assessment report in terms of the EIA regulations is only triggered in remaining natural habitat within each ecosystem and not in portions of the ecosystem where natural habitat has already been irreversibly lost.	Wetland Buffer	There are no wetland buffers associated with the study area.
		River Buffer	There are no rivers associated with the study area.
		Ridges (Figure 6)	The study area is situated within the Bronberg Ridge, which is considered a class 2 ridge. Class 2 ridges include ridges of which more than 5% but less than 35% of their surface area has been converted to urban development, quarries and/or alien vegetation.
SAPAD (2017), SACAD (2017) & NPAES (2009) (Figure 3)	According to SACAD (2017), the study area is situated approximately 4.5km southeast of the Pretoria National Botanical Garden and 8.1km southeast of the Magaliesberg Biosphere Reserve. The SAPAD (2017) database indicate the Faerie Glen Nature Reserve to be situated \pm 720m west, the Colbyn Wetland Nature Reserve situated \pm 6.2km northwest and Frank Struben Bird Sanctuary \pm 6.6km west of the study area. The NPAES (2009) corresponds with SAPAD.	Description of the vegetation type(s) relevant to the study area (Mucina & Rutherford 2012) continued	
IBA (2015) (Figure 4)	The Magaliesberg IBA is situated approximately 8.8km north of the study area.	Geology & Soils	Tholeitic basalt of the Kliprivierberg Group. Dark shale, micaceous sandstone and siltstone and thin coal seams of the Madzaringwe Formation. Weathering of these rocks give rise to shallow, rocky, clayey soils of mainly Mispah and Glenrosa.
Description of the vegetation type relevant to the study area (Mucina & Rutherford 2012)			
Climate	Summer rainfall with very dry winters	Small Trees	<i>Acacia caffra</i> (d), <i>A. karroo</i> (d), <i>Celtis africana</i> , <i>Protea caffra</i> , <i>Zanthoxylum capense</i> , <i>Ziziphus mucronata</i>
Altitude (m)	1350-1800	Tall Shrubs	<i>Asparagus laricinus</i> (d), <i>Euclea crispa</i> subsp. <i>crispa</i> (d), <i>Rhus pyroides</i> var. <i>pyroides</i> (d), <i>Diospyros lycioides</i> subsp. <i>lycioides</i> , <i>Gymnosporia polyacantha</i> , <i>Lippia javanica</i> , <i>Rhamnus rigida</i> var. <i>margaretae</i> , <i>Teucrium trifidum</i>
MAP* (mm)	660		
MAT* (°C)	15.6		
MFD* (Days)	34	Soft Shrub	<i>Isoglossa grantii</i>
MAPE* (mm)	2186	Woody Climber	<i>Rhoicissus tridentate</i> .
MASMS* (5)	76	Graminoids	<i>Eragrostis curvula</i> (d), <i>Hyparrhenia hirta</i> (d), <i>Setaria sphacelata</i> (d), <i>Themeda triandra</i> (d), <i>Cymbopogon pospischilii</i> , <i>Digitaria eriantha</i> subsp. <i>eriantha</i> , <i>Elionurus muticus</i> , <i>Eragrostis racemosa</i> , <i>E. superba</i> , <i>Panicum maximum</i>
Distribution	Gauteng, North-West, Mpumalanga and Free State Provinces.		
Conservation	Least Threatened. Conservation target 24%. About 7% statutorily conserved.		
Vegetation & Landscape Features	Dense, medium-tall thorny bushveld with a well-developed grass layer on hill slopes and some valleys with undulating landscape.	Herbs	<i>Commelina africana</i> , <i>Vernonia galpinii</i> , <i>V. oligocephala</i>
		Succulent Herb	<i>Aloe greatheadii</i> var. <i>davyana</i>

NBA = National Biodiversity Assessment, SAPAD = South African Protected Areas Database, IBA = Important Bird and Biodiversity Area, CBA = Critical Biodiversity Area, ESA = Ecological Support Area, MAP = Mean Annual Precipitation, MAT = Mean Annual Temperature, MFD = Mean Frost Days, MAPE = Mean Annual Potential for Evaporation, MASMS = Mean Annual Soil Moisture Stress



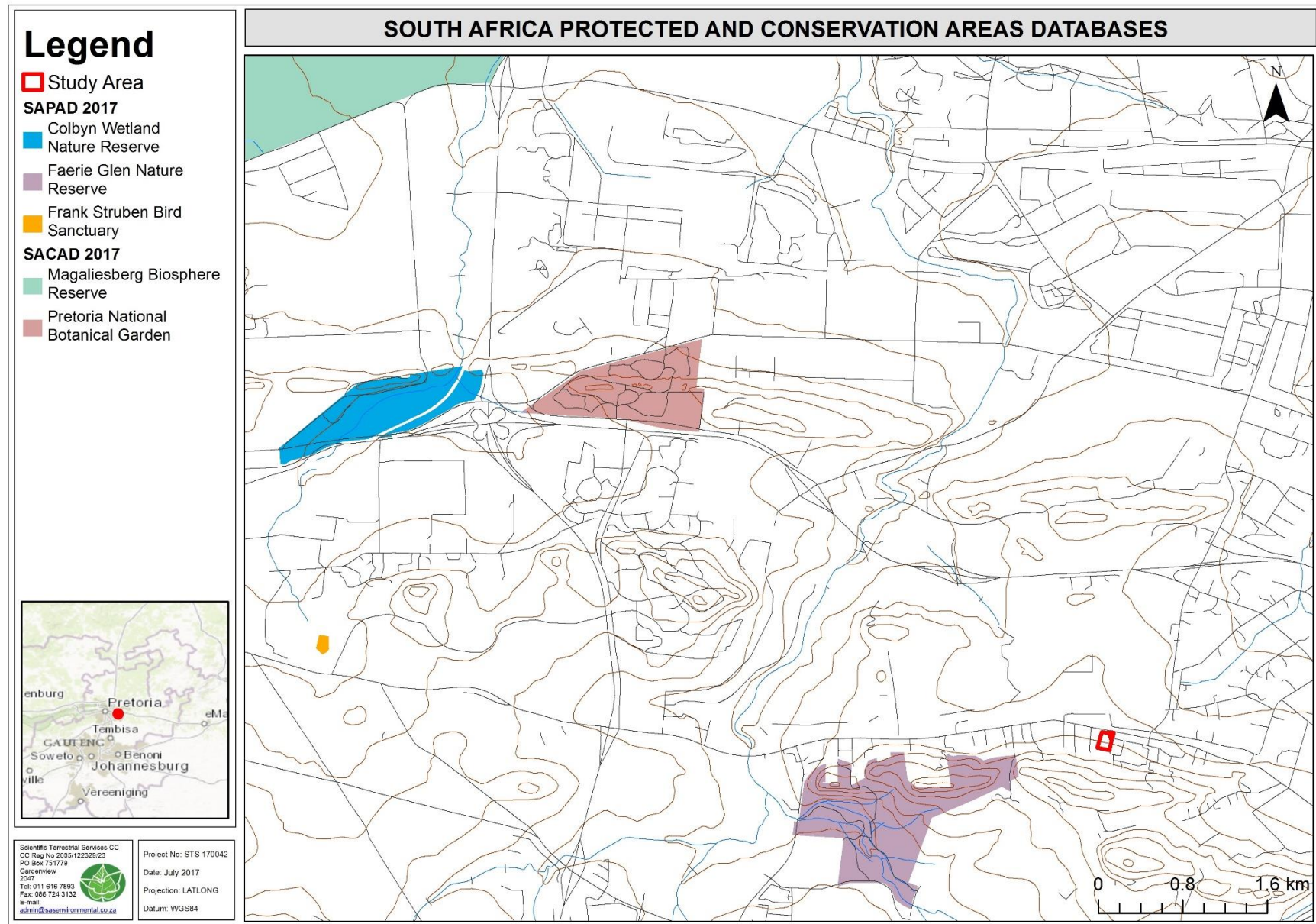


Figure 3: Protected and Conservation areas associated with the study area and surrounding area (SAPAD & SACAD, 2017).



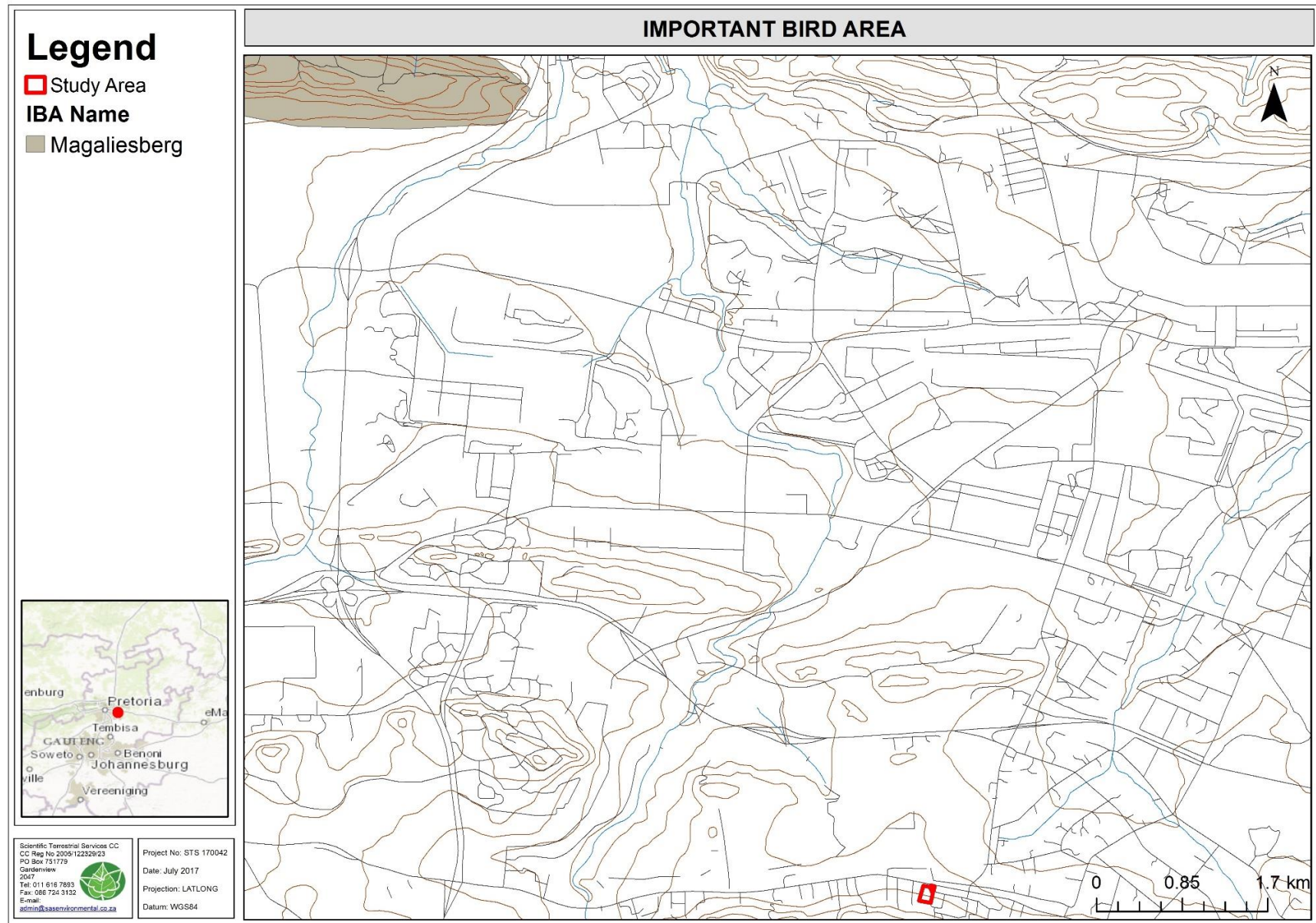


Figure 4: The study area located approximately 8.8 km south of the Magaliesberg IBA (IBA, 2015).



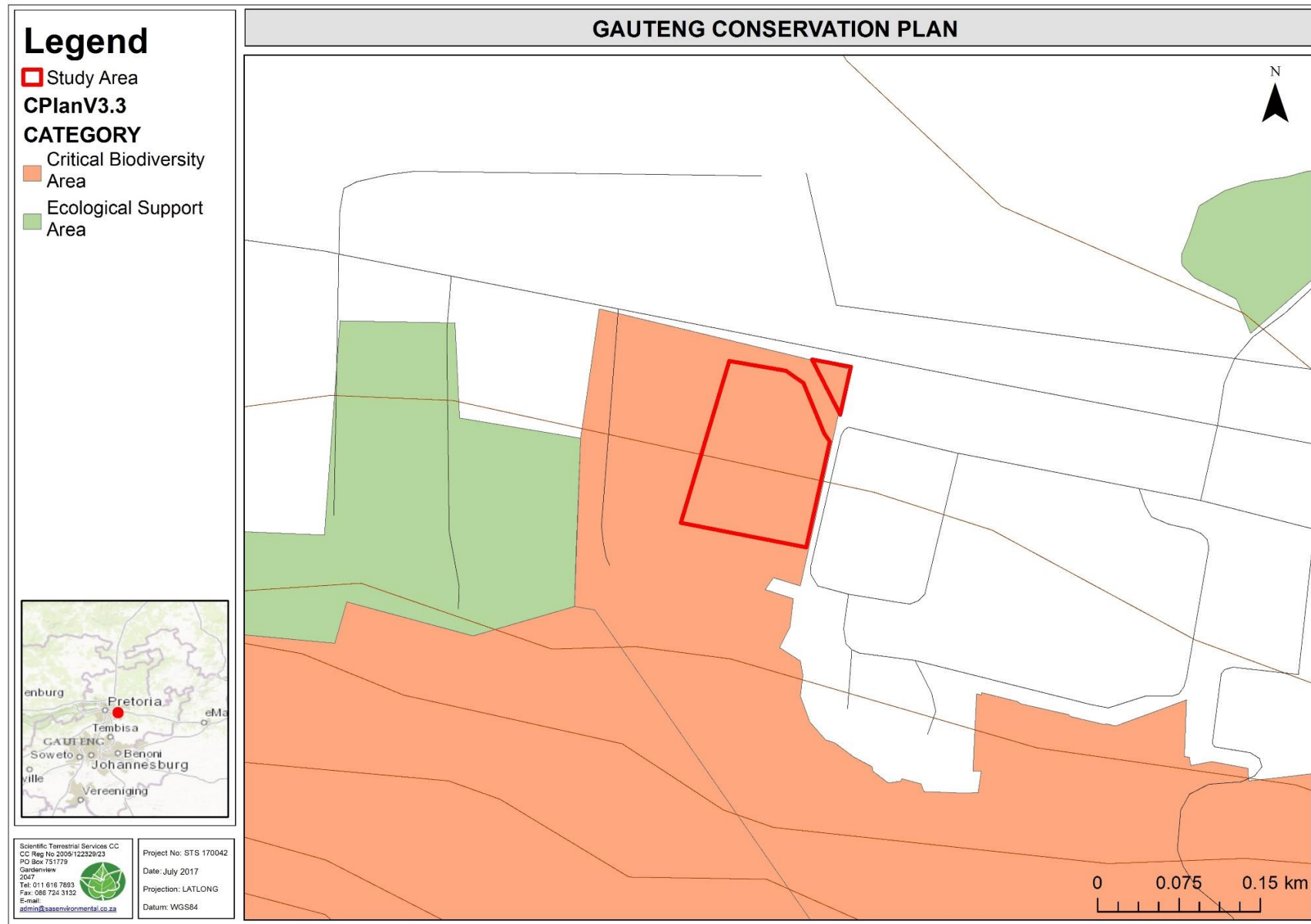


Figure 5: Gauteng C Plan v3.3 indicating a CBAs associated with the study area.



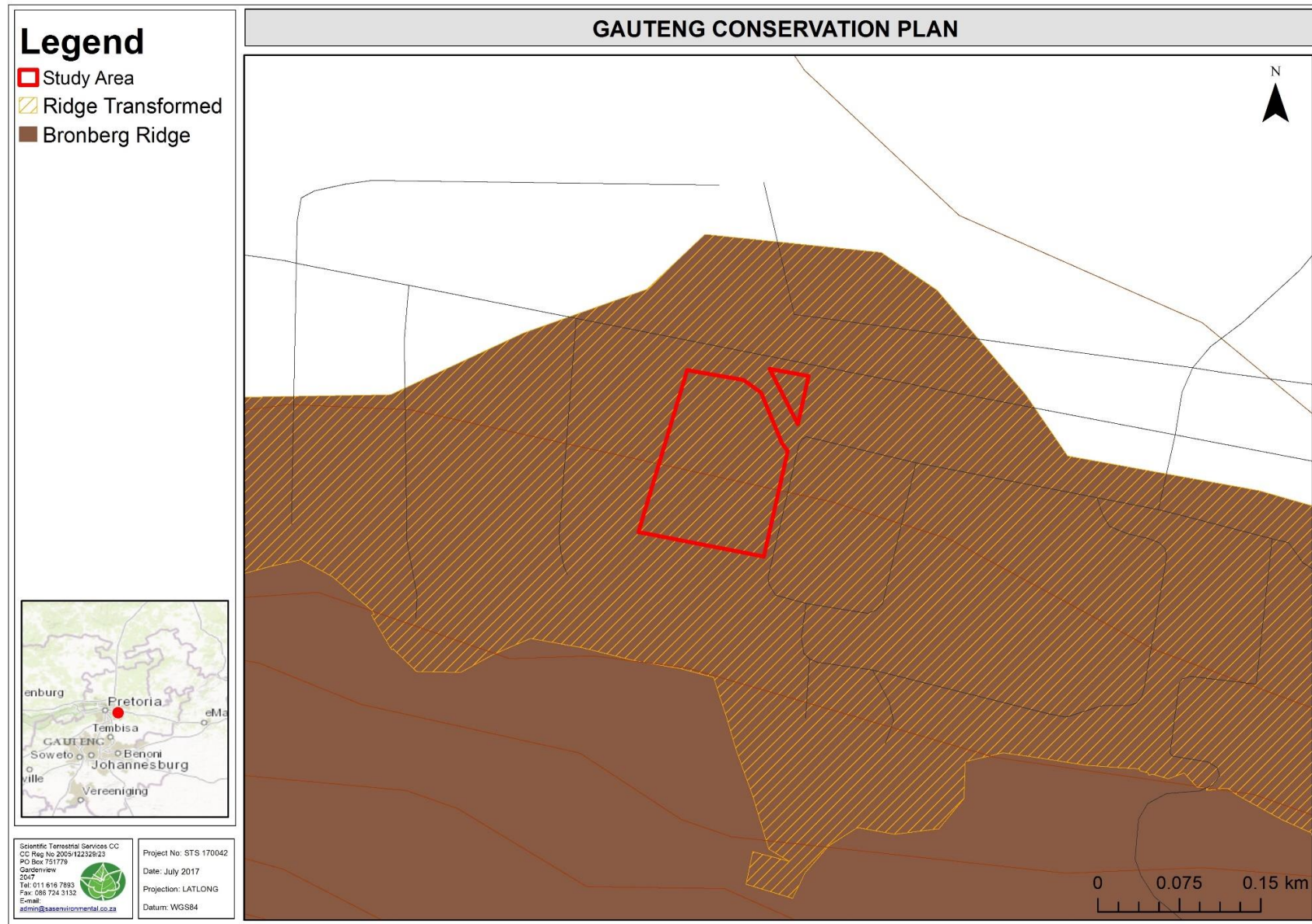


Figure 6: Gauteng C Plan v3.3 indicating the Bronberg ridge associated with the study area.



4. RESULTS OF THE TERRESTRIAL SCAN

4.1 *Habitat Unit*

One habitat unit was identified during the assessment, namely the Transformed Habitat Unit, with Figure 7 below depicting this habitat unit in relation to the surrounding area. The Transformed Habitat Unit is considered to be in a significantly modified ecological condition, since study area is heavily invested with alien and invasive species, building and household rubble present and the study area is used by vagrants. For this reason, floral species associated with the study area comprise mainly alien species and garden ornamentals, with very few species representative of the Andesite Mountain Bushveld vegetation type. The study area is therefore no longer considered representative of this vegetation type. As a result of historic and ongoing anthropogenic activities within the study area, only common faunal species adapted to an urban setting are expected to reside within the study area.

The results of the terrestrial ecological scan are presented in the figure and table below.



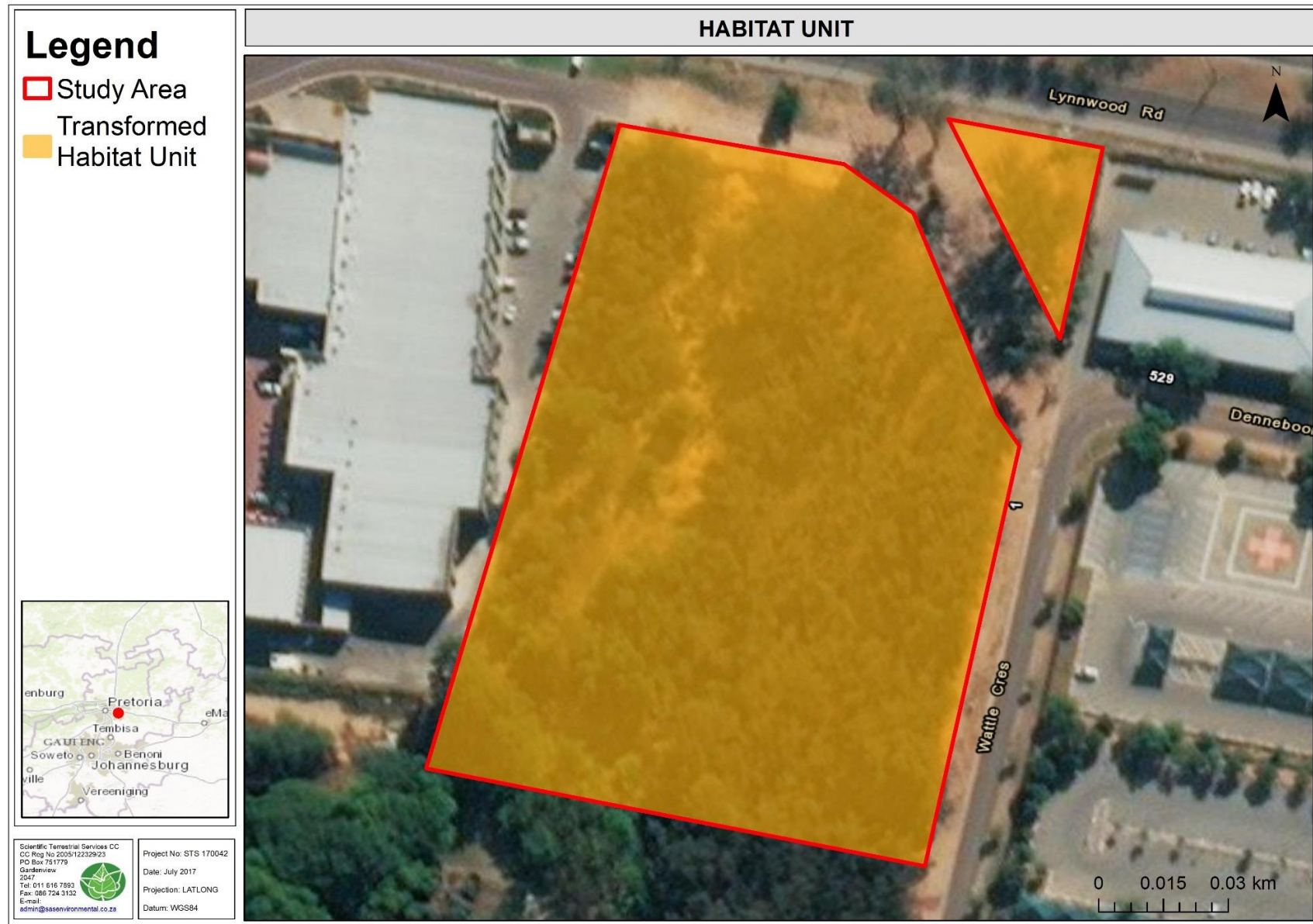


Figure 7: Habitat unit encountered within the study area.



Table 2: Summary of results of the terrestrial scan

Transformed Habitat Unit	Terrestrial Sensitivity	Low
	<p>Notes on Photograph: Top: Predominant alien and invasive vegetation present within the study area. Vagrants also use the study area for refuge.</p> <p>Bottom: <i>Cryptomys hottentotus</i> (African Molerat) and <i>Hamanumida daedalus</i> (Guinea Fowl) observed during the field assessment.</p>	

Terrestrial Sensitivity Graph:

Terrestrial Habitat Sensitivity

Category	Score
Terrestrial SCC	1
Terrestrial Diversity	1
Conservation Status	0
Habitat Integrity	1
Presence of Unique Landscape and Food availability	0



Species of Conservation Concern (SCC)	No faunal or floral SCC were observed within the study area. The study area is highlighted as preferred habitat for <i>Neamblysomus julianae</i> (Juliana's Golden Mole), but due to historic and current anthropogenic activities, especially alien and invasive plant proliferation and vagrants present within the study area makes it highly unlikely for this species to be present. Furthermore, no other faunal or floral SCC are expected to occur within this habitat unit, primarily due to the high levels of anthropogenic activities and related impacts that are ongoing within the study area and in the immediate surrounding areas.	General comments: The immediate surrounding area around the study area is used for urban development and the study area itself is used by vagrants. Building and household rubble was present within the study area. The floral community is dominated by ornamental garden plants and alien and invasive floral species. The floral sensitivity is therefore considered low and no longer representative of the natural vegetation type (Andesite Mountain Bushveld). Due to these high levels of ongoing disturbances, the likelihood of faunal or floral SCC being present within the study area is highly unlikely.	Business Case, Conclusion and Mitigation Requirements: This Transformed Habitat Unit is of low ecological importance and sensitivity. Development related activities would therefore have a low impact on this habitat unit, as significant transformation has already occurred, and the area is located within an urban setting. The habitat integrity is already considered to be highly disturbed and unlikely to support any faunal or floral SCC. Provided that all mitigation measures as stipulated in this report are adhered to, the proposed development is not deemed to have a significant risk to the ecological integrity of the habitat of the study area, and greater Bronberg region.
Terrestrial Species Diversity	Terrestrial species diversity of Transformed Habitat Unit is considered to be low and dominated by alien and invasive floral species as well as garden ornamentals such as, <i>Acacia dealbata</i> , <i>Melia azedarach</i> , and <i>Eucalyptus camaldulensis</i> . Floral species such as <i>Aristida congesta</i> , <i>Cynodon dactylon</i> and <i>Panicum maximum</i> considered to be common and wide spread were present throughout the site. Faunal species observed were primarily of the avifauna class, considered to be common and widespread species.		
Presence of Unique Landscapes and Food Availability	The Transformed Habitat Unit's ecological integrity has been too significantly degraded to be considered unique. High levels of anthropogenic activities and alien and invasive floral species proliferation have resulted in low levels of food availability within the study area. However, a number of seed bearing floral species are present within the study area, resulting in food resources for various invertebrate, avifaunal and small mammal species, therefore it is expected that common faunal species will be encountered within the study area.		
Conservation Status	Although Andesite Mountain Bushveld (Least Threatened) was indicated as being present within the study area, limited vegetation representative of the vegetation type remains, and the habitat unit is dominated by ornamental garden plants and alien and invasive floral species.		
Terrestrial Habitat Integrity	Terrestrial habitat integrity is considered to be low. Widespread habitat degradation from urban expansion has significantly degraded the study area. Furthermore, the ongoing habitat disturbances has resulted in the proliferation of alien and invasive plant species, further negatively affecting the floral community and habitat provision for faunal species.		



4.2 Floral SCC Assessment

An assessment considering the presence of any floral SCC, as well as suitable habitat to support any such species was undertaken. The SANBI PRECIS Red Data Listed plants as well as the GDARD conservation lists were acquired for the Quarter Degree Square (QDS) 2528CD, and are listed in Appendix F.

Threatened species are species that are facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) is a threatened species.

SCC are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare and Declining.

Based on the results obtained, it is highly unlikely that any floral SCC would be present within the study area, due to the high level of habitat transformation already associated with the study area. However, should any floral SCC be encountered during any phase of the proposed development, such species must be removed and relocated under the supervision of a qualified specialist to suitable, similar habitat in close proximity to its original location, but outside of the development footprint.

4.3 Faunal SCC Assessment

During a field assessment of limited duration, it is unlikely that all faunal species will be observed, largely due to the secretive nature of many faunal species, possible low population numbers or varying habits of the species. As such, and to specifically assess an area for faunal SCC, a Probability of Occurrence (POC) matrix is used, utilising several factors to determine the probability of faunal SCC occurrence within the proposed pipeline. Species listed in Appendix G with known distribution ranges and habitat preferences present along the proposed development were taken into consideration. The study area was specifically investigated and was searched for the presence of tell-tale 'trails' caused by the sub-surface 'swimming' action of *N. julianae* through soft sand. Furthermore, the soil was probed with a thin rod to identify any subterranean burrows.



As the study area is severely degraded and isolated from surrounding natural areas, no *N. julianae* or signs of this species were encountered within the study area and no other faunal SCC were observed. Furthermore, the small size and degraded state of the habitat contained within the proposed development is not deemed likely to provide viable and useable resources to faunal SCC. However, should any faunal SCC be encountered during the construction phase of the project, they are to be relocated to similar habitat within the area by a qualified specialist.

5. SENSITIVITY MAPPING

The figure below conceptually illustrates the ecological sensitivity associated with the study area. The areas are depicted according to their sensitivity in terms of the presence or potential for floral and faunal SCC, habitat integrity and levels of disturbance, threat status of the habitat type, the presence of unique landscapes and overall levels of diversity. The table below presents the sensitivity of each identified habitat unit along with an associated conservation objective and implications for development.

Table 3: A summary of sensitivity of each habitat unit and implications for development.

Habitat Unit	Sensitivity	Conservation Objective	Development Implications
Transformed Habitat Unit	Low	Optimise development potential.	The floral composition of the study area is considered to be highly transformed as a result of alien and invasive plant proliferation, this results in a low ecological importance and sensitivity for the habitat unit. Continuity to other larger natural areas in the region is limited. Historic and ongoing anthropogenic activities have resulted in severe degradation and transformation of habitat associated with the study area, and it is therefore highly unlikely to support any faunal or floral SCC. Development related activities would therefore have a low impact on this habitat unit, as the habitat integrity is historically disturbed and located within an urban setting. Thus, no significant impact is anticipated should the development proceed.





Figure 8: Sensitivity map of the study area.



6. IMPACT ASSESSMENT

The tables below serve to summarise the significance of perceived impacts on the terrestrial ecology of the study area, with each individual impact identified presented in Section 6.1 and 6.2 of this report. A summary of all potential pre-construction, construction and operational impacts is provided in Section 6.3.

The tables below present the impact assessment according to the method described in Appendix D. All impacts are considered without mitigation taking place as well as with mitigation fully implemented. All the required mitigatory measures needed to minimise the impact is presented in Section 6.4.

6.1 *IMPACT 1: Impact on Floral Species of Conservation Concern*

During the field assessment, no floral SCC were encountered and it is unlikely that any such species would be present within the study area due to the high levels of transformation that has taken place as a result of current and historic anthropogenic activities. The impact associated with the loss of habitat for these species is considered to be of low significance during both the construction and operational phases of the project prior to the implementation of mitigation measures. With the implementation of mitigation measures, the impact significance of the loss of important species may be even further reduced to very low levels.

Activities and aspects register

Construction	Operational
Site clearance and removal of indigenous vegetation, including floral SCC	An increase in alien floral species due to edge effects from the development may be promoted within the immediate surrounding areas, including the study area
Increased anthropogenic activity within the study area and an increase in the collection of plant material for medicinal and other purposes	
Potential uncontrolled fires due to increased human activity may impact on floral communities	



Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	2	1	2	6	5	30 (Low)
Operational phase	3	2	2	1	5	5	8	40 (Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	2	2	2	1	2	4	5	20 (Very-Low)
Operational phase	2	1	2	1	5	3	8	24 (Very-Low)

6.2 IMPACT 2: Impact on Faunal Species of Conservation Concern

No faunal SCC were identified within the study area and there is a low probability of such species occurring permanently within the study area due to loss of suitable habitat, historic and ongoing anthropogenic and construction activity within the study area. The impact associated with the loss of habitat for these species is considered to be of low significance during both the construction and operational phases of the project prior to the implementation of mitigation measures. With the implementation of mitigation measures, the impact significance of the loss of important species may even further reduced to very low levels.

Activities and aspects register

Construction	Operational
Site clearing and the removal of vegetation leading to habitat loss of faunal SCC	Loss of potential biodiversity of SCC due to continued habitat loss within the study area and surrounding areas
Potential uncontrolled fires due to increased human activity may impact on faunal communities within the study area	Collision of vehicles with faunal species
Increased poaching risk of potential faunal SCC in the surrounding area due to increased human activity associated with the development	Increased fire hazard which would lead to potential loss of SCC
Collision of construction vehicles with potential faunal SCC	



Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	2	3	1	3	5	7	35 (Low)
Operational phase	3	1	2	1	5	4	8	32 (Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	2	2	2	1	3	4	6	24 (Very Low)
Operational phase	1	1	2	1	5	2	8	16 (Very Low)

6.3 Impact Assessment Summary

The tables below summarises the findings indicating the significance of the impact before mitigation takes place and the likely impact if management and mitigation takes place. In the consideration of mitigation, it is assumed that a high level of mitigation takes place, but which does not lead to prohibitive costs. From the tables, it is evident that prior to mitigation the impacts on floral and faunal SCC are low significance impacts. If effective mitigation takes place, all impacts may be reduced to even lower level impacts.

Table 4: A summary of the results obtained from the impact assessment for the construction phase.

Impact	Unmanaged	Managed
1: Impact on Floral Species of Conservation Concern	Low	Very-Low
2: Impact on Faunal Species of Conservation Concern	Low	Very-Low

Table 5: A summary of the results obtained from the impact assessment for the rehabilitation and maintenance phase.

Impact	Unmanaged	Managed
1: Impact on Floral Species of Conservation Concern	Low	Very-Low
2: Impact on Faunal Species of Conservation Concern	Low	Very-Low



6.4 Integrated Impact Mitigation

Mitigation Measures

- Should any floral or faunal SCC be encountered during the site preparation or construction phase, the following measures are to be carried out:
 - Where feasible, effective relocation of individuals to suitable similar habitat in the vicinity of the proposed pipeline;
 - All rescue and relocation plans should be overseen by a suitably qualified specialist;
- It is recommended that site clearing take place in a phased manner (where possible) to allow for any faunal species present to move away from the study area to the surrounding area;
- No trapping or hunting of any faunal species are to take place during the construction phase within the study area or within the surrounding area;
- Upon completion of construction activities, it must be ensured that no bare areas remain and that indigenous grassland species are reintroduced;
- As far as possible, indigenous grassland species, including grasses, should be used as part of the landscaping of the project and it is recommended that *Cynodon dactylon* be used instead of *Pennisetum clandestinum* (Kikuyu) for any lawned areas;
- Edge effects of activities need to be actively managed to minimise further impacts to the receiving environment, with specific consideration to erosion control, including alien and invasive species management;
- Informal fires by construction personnel within the study area should be prohibited;
- No dumping of waste should take place. If any spills occur, they should be immediately cleaned up;
- In the event of a breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced preventing the ingress of hydrocarbons into the topsoil; and
- Alien vegetation as listed in Appendix E must be removed from the study area during both the construction and operational phases of the development, with specific mention of Category 1b species in line with the NEMBA Alien and Invasive Species Regulations (2014).

Possible latent impacts:

- Loss of floral and faunal habitat;
- Permanent loss of and altered floral and faunal species diversity;
- Alien and invasive floral species invasion;



7. CONCLUSION

Scientific Terrestrial Services (STS) was appointed to conduct a terrestrial ecological habitat integrity investigation as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed development on Die Wilgers Extension (Ext) 83 (Tucker Site), in Pretoria, within the Gauteng Province. The objective of this study was to provide sufficient information on the terrestrial ecology of the area, in order for the relevant proponents and the relevant authorities to apply the principles of Integrated Environmental Management (IEM) and the concept of sustainable development.

Based on the terrestrial impact assessment of potential impacts on floral and faunal SCC within the study area, it is evident that both impacts are low prior to mitigation and very low should mitigation measures be put in place. This is due to no such species being encountered during the field assessment and considered highly unlikely to occur within the study area.

It is the opinion of the ecologists that, from a terrestrial ecological point of view, the proposed development be considered favorably provided that the recommended mitigation measures for the identified impacts (as outlined in Section 6.4) are adhered to.



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APPENDIX A – Legislative Requirements

National Environmental Management Act, 1998

The National Environmental Management Act (NEMA; Act 107 of 1998) and the associated Environmental Impact Assessment (EIA) Regulations (GN R982 of 2014) and well as listing notices 1, 2 and 3 (GN R983, R984 and R985 of 2014), state that prior to any development taking place which triggers any activity as listed within the abovementioned regulations, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment process or the EIA process depending on the nature of the activity and scale of the impact.

National Environmental Management Biodiversity Act (NEMBA, Act No. 10 of 2004)

The objectives of this act are (within the framework of NEMA) to provide for:

- The management and conservation of biological diversity within the Republic of South Africa and of the components of such diversity;
- The use of indigenous biological resources in a sustainable manner;
- The fair and equitable sharing among stakeholders of the benefits arising from bio prospecting involving indigenous biological resources;
- To give effect to ratify international agreements relating to biodiversity which are binding to the Republic;
- To provide for cooperative governance in biodiversity management and conservation; and
- To provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act.

This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of the surrounding areas are not negatively impacted upon, by any activity being undertaken, in order to ensure the fair and equitable sharing among stakeholders of the benefits arising from indigenous biological resources.

Furthermore, a person may not carry out a restricted activity involving either:

- a) A specimen of a listed threatened or protected species;
- b) Specimens of an alien species; or
- c) A specimen of a listed invasive species without a permit.

Conservation of Agricultural Resources Act (CARA, Act 43 of 1983)

Removal of the alien and weed species encountered in the application area must take place in order to comply with existing legislation (amendments to the regulations under the CARA, 1983 and Section 28 of the NEMA, 1998). Removal of species should take place throughout the construction and operation, phases.

GDARD Requirements for Biodiversity Assessments Version 3 (GDARD, 2014b).

The biodiversity assessment must comply with the minimum requirements as stipulated by GDARD Version 3 of 2014 and must contain the following information:

- A location and description of the application site and proposed activities;
- Photographic record and description of the site characteristics and inventories of the faunal and floral species observed on site, with special mention to Red Listed species;
- Sensitivity map displaying all sensitive areas and associated buffers as listed in the Sensitivity Mapping Rules for Biodiversity Assessments section of GDARD V3 (2014); and
- A list of recommendations and mitigation measures to reduce the potential environmental impacts that the proposed development might have on the terrestrial ecology associated with the site.



Indemnity and Terms of use of this Report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and STS CC and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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APPENDIX B – Floral Method of Assessment

Floral Method of Assessment

Floral Species of Conservation Concern Assessment

Prior to the field visit, a record of floral SCC and their habitat requirements was acquired from SANBI for the Quarter Degree Square in which the study area is situated, as well as relevant regional, provincial and national lists. Throughout the floral assessment, special attention was paid to the identification of any of these SCC as well as the identification of suitable habitat that could potentially support these species.

The Probability of Occurrence (POC) for each floral SCC was determined using the following calculations wherein the distribution range for the species, specific habitat requirements and level of habitat disturbance were considered. The accuracy of the calculation is based on the available knowledge about the species in question, with many of the species lacking in-depth habitat research.

Each factor contributes an equal value to the calculation.

Distribution						
	Outside of known distribution range					Inside known distribution range
Site score						
EVC 1 score	0	1	2	3	4	5
Habitat availability						
	No habitat available					Habitat available
Site score						
EVC 1 score	0	1	2	3	4	5
Habitat disturbance						
	0	Very low	Low	Moderate	High	Very high
Site score						
EVC 1 score	5	4	3	2	1	0

$[\text{Distribution} + \text{Habitat availability} + \text{Habitat disturbance}] / 15 \times 100 = \text{POC}\%$

Floral Habitat Sensitivity

The floral habitat sensitivity of each habitat unit was determined by calculating the mean of five different parameters which influence floral communities and provide an indication of the overall floristic ecological integrity, importance and sensitivity of the habitat unit. Each of the following parameters are subjectively rated on a scale of 1 to 5 (1 = lowest and 5 = highest):

- **Floral SCC:** The confirmed presence or potential for floral SCC or any other significant species, such as endemics, to occur within the habitat unit;
- **Unique Landscapes:** The presence of unique landscapes or the presence of an ecologically intact habitat unit in a transformed region;
- **Conservation Status:** The conservation status of the ecosystem or vegetation type in which the habitat unit is situated based on local, regional and national databases;
- **Floral Diversity:** The recorded floral diversity compared to a suitable reference condition such as surrounding natural areas or available floristic databases; and
- **Habitat Integrity:** The degree to which the habitat unit is transformed based on observed disturbances which may affect habitat integrity.

Each of these values contribute equally to the mean score, which determines the floral habitat sensitivity class in which each habitat unit falls. A conservation and land-use objective is also assigned to each sensitivity class which aims to guide the responsible and sustainable utilization of the habitat unit in



question. In order to present the results use is made of spider diagrams to depict the significance of each aspect of floral ecology for each vegetation type. The different classes and land-use objectives are presented in the table below:

Table B1: Floral habitat sensitivity rankings and associated land-use objectives.

Score	Rating significance	Conservation objective
1> and <2	Low	Optimise development potential.
2> and <3	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
3> and <4	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.
4> and <5	Moderately high	Preserve and enhance the biodiversity of the habitat unit limit development and disturbance.
5	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.



APPENDIX C – Faunal Method of Assessment

Faunal Assessment Methodology

A reconnaissance 'walk through' on foot was undertaken to determine the general habitat types found throughout the study area. Special emphasis was placed on areas that may potentially support faunal SCC. Sites were investigated on foot in order to identify the occurrence of the dominant faunal communities, species and habitat diversities. The presence of any faunal inhabitants of the study area was also assessed through direct visual observation or identifying such species through calls, tracks, scats and burrows.

It is important to note that faunal species have varied life cycles, breeding patterns, and are subject to seasonal fluctuations. As such, it is unlikely that all faunal species will have been recorded during the site assessment. However, even though some faunal species may not have been identified during the sight assessment, the habitat units and degree of transformation can be used to establish an accurate understanding of faunal assemblages most likely associated with the study area.

Faunal Species of Conservational Concern Assessment

The Probability of Occurrence (POC) for each faunal SCC was determined using the following four parameters:

- Species distribution;
- Habitat availability;
- Food availability; and
- Habitat disturbance.

The accuracy of the calculation is based on the available knowledge about the species in question. Therefore, it is important that the literature available is also considered during the calculation.

Each factor contributes an equal value to the calculation.

Scoring Guideline				
Habitat availability				
No Habitat	Very low	Low	Moderate	High
1	2	3	4	5
Food availability				
No food available	Very low	Low	Moderate	High
1	2	3	4	5
Habitat disturbance				
Very High	High	Moderate	Low	Very Low
1	2	3	4	5
Distribution/Range				
Not Recorded	Historically Recorded		Recently Recorded	
1	3		5	

[Habitat availability + Food availability + Habitat disturbance + Distribution/Range] / 20 x 100 = POC%

Faunal Habitat Sensitivity

The sensitivity of the study area for each faunal class (i.e. mammals, birds, reptiles, amphibians and invertebrates) was determined by calculating the mean of five different parameters which influence each faunal class and provide an indication of the overall faunal ecological integrity, importance and



sensitivity of the study area for each class. Each of the following parameters are subjectively rated on a scale of 1 to 5 (1 = lowest and 5 = highest):

- **Faunal SCC:** The confirmed presence or potential for faunal SCC or any other significant species, such as endemics, to occur within the habitat unit;
- **Habitat Availability:** The presence of suitable habitat for each class;
- **Food Availability:** The availability of food within the study area for each faunal class;
- **Faunal Diversity:** The recorded faunal diversity compared to a suitable reference condition such as surrounding natural areas or available faunal databases; and
- **Habitat Integrity:** The degree to which the habitat is transformed based on observed disturbances which may affect habitat integrity.

Each of these values contribute equally to the mean score, which determines the suitability and sensitivity of the study area for each faunal class. A conservation and land-use objective is also assigned to each sensitivity class which aims to guide the responsible and sustainable utilization of the study area in relation to each faunal class. The different classes and land-use objectives are presented in the table below:

Table C1: Faunal habitat sensitivity rankings and associated land-use objectives.

Score	Rating significance	Conservation objective
1> and <2	Low	Optimise development potential.
2> and <3	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
3> and <4	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.
4> and <5	Moderately high	Preserve and enhance the biodiversity of the habitat unit limit development and disturbance.
5	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.



APPENDIX D - Impact Assessment Methodology

In order for the Environmental Assessment Practitioner (EAP) to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'¹. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the Table D1. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance-rating matrix and are used to determine whether mitigation is necessary².

The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by

¹ The definition has been aligned with that used in the ISO 14001 Standard.

² Some risks/impacts that have low significance will however still require mitigation.



increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

Table D1: Criteria for assessing significance of impacts

LIKELIHOOD DESCRIPTORS

Probability of impact	RATING
Highly unlikely	1
Possible	2
Likely	3
Highly likely	4
Definite	5
Sensitivity of receiving environment	RATING
Ecology not sensitive/important	1
Ecology with limited sensitivity/importance	2
Ecology moderately sensitive/ /important	3
Ecology highly sensitive /important	4
Ecology critically sensitive /important	5

CONSEQUENCE DESCRIPTORS

Severity of impact	RATING
Insignificant / ecosystem structure and function unchanged	1
Small / ecosystem structure and function largely unchanged	2
Significant / ecosystem structure and function moderately altered	3
Great / harmful/ ecosystem structure and function largely altered	4
Disastrous / ecosystem structure and function seriously to critically altered	5
Spatial scope of impact	RATING
Activity specific/ < 5 ha impacted / Study areas affected < 100m	1
Development specific/ within the site boundary / < 100ha impacted / Study areas affected < 100m	2
Local area/ within 1 km of the site boundary / < 5000ha impacted / Study areas affected < 1000m	3
Regional within 5 km of the site boundary / < 2000ha impacted / Study areas affected < 3000m	4
Entire habitat unit / Entire system/ > 2000ha impacted / Study areas affected > 3000m	5
Duration of impact	RATING
One day to one month	1
One month to one year	2
One year to five years	3
Life of operation or less than 20 years	4
Permanent	5



Table D2: Significance Rating Matrix.

LIKELIHOOD (Frequency of activity + Frequency of impact)	CONSEQUENCE (Severity + Spatial Scope + Duration)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Table D3: Positive/Negative Mitigation Ratings.

Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
Very high	126-150	Critically consider the viability of proposed projects Improve current management of existing projects significantly and immediately	Maintain current management
High	101-125	Comprehensively consider the viability of proposed projects Improve current management of existing projects significantly	Maintain current management
Medium-high	76-100	Consider the viability of proposed projects Improve current management of existing projects	Maintain current management
Medium-low	51-75	Actively seek mechanisms to minimise impacts in line with the mitigation hierarchy	Maintain current management and/or proposed project criteria and strive for continuous improvement
Low	26-50	Where deemed necessary seek mechanisms to minimise impacts in line with the mitigation hierarchy	Maintain current management and/or proposed project criteria and strive for continuous improvement
Very low	1-25	Maintain current management and/or proposed project criteria and strive for continuous improvement	Maintain current management and/or proposed project criteria and strive for continuous improvement

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
 - Primary project site and related facilities that the client and its contractors develops or controls;
 - Areas potentially impacted by cumulative impacts for any existing project or condition and other project-related developments; and
 - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for all stages of the project cycle including:
 - Pre-construction;
 - Construction; and
 - Operation.
- If applicable, transboundary or global effects were assessed.
- Individuals or groups who may be differentially or disproportionately affected by the project because of their *disadvantaged* or *vulnerable* status were assessed.
- Particular attention was paid to describing any residual impacts that will occur after rehabilitation.



Mitigation measure development

The following points present the key concepts considered in the development of mitigation measures for the proposed development.

- *Mitigation and performance improvement measures* and actions that address the risks and impacts³ are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation.
- Desired outcomes are defined, and have been developed in such a way as to be *measurable events with performance indicators, targets and acceptable criteria* that can be tracked over *defined periods*, with estimates of the *resources* (including human resource and training requirements) *and responsibilities for implementation*.

Recommendations

Recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the operation from planning, through to construction and operation.

³ Mitigation measures should address both positive and negative impacts



APPENDIX E – Species List

Table F1: Dominant floral species encountered in the study area. Alien species are indicated with an asterisk (*). Also indicated are species falling within an alien invasive category as per the National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, 2016.

Grasses and sedges	Forbs and groundcovers	Trees and shrubs
<i>Aristida congesta</i> subsp. <i>congesta</i>	<i>Aloe arborescens</i>	* <i>Acacia dealbata</i> 2
<i>Cynodon dactylon</i>	<i>Aloe greatheadii</i>	* <i>Agave sisalana</i> 2
<i>Cymbopogon excavatus</i>	<i>Anthericum fasciculatum</i>	<i>Celtis Africana</i>
<i>Eragrostis rigidior</i>	* <i>Bidens pilosa</i>	* <i>Cereus jamacaru</i> 1b
<i>Heteropogon contortus</i>	* <i>Bryophyllum delagoense</i> 1b	* <i>Eucalyptus grandis</i> 1b
<i>Melinis repens</i>	* <i>Cana indica</i> 1b	<i>Erythrina lysistemon</i>
<i>Panicum maximum</i>	* <i>Datura stramonium</i> 1b	* <i>Lantana camara</i> 1b
<i>Pogonarthria squarrosa</i>	* <i>Tagetes minuta</i>	* <i>Melia azedarach</i> 1b
<i>Setaria sphacelata</i>	<i>Stapelia gigantea</i>	* <i>Opuntia ficus-indica</i> 1b
<i>Sporobolus africanus</i>	<i>Zinnia peruviana</i>	* <i>Opuntia imbricate</i> 1b
		* <i>Pinus patula</i> 1b
		* <i>Populus x canensis</i> 1b
		<i>Psidium guajava</i> 2
		* <i>Solanum mauritianum</i> 1b

1a: Category 1a – Invasive species that require compulsory control.

1b: Category 1b – Invasive species that require control by means of an invasive species management programme.

2: Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.

3: Category 3 – Ornamentally used plants that may no longer be planted; existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

Mammal species observed

Scientific name	Common Name	IUCN Red List Status
<i>Cryptomys hottentotus</i>	Common Mole Rat	LC

LC = Least concerned. NT = Near Threatened, NYBA = Not yet been assessed by the IUCN.



Avifaunal species observed

Scientific Name	Common Name	IUCN status
<i>Pycnonotus tricolor</i>	Dark-capped Bulbul	NYBA
<i>Passer melanurus</i>	Cape Sparrow	LC
<i>Lanius collaris</i>	Common Fiscal	LC
<i>Acridotheres tristis</i>	Common Myna	LC
<i>Bostrychia hagedash</i>	Hadedda Ibis	LC
<i>Streptopelia capicola</i>	Cape Turtle Dove	LC
<i>Passer domesticus</i>	House Sparrow	LC
<i>Streptopelia senegalensis</i>	Laughing Dove	LC
<i>Lagonosticta rhodopareia</i>	Jameson's Firefinch	LC
<i>Colius striatus</i>	Speckled Mousebird	LC

LC = Least concerned. NT = Near Threatened, NYBA = Not yet been assessed by the IUCN.

Insect species observed

Scientific Name	Common Name	IUCN Status
<i>Junonia hierta</i>	Yellow Pansy	LC
<i>Danaus chrysippus</i>	African Monarch	NYBA
<i>Acanthacris ruficornis</i>	Garden Locust	NYBA
<i>Oedaleus sp</i>	N/A	NYBA
<i>Gastrimargus sp</i>	N/A	NYBA
<i>Orthoctha dasycnemis</i>	B/A	NYBA
<i>Anoplolepis custodiens</i>	Pugnacious Ant	NYBA
<i>Acrea horta</i>	Garden Acrea	NYB
<i>Musca domestica</i>	House fly	NYBA
<i>Cheilomenes lunata</i>	Lunate Ladybird	NYBA

NYBA = Not Yet Been Assessed, LC = Least Concern



APPENDIX F – Floral SCC

Table F1: PRECIS plant list and GDARD Conservation list for the QDS 2528CD (Raimondo *et al.*, 2009; SANBI, www.sanbi.org).

Family	Species	Threat status	Habitat
Crassulaceae	<i>Adromischus umbraticola</i> subsp. <i>umbraticola</i>	NT	South-facing rock crevices on ridges, restricted to Gold Reef Mountain Bushveld in the northern parts of its range, and Andesite Mountain Bushveld in the south
Fabaceae	<i>Argyrobium campicola</i>	NT	Highveld Grassland
Amaryllidaceae	<i>Boophone disticha</i>	Declining	Dry grassland and rocky areas.
Hyacinthaceae	<i>Bowiea volubilis</i> subsp. <i>volubilis</i>	VU	Low and medium altitudes, usually along mountain ranges and in thickly vegetated river valleys, often under bush clumps and in boulder screes, sometimes found scrambling at the margins of karroid, succulent bush in the Eastern Cape. It is often found in open woodland or on steep rocky hills usually in well-shaded situations. Tolerates wet and dry conditions, growing predominantly in summer rainfall areas with an annual rainfall of 200-800 mm.
Orchidaceae	<i>Brachycorythis conica</i> subsp. <i>transvaalensis</i>	CR	Short, open grassland and wooded grassland, on sandy gravel overlying dolomite, sometimes also on quartzite, 1 000-1 705 m.
Asteraceae	<i>Callilepis leptophylla</i>	Declining	Grassland or open woodland, often on rocky outcrops or rocky hill slopes
Apocynaceae	<i>Ceropegia decidua</i> subsp. <i>pretoriensis</i>	VU	Associated with ridges and quartzitic rocky outcrops in pockets of soil among rocks in direct sunshine or shaded areas.
Pteridaceae	<i>Cheilanthes deltoidea</i> subsp. <i>silicicola</i>	VU	Southwest-facing soil pockets and rock crevices in chert rock.
Amaryllidaceae	<i>Crinum macowanii</i>	Declining	Mountain grassland and stony slopes in hard dry shale, gravelly soil or sandy flats
Aizoaceae	<i>Delosperma leendertziae</i>	NT	Steep, south-facing slopes of quartzite in mountain grassland.
Hyacinthaceae	<i>Eucomis autumnalis</i>	Declining	Damp, open grassland and sheltered places from the coast to 2450 m.
Orchidaceae	<i>Eulophia coddii</i>	VU	Steep slopes, growing on sandstone-derived soils in grassland or bushveld.
Gunneraceae	<i>Gunnera perpensa</i>	Declining	Damp marshy area and vleis from coast to 2400 m.
Orchidaceae	<i>Habenaria barbertoni</i>	NT	Rocky hillsides, in bushveld in association with acacias, 1000-1500 m.
Orchidaceae	<i>Habenaria bicolor.</i>	NT	Well-drained grasslands at around 1600 m in South Africa.
Orchidaceae	<i>Habenaria kraenzliniana.</i>	NT	Stony, grassy hillsides, 1000-1400 m.
Orchidaceae	<i>Habenaria mossii</i>	EN	Open grassland on dolomite or in black, sandy soil.
Hypoxidaceae	<i>Hypoxis hemerocallidea</i>	Declining	Occurs in a wide range of habitats, from sandy hills on the margins of dune forests to open rocky grassland; also grows on dry, stony, grassy slopes, mountain slopes and plateaux; appears to be drought and fire tolerant.
Aquifoliaceae	<i>Ilex mitis</i> var. <i>mitis</i>	Declining	Along rivers and streams in forest and thickets, sometimes in the open. Found from sea level to inland mountain slopes.
Fabaceae	<i>Indigofera hybrida</i>	VU	Dry Highveld grassland.
Anacardiaceae	<i>Searsia gracillima</i> var. <i>gracillima</i>	NT	Rocky quartzitic outcrops in bushveld.
Apocynaceae	<i>Stenostelma umbelluliferum</i>	NT	Deep black turf in open woodland mainly in the vicinity of drainage lines.

VU = Vulnerable, NT = Near Threatened, EN = Endangered, CR = Critically Endangered



Table F2: Additional floral SCC for the QDS 2528CD as obtained from GDARD.

Family	Species	Threat status	Habitat
CRASSULACEAE	<i>Adromischus umbraticola</i> subsp. <i>umbraticola</i>	NT	Rock crevices on rocky ridges, usually south-facing, or in shallow gravel on top of rocks, but often in shade of other vegetation.
FABACEAE	<i>Argyrobium campicola</i>	NT	Highveld grassland.
PTERIDACEAE	<i>Cheilanthes deltoidea</i>	VU	Southwest-facing soil pockets and rock crevices in chert rock.
AIZOACEAE	<i>Delosperma leendertziae</i>	NT	Rocky ridges; on rather steep south facing slopes of quartzite in mountain grassveld.
HYACINTHACEAE	<i>Eucomis autumnalis</i>	Declining	Damp, open grassland and sheltered places.
ORCHIDACEAE	<i>Eulophia coddii</i>	VU	Steep hillsides on soil derived from sandstone, grassland or mixed bush.
ORCHIDACEAE	<i>Habenaria mossii</i>	EN	Open grassland on dolomite or in black sandy soil.
APOCYNACEAE	<i>Miraglossum laeve</i>	CR	Hills in Gold Reef Mountain Bushveld and possibly Gauteng Shale Mountain Bushveld.

VU = Vulnerable, NT = Near Threatened, EN = Endangered, CR = Critically Endangered



APPENDIX G – Faunal SCC

TableG1: RDL Mammal Species for the Gauteng Province (GDARD 2014).

Scientific Name	Common name	IUCN Status	GDARD Status
<i>Neamblysomus julianae</i>	Juliana's Golden Mole	EN	VU
<i>Mystromys albicaudatus</i>	White-tailed Mouse	EN	EN
<i>Atelerix frontalis</i>	Southern African Hedgehog	LC	NT
<i>Lutra maculicollis</i>	Spotted-necked Otter	NT	NT
<i>Miniopterus schreibersii</i>	Scheiber's Long-Fingered Bat	NT	NT
<i>Myotis tricolor</i>	Temminck's Hairy Bat	LC	NT
<i>Rhinolophus blasii</i>	Blasius's/Peak-Saddle Horseshoe Bat	LC	VU
<i>Rhinolophus clivosus</i>	Horseshoe Bat	LC	NT
<i>Rhinolophus darlingi</i>	Darling's Horseshoe Bat	LC	NT
<i>Rhinolophus hildebrandtii</i>	Hildebrandt's Horseshoe Bat	LC	NT

VU = Vulnerable, EN = Endangered, NT = Near Threatened, LC= Least Concern

Table G2: RDL Avifaunal Species for the Gauteng Province (GDARD 2014).

Scientific Name	Common name	IUCN Status	Regional Status	GDARD Status
<i>Gyps coprotheres</i>	Cape Vulture	EN	EN	VU
<i>Anthropoides paradiseus</i>	Blue Crane	VU	NT	VU
<i>Falco naumanni</i>	Lesser Kestrel	LC	Ad mon	-
<i>Tyto capensis</i>	African Grass-Owl	LC	VU	VU
<i>Circus ranivorus</i>	African Marsh-Harrier	LC	EN	VU
<i>Gorsachius leuconotus</i>	White-backed Night Heron	LC	VU	VU
<i>Eupodotis senegalensis</i>	White-bellied Korhaan	LC	VU	VU
<i>Podica senegalensis</i>	African Finfoot	LC	VU	VU
<i>Mirafraga cheniana</i>	Melodious Lark	NT	End and N-end	NT
<i>Sagittarius serpentarius</i>	Secretary bird	VU	VU	NT
<i>Ciconia nigra</i>	Black Stork	LC	VU	-
<i>Eupodotis caerulescens</i>	Blue Korhaan	NT	End and N-end	NT
<i>Polemaetus bellicosus</i>	Martial Eagle	VU	EN	-
<i>Phoenicopterus minor</i>	Lesser Flamingo	NT	NT	-
<i>Phoenicopterus roseus</i>	Greater Flamingo	LC	NT	-
<i>Alcedo semitorquata</i>	Half-collared Kingfisher	LC	NT	NT

VU = Vulnerable, NT = Near Threatened, LC = Least Concern, EN = Endangered, Ad mon = Additional Monitoring, End and N-end = Endemic and Near endemic



Table G3: RDL Invertebrates Species for the Gauteng Province (GDARD 2014)

Scientific Name	Common name	IUCN Status	GDARD Status
<i>Lepidochrysops praeterita</i>	Highveld Blue Butterfly	NYBA	VU
<i>Chrysoritis aureus</i>	Heidelberg Copper	NYBA	VU
<i>Ichneustoma stobbiai</i>	Stobbia's Fruit Chafer Beetle	NYBA	VU
<i>Aloeides dentatis</i>	Roodepoort Copper Butterfly	NYBA	VU

VU = Vulnerable, NYBA = Not yet been assessed

Table G4: RDL Reptile Species for the Gauteng Province (GDARD 2014)

Scientific Name	Common name	IUCN Status	GDARD Status
<i>Homoroselaps dorsalis</i>	Striped Harlequin Snake	NT	NT

NT = Near Threatened

Avifaunal Species for the pentad 2610_2825 within the QDS 2528CD,

http://sabap2.adu.org.za/pentad_info.php?pentad=2610_2825§ion=species



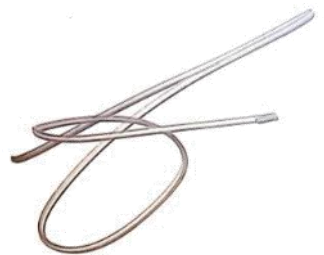
APPENDIX H – Declaration and Specialists CV's

Declaration

Declaration that the specialist is independent in a form as may be specified by the competent authority

I, Emile van der Westhuizen, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct



Signature of the Specialist



SCIENTIFIC TERRESTRIAL SERVICES (STS) – SPECIALIST CONSULTANT INFORMATION CURRICULUM VITAE OF EMILE BASSON VAN DER WESTHUIZEN

PERSONAL DETAILS

Position in Company	Ecologist, Botanist
Date of Birth	30 May 1984
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2008

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Council for Natural Scientific Professions (SACNASP) (Reg. Number 100008/15).

EDUCATION

Qualifications		
BSc (Hons) Plant Science (University of Pretoria)		2012
B.Sc. Botany and Environmental Management (University of South Africa)		2010
Short Courses		
Grass Identification – Africa Land Use Training		2009
Wild Flower Identification – Africa Land Use Training		2009

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Free State, Eastern Cape.
Mozambique (Tete, Sofala and Manica Provinces)
Democratic Republic of the Congo (Katanga and Kivu Provinces)
Ghana (Western and Greater Accra Provinces)

SELECTED PROJECT EXAMPLES

Floral Assessments

- Floral assessment for the proposed Modikwa Platinum Mine South 2 Shaft Project, Burgersfort, Limpopo Province.
- Floral assessment for the proposed New Clydesdale Colliery Stopping Project, Vandyksdrift, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed Harriet's Wish PGM Project, Limpopo Province.
- Floral assessment as part of the environmental authorisation process for the proposed Shanduka Coal Argent Colliery in the vicinity of Argent, Mpumalanga.
- Floral assessment for the Auroch Resources Manica Gold Mining Project, Manica, Mozambique.
- Floral assessment for the Namoya Gold Mine project in Namoya, Democratic Republic of Congo.
- High level floral risk assessment and alternatives analysis for the proposed new Tete Airport, Tete, Mozambique.
- Floral assessment for the proposed Richardsbay Harbour Compactor Slab development, Richardsbay, Kwa-Zulu-Natal Province.
- Site walkdown and floral ecological input prior to the construction of the proposed 180km Mfolozi-Mbewu powerline, Richardsbay, Kwa-Zulu-Natal Province.
- Floral assessment as part of the EIA process for the proposed Peerboom Colliery, Lephalale, Limpopo Province.
- Floral assessment as part of the EIA process for the proposed Overvaal Underground Coal Mine Project, Ermelo, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed King's City Takoradi 3000-hectare development, Takoradi, Ghana.
- Floral assessment as part of the EIA process for the proposed Aquarius Platinum Fairway Platinum Mine, Steelpoort, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed Geniland Lubumbashi City 4000-hectare development, Likasi, Katanga Province, Democratic Republic of Congo.
- Floral, faunal, aquatic and wetland assessment as part of the EIA process for the proposed Appollonia City Accra 3000-hectare development, Accra, Ghana.
- Floral assessment as part of the EIA process for the proposed Leeuw Colliery, Utrecht, Kwa-Zulu Natal Province.



- Floral assessment as part of the EIA process for the proposed Lubembe Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Kinsenda Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Lonshi Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Jozini Shopping Mall, Jozini, Kwa-Zulu Natal Province.
- Floral assessment as part of the Biodiversity Action Plan for the Assmang Chrome Dwarsrivier Mine, Steelpoort, Mpumalanga Province.





SCIENTIFIC TERRESTRIAL SERVICES (STS) – SPECIALIST CONSULTANT INFORMATION CURRICULUM VITAE OF **HENNIE DE BEER**

PERSONAL DETAILS

Position in Company	Ecologist – Focusing on Avifaunal species
Date of Birth	20 October 1986
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2014

EDUCATION

Qualifications

National Diploma Nature Conservation (Tshwane University of Technology)	2008
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COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Eastern Cape, Western Cape, Northern Cape and Free state Mozambique
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SELECTED PROJECT EXAMPLES

Faunal Assessments

- Leandra Colliery (2015) – Faunal assessment as part of the environmental assessment and authorisation process for the proposed the Leandra Coal Project, Gauteng and Mpumalanga Provinces;
- Siyanda Chrome Smelter (2015) - Faunal assessment as part of the environmental assessment and authorisation process for a proposed construction of a ferrochrome smelter, Limpopo province;
- Lace Diamond Mine (2015) – Faunal assessment as part of the environmental assessment and authorisation process for the lace diamond mine near Kroonstad, free state province;
- Duhva Solar Plant (2015) – Avifaunal as part of the Environmental Impact Assessment and authorisation process for the proposed solar photovoltaic power plant with associated infrastructure at the Duvha Coal Fired Power Station, Mpumalanga province;
- Arnot Solar Plant – Avifaunal Assessment as part of the Environmental Impact Assessment and authorisation process for the proposed solar photovoltaic power plant with associated infrastructure at the Arnot coal fired power station, Mpumalanga Province;
- Braakfontein Colliery – Faunal Assessment as part of the Environmental Assessment and authorisation process for the proposed Braakfontein Coal Mine near Newcastle, KwaZulu-Natal Province;
- Kekana Powerline – Faunal Ecological Assessment as part of the Environmental Assessment and authorisation process for the proposed Kekana and Wonderboom 132kv powerlines and substations, Hammanskraal, Gauteng;
- Samrand Phase 3 / Olievenhoutbosch – Floral, Faunal and Wetland Ecological Assessment as part of the Environmental Assessment and authorisation process for the proposed development of the Kosmosdal township on the remainder of portion 2 of the farm Olievenhoutbosch no. 389-jr, Gauteng Province;
- Jeanette Gold Mine – Faunal Assessment as part of the Environmental assessment and authorisation process for Jeanette expansion project at the Taung Gold International mine near Welkom within the Free State Province; and
- PTN 38 Elandspruit Farm – Faunal Assessment as part of the Environmental Assessment and authorisation process for the proposed mining development on portion 38 of the Elandspruit farm. Mpumalanga Province.

Terrestrial scan:

- K77 (2014) - Terrestrial scan Assessment as part of the Environmental Impact Assessment and authorisation process for the proposed development of the Provincial road K77, Gauteng highlands: Elizabeth road to K154; and
- Blue Hills EXT 39 - Biodiversity Assessment Fauna and Flora.

Alien Vegetation Monitoring Plan:

- Bokoni Platinum Mine (2015) - Alien vegetation study.



Maintenance and Management Plans:

- Levendal Pearl Valley Phase 2 Roads Bar – Maintenance and Management Plan;
- Sanbona Wildlife Reserve/Dwyka Lodge – Maintenance and Management Plan;
- Pearl Valley Bulk Services – Maintenance and Management Plan;
- Ariadne Eros Powerline – Maintenance and Management Plan; and
- Rhodes Drive/Constantia – Maintenance and Management Plan.

Wetland:

R40 Ring Road Bushbuck Ridge – Wetland delineation and field work.

Previous Work Experience

- Eradication of aquatic plants from water canals using chemicals.
- Junior Research Technician National Rangeland Monitoring Program (NRMP) at Agriculture Research Council (ARC) doing Vegetation Condition Assessment for cattle farmers in the Vryheid area. Also did the following work for the Savanna Ecosystem Project: Vegetation Condition Assessments, Carrying Capacity, and annual game counts were done on 24 reserves in the Lowveld area, also at Gorongosa Mozambique. Rehabilitation monitoring of the mine dumps for Phalaborwa Mining Company.
- Assisted in the following programs doing practical year at Timbavati Private Nature Reserve:
 - Ringing of Ground Hornbill chicks on the reserve;
 - Monitoring project on nesting sites of White backed Vultures at Timbavati Private Nature Reserve by using game census data and visiting the sites to see if the nesting sites were still active or not;
 - Burning programs;
 - Anti-poaching;
 - Hunting;
 - Culling;
 - Bush thinning of *Colophospermum mopane* (Mopane); and
 - Started a Lion identification key for all the Male lions on the reserve.

