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**BIODIVERSITY ASSESSMENT AS PART OF THE  
ENVIRONMENTAL AUTHORISATION PROCESS FOR THE  
PROPOSED MODDERFONTEIN TOWNSHIP  
DEVELOPMENT, GAUTENG PROVINCE**

**Prepared for**

**Nali Sustainability Solutions**

**April 2020**

**Part B: Floral Assessment**

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SAS Environmental Group of Companies

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## LIST OF ACRONYMS

<b>BGIS</b>	Biodiversity Geographic Information Systems
<b>CARA</b>	Conservation of Agricultural Resources Act
<b>CBA</b>	Critical Biodiversity Area
<b>CITES</b>	Convention on International Trade in Endangered Species of Wild Fauna and Flora
<b>CR</b>	Critically Endangered
<b>DWS</b>	Department of Water and Sanitation
<b>GDARD</b>	Gauteng Department of Agriculture and Rural Development
<b>EAP</b>	Environmental Assessment Practitioner
<b>EIA</b>	Environmental Impact Assessment
<b>EN</b>	Endangered
<b>ESA</b>	Ecological Support Area
<b>GIS</b>	Geographic Information System
<b>GPS</b>	Global Positioning System
<b>IBA</b>	Important Bird Area
<b>IUCN</b>	International Union for the Conservation of Nature
<b>NBA</b>	National Biodiversity Assessment (2011)
<b>NEMA</b>	National Environmental Management Act, 1998 (Act No. 107 of 1998)
<b>NEMBA</b>	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
<b>NT</b>	Near Threatened
<b>PES</b>	Present Ecological State
<b>POC</b>	Probability of Occurrence
<b>POSA</b>	Plants of Southern Africa
<b>PRECIS</b>	Pretoria Computer Information Systems
<b>QDS</b>	Quarter Degree Square (1:50,000 topographical mapping references)
<b>RDL</b>	Red Data Listed
<b>SANBI</b>	South African National Biodiversity Institute
<b>SCC</b>	Species of Conservation Concern
<b>STS</b>	Scientific Terrestrial Services CC
<b>VU</b>	Vulnerable



## GLOSSARY OF TERMS

Most definitions are based on terms and concepts elaborated by Richardson *et al.* (2011), Hui and Richardson (2017) and Wilson *et al.* (2017), with consideration to their applicability in the South African context, especially South African legislation [notably the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), and the associated Alien and Invasive Species (A&I) Regulations, 2014.

<b>Alien species</b> (syn. exotic species; non-native)	A species that is present in a region outside its natural range due to human actions (intentional or accidental) that have enabled it to overcome biogeographic barriers.
<b>Biological diversity or Biodiversity</b> (as per the definition in NEMBA)	The variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems.
<b>Biome</b> - as per Mucina and Rutherford (2006); after Low and Rebelo (1998).	A broad ecological spatial unit representing major life zones of large natural areas – defined mainly by vegetation structure, climate and major large-scale disturbance factors (such as fires).
<b>Bioregion</b> (as per the definition in NEMBA)	A geographic region which has in terms of section 40(1) been determined as a bioregion for the purposes of this Act;
<b>CBA</b> (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.
<b>Disturbance</b>	A temporal change, either regular or irregular (uncertain), in the environmental conditions that can trigger population fluctuations and secondary succession. Disturbance is an important driver of biological invasions.
<b>Endangered</b>	Organisms in danger of extinction if causal factors continue to operate.
<b>Endemic species</b>	Species that are only found within a pre-defined area. There can therefore be sub-continental (e.g. southern Africa), national (South Africa), provincial, regional or even within a particular mountain range.
<b>ESA</b> (Ecological Support Area)	An ESA provides connectivity and important ecological processes between CBAs and is therefore important in terms of habitat conservation.
<b>Habitat</b> (as per the definition in NEMBA)	A place where a species or ecological community naturally occurs.
<b>IBA</b> (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.
<b>Indigenous vegetation</b> (as per the definition in NEMA)	Vegetation occurring naturally within a defined area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.
<b>Integrity</b> (ecological)	The integrity of an ecosystem refers to its functional completeness, including its components (species) its patterns (distribution) and its processes.
<b>Invasive species</b>	Alien species that sustain self-replacing populations over several life cycles, produce reproductive offspring, often in very large numbers at considerable distances from the parent and/or site of introduction, and have the potential to spread over long distances.
<b>Listed alien species</b>	All alien species that are regulated in South Africa under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004), Alien and Invasive Species (A&I) Regulations, 2016.
<b>Least Threatened</b>	Least threatened ecosystems are still largely intact.
<b>Native species</b> (syn. indigenous species)	Species that are found within their natural range where they have evolved without human intervention (intentional or accidental). Also includes species that have expanded their range as a result of human modification of the environment that does not directly impact dispersal (e.g. species are still native if they increase their range as a result of watered



	gardens, but are alien if they increase their range as a result of spread along human-created corridors linking previously separate biogeographic regions).
<b>Primary Grassland</b> (as per SANBI Grassland Guidelines, 2013)	Primary grasslands are those that have not been significantly modified from their original state; even though they may no longer have their full complement of naturally-occurring species, they have not undergone significant or irreversible modification and still retain their essential ecological characteristics.
<b>RDL (Red Data listed species)</b>	According to the Red List of South African plants ( <a href="http://redlist.sanbi.org/">http://redlist.sanbi.org/</a> ) and the International Union for Conservation of Nature (IUCN), organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.
<b>SCC (Species of Conservation Concern)</b>	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 threatened species as well as protected species of relevance to the project.
<b>Secondary Grassland</b> (as per SANBI Grassland Guidelines, 2013)	Secondary grasslands are those that have undergone extensive modification and a fundamental shift from their original state (e.g. to cultivated areas), but have then been allowed to return to a 'grassland' state (e.g. when old cultivated lands are re-colonised by a few grass species).



## DOCUMENT GUIDE

The following table indicates the requirements for Specialist Studies as per Appendix 6 of Government Notice 326 as published in Government Notice 40772 of 2017, amendments to the Environmental Impact Assessment (EIA) Regulations, 2014 as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998).

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Part A: Appendix E
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Part A: Appendix E
b)	A declaration that the specialist is independent	Part A: Appendix E
c)	An indication of the scope of, and the purpose for which, the report was prepared	Part B: Section 1
cA)	An indication of the quality and age of base data used for the specialist report	Part B: Section 2 and Part A: 3
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Part B: Section 3 and Section 5
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Part B: Section 2
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Part B: Appendix A and Part A: Appendix 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	Part B: Section 3 and 4
g)	An identification of any areas to be avoided, including buffers	Part B: Section 4
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	Part B: Section 4
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Part B: Section 1.3
j)	A description of the findings and potential implication\ s of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Part B: Section 5
k)	Any mitigation measures for inclusion in the EMPr	Part B: Section 5
l)	Any conditions for inclusion in the environmental authorisation	Part B: Section 5
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Part B: Section 5
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	S Part B: Section 6
(iA)	Regarding the acceptability of the proposed activity or activities	Part B: Section 6
(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	Part B: 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



# 1 INTRODUCTION

## 1.1 Background

Scientific Terrestrial Services (STS) was appointed to conduct a biodiversity assessment as part of the Environmental Impact Assessment and Authorisation process for proposed Modderfontein Township Development, within the Gauteng Province (hereafter referred to as the “study area”) (Figure 1). At the time of the assessment, no final development plant layouts were available.

The study area is located in the Gauteng Province, approximately 4.7 km west of the Kempton Park, 617m northeast of Eden Glen and 3.5km southeast of Limbro Park. The study area is comprised of the remaining extent of the Portion 36 of the Farm Modderfontein 35 IR, falling within the City of Johannesburg Local Municipality. The R25 roadway is located approximately 186m north of the study area, while the M32 roadway is 1.8km east and the N3 Eastern Bypass is 3.6km to the west of the study area. The broader landscape primarily comprises urban built-up areas in all directions; grassland is, however, present to the northeast of the study area.

The purpose of this report is to define the floral ecology of the study area, to identify areas of increased Ecological Importance and Sensitivity (EIS), as well as the mapping of such areas, and to describe the Present Ecological State (PES) of the study area.

## 1.2 Scope of Work

Specific outcomes in terms of the report are as follows:

- To determine and describe habitat types, communities and the ecological state of the study area and to rank each habitat type based on conservation importance and ecological sensitivity;
- To provide inventories of floral species as encountered within the study area;
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and/or any other special features;
- To conduct a Red Data Listed (RDL) floral species assessment as well as an assessment of other Species of Conservation Concern (SCC), including the potential for such species to occur within the study area;
- To provide detailed information to guide the activities associated with the proposed development within the study area; and





- To ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.

### **1.3 Assumptions and Limitations**

The following assumptions and limitations are applicable to this report:

- The floral assessment is confined to the study area and does not include the neighbouring and adjacent properties;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. The field assessment took place during the summer season when most species were still in flower and thus provided ideal conditions for plant identification. The floral ecology associated with the study area is considered to have been adequately assessed and considered, and the information provided is assumed to be sufficient to allow for informed decision making and to facilitate integrated environmental management;
- Sampling by its nature means that not all individuals are assessed and identified. Some species and taxa within the study area may have been missed during the assessment; and
- The floral field assessment was undertaken on the 20<sup>th</sup> and 21<sup>st</sup> of February 2020 (summer season), to determine the floral ecological status of the study area, and to “ground-truth” the results of the desktop assessment (presented in Part A). A more accurate assessment would require that assessments take place in all seasons of the year. On-site data was, therefore augmented with all available desktop data and specialist experience in the area, and the findings of this assessment are considered to be an accurate reflection of the ecological characteristics of the study area.



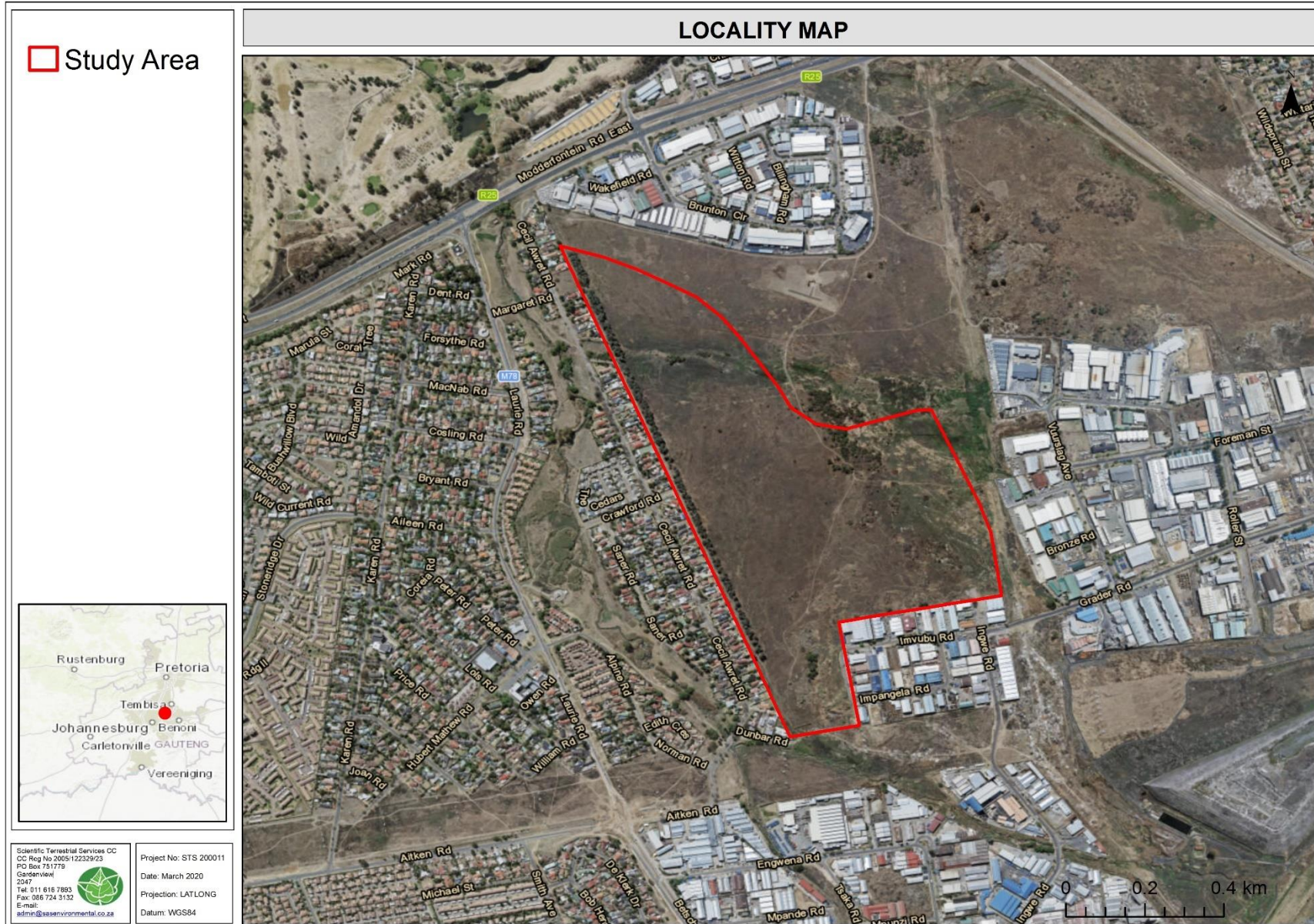


Figure 1: Conceptual illustration of the study area in relation to the surrounding areas.



## 2 ASSESSMENT APPROACH

The field assessment was undertaken on the 20<sup>th</sup> and 21<sup>st</sup> of February 2020 (summer season), to determine the floral ecological status of the study area.

The below sections provide the approach followed during the field assessment and reporting of results.

### 2.1 General Approach

To accurately determine the ecological state of the study area and to capture comprehensive data with respect to floral ecology, the following methodology was followed:

- Maps and digital satellite imagery were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. The results of these analyses were then used to guide the fieldwork component;
- All relevant information as presented by SANBI's Biodiversity Geographic Information Systems (BGIS) website (<http://bgis.sanbi.org>), including the Gauteng Conservation Plan (2011), was consulted to gain background information on the physical habitat and potential floral diversity associated with the study area; and
- For the field assessments, a reconnaissance 'walkabout' was undertaken to determine the general habitat types found throughout the study area - with special emphasis being placed on areas that may potentially support floral SCC. The field assessments took place on foot in order to identify the occurrence of the dominant plant species and habitat diversities.

Additional information on the method of assessment is provided in **Appendix A** of this report.

### 2.2 Sensitivity Mapping

All the ecological features of the study area were considered, and sensitive areas were assessed and projected onto satellite imagery. The sensitivity map should assist the Environmental Assessment Practitioner (EAP) / proponent as to the suitability of the proposed development within the study area.



### 3 RESULTS OF FLORAL ASSESSMENT

The study area is situated in the Dry Highveld Grassland Bioregion, which is considered fundamentally different from all other South African grassland ecosystems in that it is associated with a different climate. In this semi-arid ecosystem, water and not the duration and temperature of the growing season is the limiting factor to growth. The patch of approximately 10 000 hectares (ha) of Dry Highveld Grassland in which the study area is situated is almost entirely surrounded by Mesic Highveld Grassland. As such, the grasslands associated with the study area present with some influences from the Mesic Highveld Grassland Bioregion, including slightly higher annual rainfall (593 mm) than what is typical for the Dry Highveld Grasslands (400 – 550 mm).

Following the field assessment, three broad habitat units could be distinguished within the study area, namely Degraded Habitat, Grassland Habitat and Wetland Habitat. The habitat ranged from areas heavily influenced by the surrounding anthropogenic activities (degraded habitat with alien vegetation dominant) to areas largely isolated from anthropogenic-related pressures (intact grasslands). Specific details pertaining to habitat integrity, threat status of the habitat type, the presence of unique landscapes and overall levels of diversity, are described in more detail in sections 3.1 – 3.3. The three habitat units are introduced in below.

#### Degraded Habitat:

The western and southern sections of the study area are associated with Degraded Habitat. Historical disturbance within these areas, such as dumping of rubble and adjacent urban expansions, have resulted in poor habitat conditions. With ongoing anthropogenic activities occurring immediately adjacent to the Degraded Habitat, alien vegetation has encroached into these areas. Since there is no current control of alien vegetation, these species have spread and displaced indigenous<sup>1</sup> grassland vegetation.

The floral community structure in the Degraded Habitat has been modified to the extent where the vegetation is no longer representative of the reference state, i.e. the Carletonville Dolomite Grassland vegetation type (as described in Mucina and Rutherford, 2006). The southern section of the Degraded Habitat has prominent rock outcrops, which is characteristic of the reference state; however, these are now overgrown by alien and invasive plant (AIP) trees

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<sup>1</sup> NEMA: “vegetation of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.”



and thus heavily degraded. The Degraded Grassland is not considered to be primary grassland<sup>2</sup>.

Section 3.1 provides more detailed descriptions of the floral communities associated with this habitat unit.

#### Grassland Habitat:

The Grassland Habitat within the study area is an isolated ecosystem of approximately 22 ha that is surrounded by housing and industrial developments with a wetland running through its northern section. Within the study area, the Grassland Habitat is characterised by a shallow rock layer, resulting in outcrops scattered throughout this habitat unit; an anticipated feature of the Carletonville Dolomite Grassland vegetation type (i.e. the reference state).

Due to exclusion from significant historic and current modifications to the habitat, such as significant topsoil disturbance, dumping and minimal human movement, the Grassland Habitat retained most of its full complement of naturally occurring species. Habitat integrity is decreased in some sections due to *Hyparrhenia hirta* and *Hyparrhenia tamba* dominance, with minimal alien vegetation encroachment, which has contributed to this habitat unit's sensitivity being reduced from a moderately high score to an intermediate score. The Grassland Habitat unit remains of increased ecological importance as it conforms to the below:

- Representative of the reference state (vulnerable Carletonville Dolomite Grassland);
- Conforms to the definition of indigenous vegetation; and
- Considered primary grassland as it has not undergone significant or irreversible modification. With no extensive modification, the grassland cannot be considered secondary<sup>3</sup>.

Section 3.2 provides more detailed descriptions of the floral communities associated with this habitat unit.

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<sup>2</sup> SANBI (2013): Primary grasslands are those that have not been significantly modified from their original state; even though they may no longer have their full complement of naturally-occurring species, they have not undergone significant or irreversible modification and still retain their essential ecological characteristics.

<sup>3</sup> SANBI (2013): Secondary grasslands are those that have undergone extensive modification and a fundamental shift from their original state (e.g. to cultivated areas), but have then been allowed to return to a 'grassland' state (e.g. when old cultivated lands are re-colonised by a few grass species).



Wetland Habitat:

The Wetland Habitat comprises a specialist group of vegetation that is adapted to saturated soils. Within the study area, the Wetland Habitat is associated with a natural system that runs through the northern section and also borders the eastern section of the study area. Within the southern section of the study area, an artificial feature is present.

The Wetland Habitat within the northern section of the study area was generally in a better condition than the Wetland Habitat within the eastern and southern sections where the Wetland Habitat borders the Degraded Habitat. Habitat integrity has largely been degraded, especially within the eastern sections of the study area. This is not just a result of impacts on site, e.g. historic dumping and the current proliferation of AIPs, but likely also result from anthropogenic impacts in the immediate surroundings (increases in stormwater to wetlands) and upstream of the systems.

Section 3.3 provides more detailed descriptions of the floral communities associated with this habitat unit.



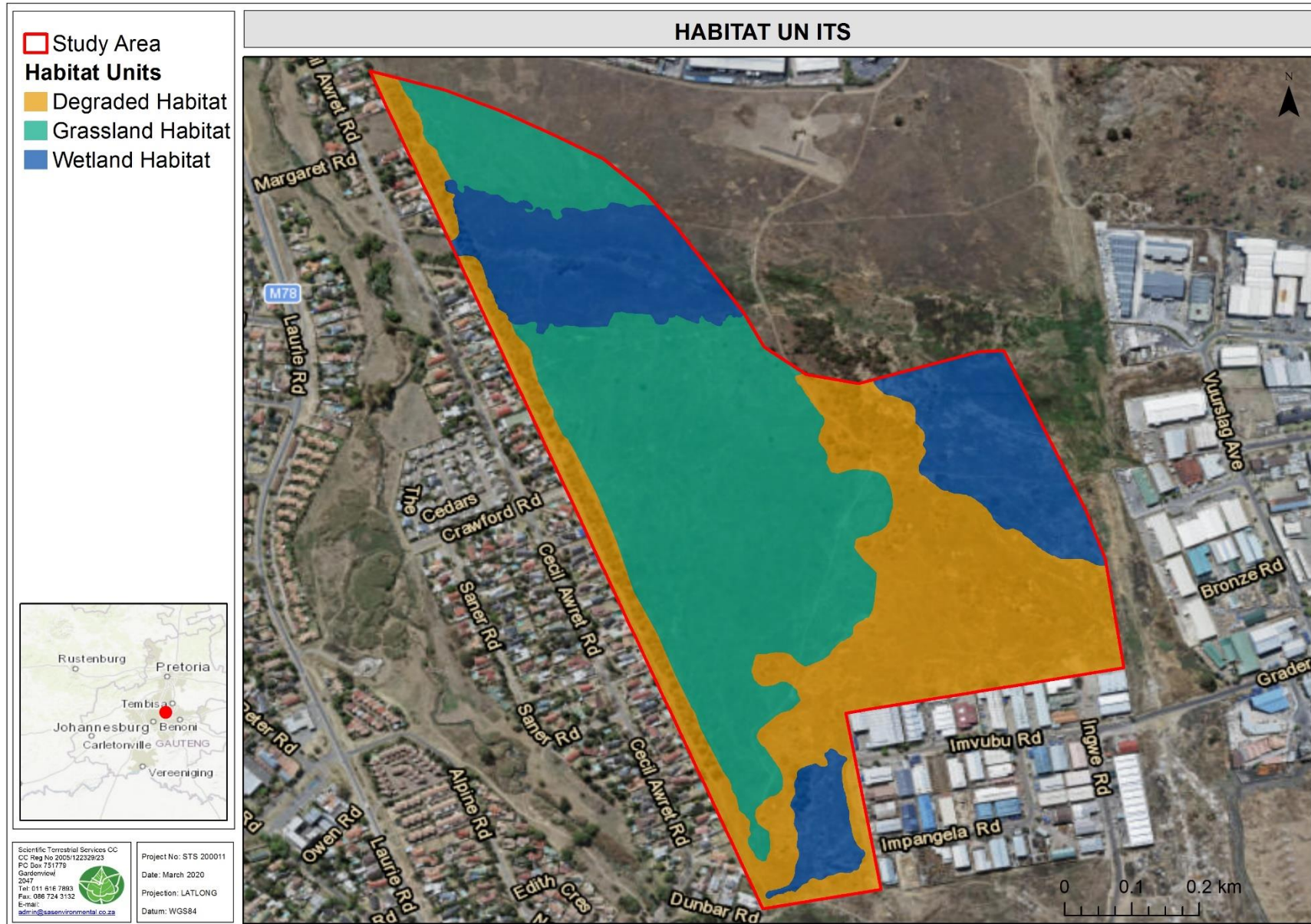
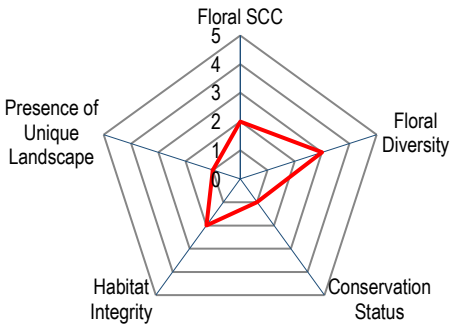



Figure 2: Conceptual illustration of the habitat units within the study area as identified during the 2020 assessment.




### 3.1 Degraded Habitat Unit

Sensitivity of the Degraded Habitat Unit	REPRESENTATIVE PHOTOS OF THE DEGRADED HABITAT
<p style="text-align: center;"><b>Moderately Low</b></p> 	 <p style="text-align: center;">Typical view of the Degraded Habitat, where alien vegetation dominates within areas where dumping has occurred.</p>
<b>Floral Ecology</b> <b>Species Diversity, Habitat integrity and Alien and Invasive species</b>	
<p>The Degraded Habitat is associated with an overall moderate species diversity of which indigenous floral species are poorly represented. Due to the extent of habitat degradation that has resulted from historic and current anthropogenic pressures on floral communities, the species composition has been altered and no longer represents the reference vegetation type (Carletonville Dolomite Grassland). Sections of this habitat unit is associated with a dominant woody layer, with graminoids better represented in other sections. Throughout this habitat unit, the indigenous forb layer is not well represented, whereas AIP forbs are abundant.</p> <p>The vegetation communities within the Degraded Habitat are broadly described below:</p> <ul style="list-style-type: none"> <li>• The woody layer was prominent in scattered clumps, some of which are associated with rock outcrops. The largest grouping of woody species is present within the northern section of the Degraded Habitat. These woody clumps chiefly comprise AIP trees such as <i>Acacia dealbata</i>, <i>Melia azedarach</i>, <i>Schinus terebinthifolia</i> and <i>Solanum mauritanum</i>. Indigenous woody species also formed an important part of these clumps, including species that are common for the areas such as <i>Celtis africana</i>, <i>Diospyros lycioides</i> subsp. <i>sericea</i>, <i>Searsia rigida</i> and <i>Vachellia karroo</i>;</li> <li>• The forb layer comprised of commonly occurring grassland species such as <i>Cleome rubella</i>, <i>Gladiolus crassifolius</i>, <i>Helichrysum rugulosum</i>, <i>Nidorella podocephala</i>, <i>Plantago lanceolate</i> and <i>Sida dregei</i> – all species that typically associate well with areas of increased disturbance. Several AIP forbs were recorded in this habitat unit, of which the most abundant species included <i>Bidens pilosa</i>, <i>Campuloclinium macrocephalum</i>, <i>Cosmos bipinnatus</i>, <i>Ipomoea purpurea</i>, <i>Tagetes minuta</i> and <i>Verbena bonariensis</i>; and</li> <li>• Graminoids occurred throughout and included a variety of species characteristic of the reference vegetation type, but these species only occurred in low abundances. The dominant graminoid species comprised species tend to form dominant stands on degraded or disturbed veld, i.e. <i>Cymbopogon pospischilii</i>, <i>Hyparrhenia hirta</i>, <i>Hyparrhenia tamba</i>, <i>Sporobolus africanus</i> and <i>Urochloa panicoides</i>.</li> </ul> <p>Floral habitat integrity is considered moderately low for this habitat unit as species compositions is largely comprised of AIP species. Refer to Appendix C for a list of species occurring within this habitat unit.</p>	





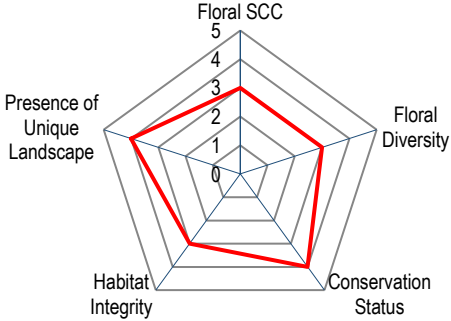

<p><b>Floral Species of Conservation Concern</b></p>	<p>During the field assessment, no floral species of conservation concern (SCC) were recorded within the Degraded Habitat. Floral cover almost entirely comprises alien vegetation or floral species associated with areas of increased disturbance. Currently, the habitat is not favourable to harbour threatened species which typically associated with specialised habitat conditions. It is highly unlikely that any such species will occur within this habitat unit. Refer to section 3.4 for a discussion on floral SCC associated with the study area.</p>	
<p><b>Conservation Status of Vegetation Type/Ecosystem</b></p>	<p>The Degraded Habitat falls within the remaining extent of the <b>critically rare (CR)</b> Rietvleiriver Highveld Grassland Ecosystems (Threatened Ecosystems, 2011) as well as within Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) (Gauteng Conservation Plan V3.3, 2011). This habitat unit is not considered representative of the above conservation features, due to extensive degradation of the floral communities. From a floral perspective, this habitat unit does not contribute towards biodiversity importance in its current state and is not deemed important for the conservation of floral communities within the area.</p>	<p style="text-align: center;"><b>Presence of Unique Landscapes</b></p> <p>No unique landscapes important to flora were present. From a floral perspective, and in its current degraded state, this habitat unit is not important for species diversity or community structure.</p>
<p>Some Degraded Habitat representatives:</p>		
		
<p>From left to right: <i>Amaranthus hybridus</i>, <i>Cosmos bipinnatus</i> and <i>Ipomoea purpurea</i>.</p>		
<p><b>Business Case, Conclusion and Recommendations</b></p>		
<p>The Degraded Habitat is of moderately low sensitivity and importance from a floral resource management perspective. Habitat integrity is significantly degraded, and no floral SCC occur in this habitat unit. Any planned development within this habitat unit will not have a direct impact on any sensitive floral communities within the area.</p>		
<p><b>Biodiversity considerations and recommendation regarding the Degraded Habitat include:</b></p>		
<ul style="list-style-type: none"> <li>• This habitat unit forms part of significant conservation features such as the remaining extent of the <b>critically rare</b> Rietvleiriver Highveld Grassland Ecosystems and also largely falls within a CBA. However, this habitat unit can no longer be regarded a representative of these features. The current dominance of AIPs within this habitat unit is likely to have negative impacts on adjacent, more sensitive floral communities in the area that are still representative of these important biodiversity features. It is therefore highly recommended that an AIP Control and Management Plan be implemented throughout the development phases to ensure these species do not continue to spread; and</li> <li>• Due to the degradation of floral communities associated with the Degraded Grassland habitat unit, it does not conform to the definition of indigenous vegetation<sup>4</sup> and cannot be considered primary grassland<sup>5</sup>.</li> </ul>		

<sup>4</sup> NEMA: “vegetation of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.”

<sup>5</sup> SANBI (2013): Primary grasslands are those that have not been significantly modified from their original state; even though they may no longer have their full complement of naturally-occurring species, they have not undergone significant or irreversible modification and still retain their essential ecological characteristics.



### 3.2 Grassland Habitat

Sensitivity of the Grassland Habitat Unit	REPRESENTATIVE PHOTOS OF THE GRASSLAND HABITAT	
<p style="text-align: center;"><b>Intermediate</b></p> 	 <p style="text-align: center;">Typical view of the Grassland Habitat, the rocky nature supports a diversity of succulent species, e.g. <i>Aloe greatheadii</i> var. <i>davyana</i> and <i>Crassula capitella</i>.</p>	
Floral Ecology Species Diversity, Habitat integrity and Alien and Invasive species		
<p>The Grassland Habitat is associated with a moderate indigenous floral diversity, but species occurred in moderately high densities, i.e. the species were not scattered throughout but occurred almost continuously. Alien vegetation does not form a dominant component within this habitat unit; although this habitat unit might be at risk of AIP proliferation due to the adjacent Degraded Habitat and Wetland Habitat being associated with high abundances of alien vegetation. The diversity of floral species varies within life forms but largely aligns with the description for the Carletonville Dolomite Grassland (reference vegetation type) where the forb and graminoid layers make up the dominant vegetation layer, with woody species mainly comprising low shrubs and geoxylic suffrutices<sup>6</sup>.</p> <p>The vegetation communities within the Grassland Habitat are broadly described below:</p> <ul style="list-style-type: none"> <li>• Where the rock outcrops were more prominent, several succulent species were recorded, including <i>Aloe greatheadii</i> var. <i>davyana</i>, <i>Crassula capitella</i> and <i>Euphorbia clavarioides</i>;</li> <li>• The graminoid layer was well represented with <i>Themeda triandra</i> often dominant – an indication of good veld conditions. Species representative of the reference state were recorded throughout this habitat unit and included <i>Bewsia biflora</i>, <i>Brachiaria serrata</i>, <i>Diheteropogon amplexans</i>, <i>Eragrostis chloromelas</i>, <i>Eragrostis racemose</i>, <i>Melinis repens</i>, <i>Themeda triandra</i> and <i>Tristachya leucothrix</i>;</li> <li>• The forb layer was species rich, especially concentrated around the rocky outcrops. Several forbs were representative of the reference state, including <i>Acalypha angustata</i>, <i>Helichrysum nudifolium</i> var. <i>nudifolium</i>, <i>Ipomoea ommaneyi</i>, <i>Pollichia campestris</i> and <i>Hilliardiella elaeagnoides</i>. The more abundant forbs were, however, limited to typical grassland species that are also generally associate with rockier environments, including <i>Cyanotis speciosa</i>, <i>Euphorbia striata</i>, <i>Geigeria burkei</i>, <i>Gladiolus crassifolius</i>, <i>Hermannia depressa</i>, <i>Ledebouria asperifolia</i>, <i>Ledebouria revoluta</i>, <i>Macledium zeyheri</i> subsp. <i>zeyheri</i>, <i>Striga elegans</i> and <i>Vernonia natalensis</i>; and</li> </ul>		

<sup>6</sup> The South African grasslands are home to so-called 'underground trees' or geoxylic suffrutices, a life form with massive underground wooden structures. These species attain only a hundredth to a tenth the height of normal trees.



- The woody component can be separated into low shrubs, geoxylic suffrutices and trees. The low shrub component comprised *Anthospermum rigidum* subsp. *pumilum*, *Indigophera zeyheri*, *Seriphium plumosum* and *Solanum panduriforme*. These species were not abundant within the Grassland Habitat and in the case of *Seriphium plumosum*, this indicates that the veld is not degraded as this species often proliferates in disturbed or overgrazed areas. The geoxylic suffrutices included *Elephantorrhiza elephantina* and *Ziziphus zeyheriana* – mostly associated with the rockier areas. Sparsely scattered tree species such as *Gymnosporia buxifolia* and *Searsia leptodictya* were located closer to areas of disturbance and/or Wetland Habitat.

Floral habitat integrity is considered intact for this habitat unit. Refer to Appendix C for a list of species occurring within this habitat unit.

**Floral Species of Conservation Concern**

No floral SCC were recorded during the site assessment; however, the **endangered** *Habenaria mossii* is associated with the Carletonville Dolomite Grassland but only flowers in March/April – which is outside of the assessment time and this species could thus have been missed.

The Grassland Habitat is also within a Critical Biodiversity Area (CBA) considered important Red and Orange Listed Plant habitat – indicating that this habitat unit likely supports SCC. Suitable conditions to support an additional Red Listed plant species, namely *Habenaria bicolor* (NT) is present within the Grassland Habitat. Several Orange List plants were also determined to have suitable habitat within this habitat unit, including *Callilepis leptophylla* (Declining), *Eucomis autumnalis* (Declining) and *Hypoxis hemerocallidea* (Declining) – All listed as declining within the Gauteng Province according to the GDARD red and orange plant list (Compaan, 2011), although they are considered to be of least concern on a National level.

Refer to section 3.4 for a discussion on floral SCC associated with the study area.

**Conservation Status of Vegetation Type/Ecosystem**

This habitat unit can be classified as primary grassland (SANBI 2013) as well as indigenous vegetation (NEMA) and, as such, is of increased conservation significance. The Grassland Habitat Unit falls within a CBA important for Red Listed and Orange Listed Plant habitat, as well as primary vegetation (Gauteng C-Plan v3.3) – these are areas required for meeting both the Province’s biodiversity pattern and ecological process targets. The Grassland Habitat is considered vulnerable, as per Mucina and Rutherford (2006), however, the recently updated National Biodiversity Assessment (2018) lists this vegetation type as Least Concern.

From a floral perspective, this habitat unit is important for the conservation of floral communities within the area.

**Presence of Unique Landscapes**

The Grassland Habitat is not well represented in the larger landscape as most grasslands have been transformed as a result of urbanisation. This habitat unit’s exclusion from historic and current disturbances has resulted in the habitat being largely intact and able to support a variety of grassland species – as opposed to the remaining natural areas in the vicinity that have been degraded by, e.g. proliferation of alien vegetation.

**Some Grassland representatives**



From left to right: *Crassula capitella*, *Euphorbia clavarioides*, *Gladiolus elliotii* and *Macledium zeyheri* subsp. *zeyheri*.



**Business Case, Conclusion and Recommendations**

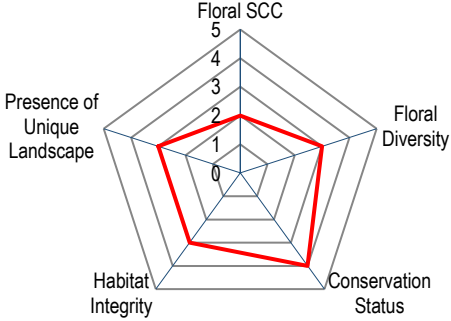

This habitat unit is of intermediate sensitivity, from a floral perspective. The grassland has retained much of its expected species composition and the lack of historic and current disturbances have resulted in no significant modification to the grassland. Natural grasslands within the urban setting is rapidly declining as they are transformed by urban expansion. This isolated grassland patch is within a CBA and is thus of provincial importance (Gauteng C-Plan v3.3). Development in this habitat unit will impact on floral communities within the study area as well as within the broader region, as intact grasslands are threatened by urban expansion.

**Below is a list of the recognised biodiversity constraints and important considerations for the Grassland Habitat:**

- CBAs are required for meeting the biodiversity pattern and ecological process targets for the Province and include areas where little to no areas remain to meet those targets. The Grassland Habitat is representative of a CBA in that the vegetation is considered primary and the floral composition representative of the reference vegetation type;
- No Floral SCC were recorded for this habitat unit, but the potential presence of SCC cannot be overlooked (refer to section 3.4). If this habitat unit will be impacted by the proposed project, a thorough walkdown of the footprint areas should take place before vegetation clearing commences where all floral SCC are marked for rescue and relocation, or removal;
- As part of best-practices and minimum ecological requirements for managing grasslands for biodiversity (SANBI, 2013), wherever possible, primary grasslands should be kept in a natural or near-natural state and should be managed to avoid degradation. This includes very strict edge effect management from activities occurring within the adjacent, less sensitive areas;
- Due to the presence of primary grassland, GDARD could recommend a 200 m buffer in which development will be restricted. The applicability of a buffer will need to be determined by a GDARD official, taking into consideration that the Grassland Habitat is of intermediate sensitivity and is isolated from other, larger natural grasslands; and
- To limit any potential latent or cumulative impacts on the floral ecology within the habitat unit, it is important to limit the footprint of the proposed project to the degraded areas and to ensure that no additional AIP species are introduced to this habitat unit. This will increase the effort required to clear or manage AIPs down the line.



### 3.3 Wetland Habitat

Sensitivity of the Degraded Habitat Unit	REPRESENTATIVE PHOTOS OF THE WETLAND HABITAT	
<p style="text-align: center;"><b>Intermediate</b></p> 	 <p style="text-align: center;">Typical view of the Wetland Habitat, with several sections dominated by alien vegetation (left) and other stretches still intact and represented by indigenous grass species.</p>	
<p><b>Floral Ecology</b>  <b>Species Diversity, Habitat integrity and Alien and Invasive species</b></p>		
<p>The Wetland Habitat is associated with an intermediate floral diversity, though this diversity was unevenly distributed within the study area. Areas within the northern section of the study area, as well as some sections within the east, was less degraded and supported several indigenous floral species. In more disturbed areas adjacent to the Degraded Habitat, alien vegetation formed the dominant floral component and grasses such as <i>Hyparrhenia tamba</i> formed monodominant stands.</p>		
<p>The vegetation communities within the Grassland Habitat are broadly described below:</p> <ul style="list-style-type: none"> <li>• No indigenous succulent species are associated with the Wetland Habitat, only the AIP <i>Opuntia ficus-indica</i> was present;</li> <li>• The graminoid layer varied in species diversity, but largely consisted of grass species such as <i>Paspalum urvillei</i>, <i>Andropogon appendiculatus</i>, <i>Calamagrostis epigejos</i>, <i>Chloris gayana</i>, <i>Cynodon dactylon</i>, <i>Hyparrhenia tamba</i>, <i>Imperata cylindrica</i> and <i>Setaria sphacelata</i> var <i>sericea</i> – all species that are characteristically associated with areas of increased soil moisture;</li> <li>• The forb layer was species rich in some patches and poorly represented in more disturbed areas. Commonly occurring forb species were <i>Helichrysum nudifolium</i>, <i>Helichrysum rugulosum</i>, <i>Nesaea schinzii</i>, <i>Nidorella anomala</i>, <i>Pulicaria scabra</i>, <i>Senecio inornatus</i> and <i>Wahlenbergia undulata</i>; and</li> <li>• The woody component did not comprise species specifically associated with wetland conditions, but rather included species commonly occurring in the region. These species included trees such as <i>Celtis africana</i>, <i>Diospyros lycioides</i> subsp. <i>sericea</i> and <i>Vachellia karroo</i>. Alien tree species were also recorded within this habitat unit, sometimes forming the dominant floral component. Of most concern is <i>Acacia dealbata</i>, <i>Melia azedarach</i> and <i>Schinus terebinthifolia</i> as these are all listed as Category invaders in the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA) List of Alien and Invasive Species (2016).</li> </ul> <p>Floral habitat integrity is considered altered and, in some areas, degraded for this habitat unit. The species composition is no longer a representative of the reference vegetation type. Refer to Appendix C for a list of species occurring within this habitat unit.</p>		
<p><b>Floral Species of Conservation Concern</b></p>	<p>During the field assessment, no floral species of conservation concern (SCC) were recorded within the Wetland Habitat. For the most part the habitat does not provide favourable conditions for floral SCC to establish successfully, especially with AIPs increasing in abundance and extent in this habitat unit. However, Orange Listed species such as <i>Eucomis autumnalis</i> (Declining), <i>Gunnera purpensa</i> (Declining) and <i>Hypoxis hemerocallidea</i> (Declining) are able to tolerate conditions of increased disturbance and are this likely to establish within the Wetland Habitat. Refer to section 3.4 for a discussion on floral SCC associated with the study area.</p>	



<p><b>Conservation Status of Vegetation Type/Ecosystem</b></p>	<p>The Wetland Habitat in the eastern portion of the study area falls within the remaining extent of the <b>critically rare</b> Rietvleiriver Highveld Grassland Ecosystems (Threatened Ecosystems, 2011). The Wetland Habitat also falls within a Critical Biodiversity Area (CBA), which is important for Red Listed and Orange Listed Plant habitat, as well as primary vegetation (Gauteng C-Plan v3.3). The degraded condition of the vegetation has rendered the Wetland Habitat a poor representation of threatened ecosystems and CBAs. Watercourses are further legally protected within the National Water Act, 1998 (Act No. 36 of 1998) (NWA).</p> <p>From a floral perspective, this habitat unit is of moderately low importance from a floral conservation perspective.</p>	<p><b>Presence of Unique Landscapes</b></p> <p>From a floral perspective, the wetland habitat is unique in providing habitat for species associated with wetland or soil saturated conditions. The presence of AIPs are limiting the Wetland Habitat's potential to function as a linkage corridor along which faunal and floral species can move and disperse.</p>
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**Some Wetland representatives**



From left to right: *Hypoxis obtusa*, *Chironia purpurascens*, *Helichrysum setosum* and *Nesaea schinzii*.

**Business Case, Conclusion and Recommendations**

The Wetland Habitat is of intermediate sensitivity and importance from a floral resource management perspective. This habitat unit is associated with an altered vegetation structure that is either dominated by alien vegetation or that is dominated by the grass species *Hyparrhenia tamba*. As a whole this habitat unit is still ecologically functioning and support a moderate diversity of indigenous flora. Development in this habitat unit will impact on floral communities within the study area but is less likely to have any significant impact within the broader region.

**Below is a list of the recognised biodiversity constraints and important considerations for the Grassland Habitat:**

- Despite the habitat integrity being reduced, the Wetland Habitat is within a CBA (Gauteng C-Plan, 2011). Development within a CBA should be avoided to allow for ecological processes within the study area, and beyond, to continue without resulting in a loss of the region's biodiversity;
- Extensive proliferation of AIPs will continue to place pressure on remaining indigenous floral communities. An AIP Control and Management Plan is recommended for this habitat unit; and
- It is recommended that a Freshwater Assessment be undertaken for the study area as any activities planned within the delineated wetlands or the zones of regulation, as identified by a qualified freshwater ecologist, will require authorisation from the Department of Water and Sanitation (DWS). These include areas within the wetland and their associated 32m GDARD (wetlands setback zone). The habitat integrity of the wetlands is greatly compromised by the presence of alien vegetation; however, the wetlands provide unique habitat for several indigenous flora dependant on soil-saturated conditions and further serve as an important dispersal corridor.



### 3.4 Floral Species of Conservation Concern Assessment

Threatened/protected species are species that are facing a high risk of extinction. Any species classified in the International Union for the Conservation of Nature (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. A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7 of the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA).

The SCC assessment not only considers floral SCC recorded on site during the field assessment but also includes a Potential of Occurrence (POC) assessment where the assessment takes suitable habitat to support any such species into consideration. Thus, for the POC assessment, a list of Red Data Listed (RDL) species previously recorded within the QDS 2628AA was obtained from Gauteng Department of Agriculture and Rural Development (GDARD), comprising SANBI Red Data Listed species.

During the field assessment, no floral SCC were recorded, which is not uncommon for once-off site assessments, as species turnover in grasslands are typically high. The study area was also degraded in several sections and thus habitat to support floral SCC has been lost. Only the Grassland Habitat was still intact and provided favourable habitat to support floral SCC. According to the list provided by GDARD, the following Red/Orange List plant taxa have been recorded from the farm on which the study area is situated or within 5 km of the study area:

- *Habenaria bicolor*
- *Holothrix micrantha*

For the above floral species, the Grassland Habitat provides suitable habitat for *Habenaria bicolor* but not for *Holothrix micrantha* which occur along grass cliffs. *Habenaria bicolor* is a rare species that is currently listed as near threatened (NT) both nationally and provincially (Table 1). This species flowers between March and April, which is outside of the time the field assessments took place. This species could thus be present within the study area.

For the species within the remainder of the QDS 2628AA, as provided by GDARD, their calculated Probability of Occurrence (POC) ratings are tabulated in Appendix B. Table 1 lists those species that obtained a POC score of 60% or more. In addition to the already mentioned *Habenaria bicolor*, the study area (mostly the Grassland Habitat) provides suitable habitat for five RDL species, namely *Callilepis leptophylla*, *Eucomis autumnalis*, *Gunnera perpensa*,



*Habenaria mossii* and *Hypoxis hemerocallidea*. Of these species, only *Habenaria mossii* is considered **endangered (EN)** nationally, with the remaining species listed as declining within the Gauteng Province according to the GDARD red an orange plant list (Compaan, 2011), although they are considered to be of least concern on a National level.

Should any floral SCC be encountered during any phase of the proposed development, these species should be rescued and relocated by a suitably qualified specialist and either relocated to similar suitable habitat within the study area, but outside the development footprint, utilised within the landscaping plan of the project, or moved to registered nurseries such as the Agricultural Research Council (ARC) or the South African National Biodiversity Institute (SANBI). Any other floral SCC encountered during the construction phase of the proposed development should also be relocated by a suitably qualified specialist and, where required, the necessary permits should be applied for.

**Table 1: Floral SCC that were not recorded during the field assessment but, due to suitable habitat, potentially occurs on site. A full list of POC calculations is presented in Appendix B.**

Species	National Threat status	Provincial Status	Habitat	POC %
<i>Callilepis leptophylla</i>	LC	Declining	<b>Range:</b> Widespread in eastern half of South Africa. Also in Swaziland. <b>Major habitats:</b> Grassland, Savanna. <b>Description:</b> Grassland or open woodland, often on rocky outcrops or rocky hill slopes.	60
<i>Eucomis autumnalis</i>	LC	Declining	<b>Range:</b> South Africa, Swaziland, Lesotho, Botswana, Zimbabwe and Malawi. <b>Major habitats:</b> Grassland. <b>Description:</b> Damp, open grassland and sheltered places from the coast to 2450 m	73
<i>Gunnera perpensa</i>	LC	Declining	<b>Range:</b> Western Cape to Ethiopia. <b>Major habitats:</b> Albany Thicket, Fynbos, Grassland, Indian Ocean Coastal Belt, Nama Karoo, Savanna <b>Description:</b> Damp marshy area and vleis from coast to 2400 m.	73
<i>Habenaria bicolor</i>	NT	NT	<b>Range:</b> Gauteng and near Middelburg in Mpumalanga. Also known from two records from Zimbabwe. <b>Major habitats:</b> Grassland. <b>Description:</b> Well-drained grasslands at around 1600 m in South Africa.	60
<i>Habenaria mossii</i>	EN	EN	<b>Range:</b> Johannesburg, Pretoria and Krugersdorp. <b>Major habitats:</b> Carletonville Dolomite Grassland, Andesite Mountain Bushveld. <b>Description:</b> Open grassland on dolomite or in black, sandy soil.	60





Species	National Threat status	Provincial Status	Habitat	POC %
<i>Hypoxis hemerocallidea</i>	LC	Declining	<p><b>Range:</b> Widespread in the eastern part of southern Africa from the Eastern Cape to Botswana and Mozambique.</p> <p><b>Major habitats:</b> Albany Thicket, Grassland, Indian Ocean Coastal Belt, Savanna.</p> <p><b>Description:</b> Occurs in a wide range of habitats, including sandy hills on the margins of dune forests, open, rocky grassland, dry, stony, grassy slopes, mountain slopes and plateaus. Appears to be drought and fire tolerant</p>	73

EN = Endangered; LC = Least Concern.

### 3.5 Medicinal Plant Species

Medicinal plant species are not necessarily indigenous species, with many of them regarded as alien invasive weeds. Table 2 presents a list of plant species with traditional medicinal value and the plant parts traditionally used, which were identified during the field assessment.

A high abundance of medicinal species was encountered during the field assessment, especially among the forbs. The species listed in the table below are common, widespread species and not confined to the study area, with a number of species listed as AIPs.

**Table 2: Dominant traditional medicinal floral species identified during the field assessment. Medicinal applications and application methods are also presented (van Wyk, Oudtshoorn, Gericke, 2009). Alien species are indicated with an asterisk (\*).**

Scientific Name	Common Name	Plant parts used	Medicinal uses
<b>WOODY SPECIES</b>			
* <i>Melia azedarach</i>	Syringa	Leaves, roots, bark, seeds, fruit	<p>An aqueous extract reduces the intensity of asthmatic attacks. The leaf juice is anthelmintic, antilithic, diuretic and emmenagogue. A decoction is astringent and stomachic. A decoction is used to treat diarrhoea. The leaves are used externally to treat skin conditions such as scabies and itch. A decoction is used as a gargle to treat tooth problems and strengthen the gums. The leaves are harvested during the growing season and can be used fresh or dried.</p> <p>The flowers and leaves are applied as a poultice in the treatment of neuralgia and nervous headache. The stem bark is anthelmintic, astringent and bitter tonic. It is used as a tonic in India. It can be harvested at any time of the year and is used fresh or dried.</p> <p>The root bark is emetic, emmenagogue, purgative and vermifuge. It is highly effective against ringworm and other parasitic skin diseases. It can be harvested at any time of the year and is used fresh or dried.</p> <p>The fruit is antiseptic and febrifuge. The pulp is used as a vermifuge. The fruit is harvested in the autumn when it is fully ripe and can be used fresh or dried. The seed is antirheumatic. It is used externally.</p> <p>A gum that exudes from the tree is considered by some to have aphrodisiac properties]. This plant should be used with caution, preferably under the supervision of a qualified practitioner. Excess causes diarrhoea, vomiting and symptoms of narcotic poisoning.</p> <p>Source:  <a href="http://tropical.theferns.info/viewtropical.php?id=Melia+azedarach">http://tropical.theferns.info/viewtropical.php?id=Melia+azedarach</a> </p>



Scientific Name	Common Name	Plant parts used	Medicinal uses
<i>Elephantorrhiza elephantina</i>	Elandsbean	Underground rhizomes, commonly referred to as roots, are used	Traditional remedy for a wide range of ailments, including diarrhoea and dysentery, stomach disorders, haemorrhoids and perforated peptic ulcers, and as emetics. It is popular for the treatment of skin diseases and acne.
<i>Gymnosporia buxifolia</i> (SANBI PlantzAfrica)	Spikethorn, common spikethorn	Not specified	Used in traditional medicine for pleurisy, diarrhoea, as a snakebite remedy, chest colds and coughs.
<i>Senegalia caffra</i>	Common Hook Thorn	Bark	Bark infusion has been used as an emetic for blood cleansing and children were sometimes made to chew the leaves to relieve abdominal troubles.
<i>Vachellia karroo</i>	Sweet thorn	Bark, leaves and gum	Remedy for diarrhoea and dysentery.
FORB SPECIES			
* <i>Achyranthes aspera</i>	Burweed	Roots	Expectorant; inflammation of mouth; hypotonic, diuretic, uterus contractant
* <i>Bidens pilosa</i>	Blackjack	Herb	Astringent, diuretic, inflammation of the digestive tract; antidiarrheal
* <i>Opuntia ficus-indica</i>	Mission prickly pear, Sweet prickly pear	Flowers and fruit	Astringent; haemostyptic; intestinal disorders
* <i>Tagetes minuta</i>	Khaki bush, Khaki weed, African marigold	Leaves, stalks and flowers	It is also grown commercially in South Africa, France and North America for its essential oil. The oil is very effectively used for wounds and a wide variety of infections.
<i>Helichrysum rugulosum</i>	-	Not specified	Not specified
<i>Helichrysum</i> sp.  ( <i>Helichrysum aureonitens</i> , <i>Helichrysum nudifolium</i> var <i>nudifolium</i> )	Everlastings	Leaves and twigs, sometimes roots	Many ailments are treated, including coughs, colds, fever, headache and menstrual pain. Also used in wound dressing.
<i>Hermannia</i> sp. (SANBI PlantzAfrica)	Doll's Roses	Leaves, Roots	Many members of the genus are used medicinally, for anything ranging from respiratory diseases, coughs and internal aches, as stimulants or purgatives, to soothing wounds and cuts.
<i>Hilliardiella oligocephala</i>	Groenamara	Leaves and twigs	Infusions are taken as stomach bitters to treat abdominal pain and colic.
<i>Ledebouria</i> spp.	Ledebouria; Common squill	Various parts	Ledebouria has been cited as being used for medicinal purposes, including pregnancy, diarrhoea, influenza, backache, skin irritations, wounds and lumbago (Long 2005). The genus is also reputed to be poisonous in Africa, although it is reported that bushmen eat the bulbs of <i>L. apertiflora</i> and <i>L. evolute</i> (Pfosser & Speta 2001).
<i>Macleodium zeyheri</i> (PlantzAfrica)	Doll's Protea	Not specified	Not specified
<i>Plantago lanceolata</i>	Ribwort Plantain	Leaves and herb	Anti-inflammatory; expectorant
<i>Polygala hottentotta</i> (KZN Book)	Small Purple Broom	Not Specified	It is used in traditional medicine to treat chest ailments; decoctions are administered as blood strengtheners to mothers after a long, difficult birth.
<i>Scabiosa columbaria</i>	Wild scabious	Leaves and fleshy roots	Remedy for colic and heartburn. Grounded roots were used to make baby powder.
<i>Senecio inornatus</i>	Tall marsh senecio	Whole plant	Used extensively in traditional medicine to treat palpitations, phthisis, coughs and difficult breathing. Incorrect application of and treatment with this plant can be dangerous as it contains highly toxic alkaloids that may cause liver damage.
SUCCULENT SPECIES			
<i>Aloe greatheadii</i> var. <i>davyana</i>	Spotted aloe	Leaves	The bitter sap in the leaves is used medicinally for the treatment of wounds, sores and burns.
<i>Crassula capitella</i> (SANBI PlantzAfrica)	Red Flames	Roots	<i>Crassula capitella</i> roots are powdered and used to heal wounds.



### 3.6 Alien and Invasive Plant (AIP) Species

Alien and invasive floral species are floral species of exotic origin which are invading previously pristine areas or ecological niches (Bromilow, 2001). Not all weeds are exotic in origin but, as these exotic plant species have very limited natural “check” mechanisms within the natural environment, they are often the most opportunistic and aggressively growing species within the ecosystem. They are often the most dominant and noticeable within an area. Disturbances to the ground through trampling, excavations or landscaping often leads to the dominance of exotic pioneer species that rapidly dominate the area. Under natural conditions, these pioneer species are overtaken by sub-climax and climax species through natural veld succession. This process, however, takes many years to occur, with the natural vegetation never reaching the balanced, pristine species composition prior to the disturbance. There are many species of indigenous pioneer plants, but very few indigenous species can out-compete their more aggressively growing exotic counterparts.

Invasion by alien vegetation causes degradation of the ecological integrity of an area, causing (Bromilow, 2001):

- A decline in species diversity;
- Local extinction of indigenous species;
- Ecological imbalance;
- Decreased productivity of grazing pastures; and
- Increased agricultural input costs.

AIPs are defined in terms of the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA) and categories are assigned as per the NEMBA List of Alien and Invasive Species (2016) in accordance with Section 70(1)(a) of the NEMBA:

- Category 1a Listed Invasive Species are those species listed as species which must be combatted or eradicated;
- Category 1b Listed Invasive Species are those species listed as species which must be controlled;
- Category 2 Listed Invasive Species are those species listed as species which require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be; and
- Category 3 Listed Invasive Species are species that are listed as species which are subject to exemptions and prohibitions.

Alien species located within the SRA need to be removed regularly as part of maintenance activities - according to GN R598 Alien and Invasive Species Regulations, as published in the



Government Gazette 37885 dated 1 August 2014, as it relates to NEMBA. Duty of care related to listed invasive species are referred to in NEMBA Section 73:

- Section 73(2): A person who is the owner of land on which a listed invasive species occurs must-
  - a) notify any relevant competent authority, in writing, of the listed invasive species occurring on that land;
  - b) take steps to control and eradicate the listed invasive species and to prevent it from spreading; and
  - c) take all the required steps to prevent or minimise harm to biodiversity.

During the floral assessment, dominant alien invasive floral species were identified and are listed in the Table 3 below. Not all alien species, however, become invasive, and the list below indicates those species as listed within the NEMBA Invasive Species List (2016), as well as those considered problem plants in South Africa (Bromilow, 2001).

Of the alien species recorded during the site visit (Table 3 below), eight are listed as NEMBA Category 1b, one as NEMBA Category 2, and one as NEMBA Category 3. The AIPs associated with the study area did not include a diverse group of species, but these species were abundant in the study areas and have resulted in the loss of habitat for indigenous species. The Degraded Habitat and Wetland Habitat had the highest abundance of AIPs, with the Grassland Habitat minimally affected.

**Table 3: Dominant alien floral species identified during the field assessment with their invasive status as per NEMBA: Alien and Invasive Species Lists, GN R598 of 2016.**

Scientific Name	Common Name	Origin	NEMBA Category	Grassland Habitat	Wetland Habitat	Degraded Habitat
<b>WOODY SPECIES</b>						
<i>Acacia dealbata</i>	Silver wattle	Australia	2	X		X
<i>Melia azedarach</i>	Syringa	India	3			X
<i>Schinus terebinthifolia</i>	Brazilian pepper tree	Brazil in South America	1b			X
<i>Solanum mauritanum</i>	Bugweed	South America	1b			
<b>FORB SPECIES</b>						
<i>Achyranthes aspera</i>	Burweed	Uncertain origin	NL			X
<i>Amaranthus hybridus</i>	Smooth pigweed	eastern North America and parts of Mexico, Central America and northern South America	NL			X
<i>Bidens pilosa</i>	Blackjack	South America	NL		X	X



Scientific Name	Common Name	Origin	NEMBA Category	Grassland Habitat	Wetland Habitat	Degraded Habitat
<i>Campuloclinium macrocephalum</i>	Pom pom weed	South America (Argentina and Brazil), Central America and Mexico	1b			X
<i>Canna indica</i>	Indian shot	Caribbean region and tropical America	1b			X
<i>Cosmos bipinnatus</i>	Cosmos	the Americas	NL			X
<i>Ipomoea purpurea</i>	Common morning glory	Tropical America	1b	X	X	X
<i>Melilotus albus</i>	White sweet clover	Europe and Asia	NL			X
<i>Melilotus indicus</i>	Annual yellow sweet clover	Europe and Asia	NL		X	X
<i>Oenothera rosea</i>	Rose evening primrose	South America	NL		X	X
<i>Physalis peruviana</i>	Cape gooseberry, goldenberry, and physalis	Peru	NL			X
<i>Schkuhria pinnata</i>	Dwarf marigold	South America	NL			X
<i>Tagetes minuta</i>	Khaki bush	South America	NL		X	X
<i>Verbena bonariensis</i>	Tall Verbena	South America	1b		X	X
<b>SUCCULENT SPECIES</b>						
<i>Opuntia ficus-indica</i>	Sweet prickly pear	Central America (Mexico)	1b		X	X
<b>GRAMINOID SPECIES</b>						
<i>Arundo donax</i>	Giant reed	Mediterranean	1b			X
<i>Paspalum urvillei</i>	Tall paspalum (English) Vasey grass (English)	South America	NL		X	

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).

4. NL – Not Listed

## 4 SENSITIVITY MAPPING

Figure 3 below conceptually illustrates the areas considered to be of varying ecological sensitivity. The areas are depicted according to their sensitivity in terms of the presence or potential for floral SCC, habitat integrity and levels of disturbance, threat status of the habitat type, the presence of unique landscapes and overall levels of diversity.

Table 4 below presents the sensitivity of each identified habitat unit along with an associated conservation objective and implications for development.



**Table 4: A summary of the sensitivity of each habitat unit and implications for development.**

Habitat Unit	Sensitivity and Conservation Objective	Development Implications
<b>Grassland Habitat</b>	<p><b>Intermediate</b></p> <p>Preserve and enhance biodiversity of the habitat unit and surrounds while optimizing development potential.</p>	<p>This habitat unit is of intermediate ecological importance and sensitivity from a floral resource management perspective. This habitat unit has been excluded from historic and current disturbances and the species composition is representative of the reference vegetation type. Habitat integrity is decreased in some sections due to <i>Hyparrhenia hirta</i> and <i>Hyparrhenia tamba</i> dominance, with minimal alien vegetation encroachment.</p> <p>No floral SCC were recorded during the field assessment, but the habitat provides suitable conditions to support two Red Listed plant species, namely <i>Habenaria bicolor</i> (NT) and <i>Habenaria mossii</i> (EN). Several Orange List plants were also determined to have suitable habitat within the study area, including <i>Callilepis leptophylla</i> (Declining), <i>Eucomis autumnalis</i> (Declining), <i>Gunnera perpensa</i> (Declining) and <i>Hypoxis hemerocallidea</i> (Declining) – All listed as declining within the Gauteng Province according to the GDARD red an orange plant list (Compaan, 2011), although they are considered to be of least concern on a National level.</p> <p>This habitat unit is located in a CBA according to the Gauteng C-Plan v3.3 (2011), specifically due to the presence of primary vegetation and habitat for floral SCC. This habitat unit is important for achieving biodiversity targets within the Province.</p> <p>Development within this habitat unit will have a significant impact on the diversity of flora within the study area as well as the larger region.</p>
<b>Wetland Habitat</b>	<p><b>Intermediate</b></p> <p>Preserve and enhance biodiversity of the habitat unit and surrounds while optimizing development potential.</p>	<p>The Wetland Habitat is of intermediate ecological importance and sensitivity from a floral resource management perspective. Floral communities within this habitat unit has been degraded in several sections due to anthropogenic disturbances such as historic dumping and the current encroaching of AIP species.</p> <p>No floral SCC were recoded within this habitat unit and due to the presence of AIPs, this habitat unit is unlikely to support SCC that require specialised habitat conditions. The Wetland Habitat, however, is located in a CBA (Gauteng C-Plan, 2011).</p> <p>From a floral perspective, development within this habitat unit will impact on floral communities within the study area but is unlikely to have a significant impact on floral communities within the broader region. Any development planned within this habitat unit or the zones of regulation, as identified in the Freshwater Report (SAS 220019), will require authorisation from the Department of Water and Sanitation (DWS). These include areas within the wetland and their associated 32m GDARD (wetlands) setback zone).</p>
<b>Degraded Habitat</b>	<p><b>Moderately Low</b></p> <p>Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.</p>	<p>This habitat unit is of moderately low ecological importance and sensitivity due to the level of habitat disturbance. Within the moderately low sensitivity areas, ecological functioning and habitat integrity are significantly compromised, and these areas are not deemed important for the conservation of f flora within the study area, nor within the region.</p> <p>Development within this habitat unit, where sensitivity was classified as moderately low, should not pose significant threats to native floral communities within the central part of the focus area. However, edge effects will need to be carefully managed, especially the potential spread of AIPs.</p>



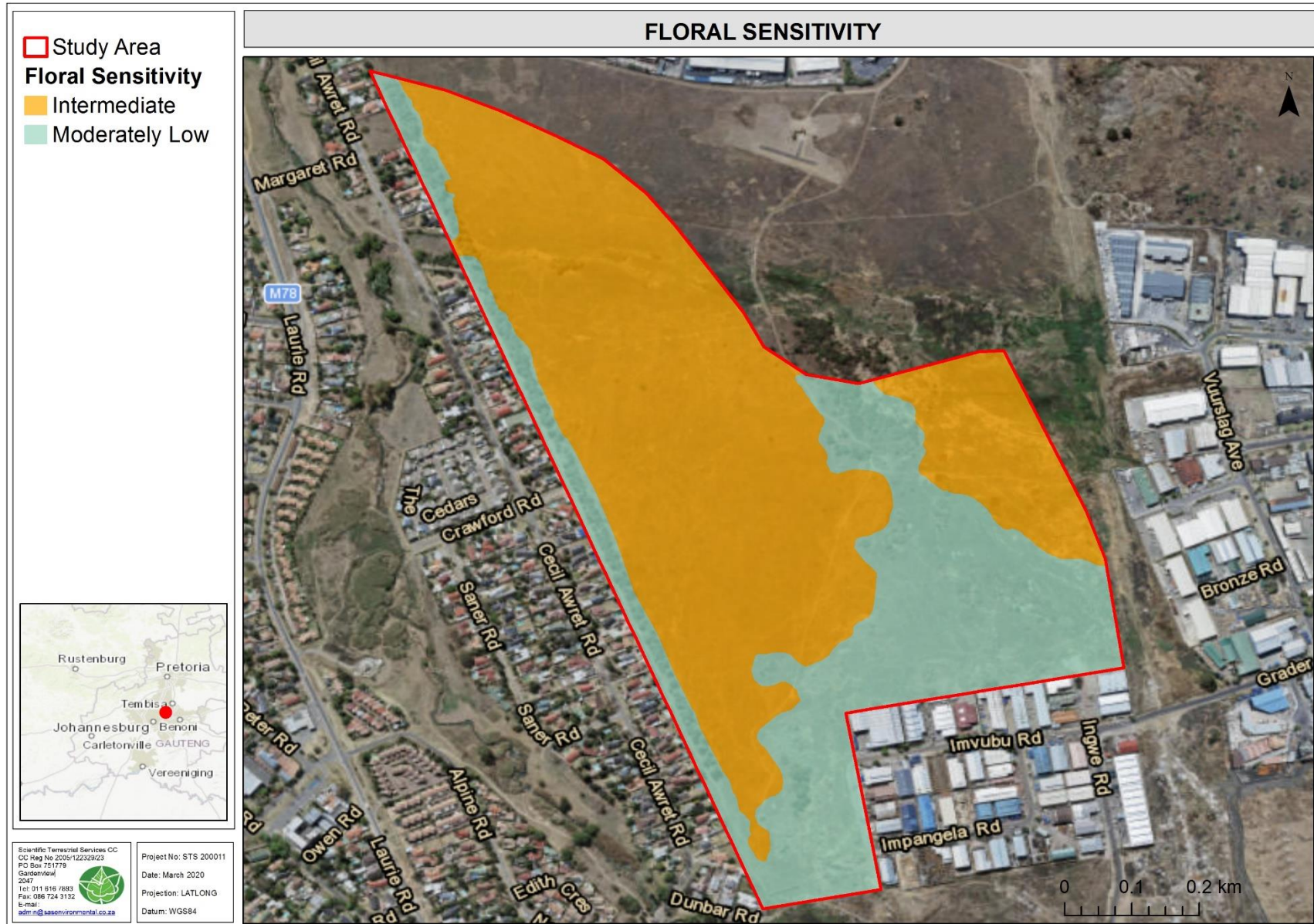


Figure 3: Sensitivity map for the study area.



## 5 IMPACT ASSESSMENT

The sections below provide the significance of perceived impacts arising from the proposed development for the study area. No planned layouts are available yet and as such the impact assessment will assume that the entire study area is targeted for development. Once a final layout is provided, the impact assessment will be updated accordingly by the biodiversity specialist.

An impact discussion and assessment of all potential pre-construction, construction, operational and maintenance phase impacts are provided in Section 5.2. All mitigatory measures required to minimise the perceived impacts are presented in Section 5.4.

### 5.1 Activities and Aspect Register

The table below indicates the perceived risks to floral species associated with the activities pertaining to the proposed Modderfontein township development.

**Table 5: Activities and Aspects likely to impact on the faunal and floral resources of the study area.**

ACTIVITIES AND ASPECTS REGISTER	
<b>Pre-Construction Phase</b>	
-	Potential failure to conduct a walkdown of the footprint area before construction activities where floral SCC, if present, are marked for rescue and relocation to suitable habitat outside the development footprint.
-	<b>Impact:</b> Permanent loss of floral SCC from the study area.
-	Inconsiderate planning of infrastructure placement and design, leading to the loss of intact floral habitat, as well as unnecessary edge effect impacts on areas outside of the proposed development footprint.
-	<b>Impact:</b> Degradation and modification of the receiving environment, loss of floral habitat.
-	Potential failure to design and implement an Alien and Invasive Plant (AIP) Management/Control plan before the commencement of construction activities, resulting in the spread of AIPs from the development footprint to surrounding natural habitat.
-	<b>Impact:</b> Spreads of AIPs, leading to potential loss of floral species diversity from surrounding natural habitat.
<b>Construction Phase</b>	
-	Site clearing and the removal of Grassland Habitat and Wetland Habitat.
-	<b>Impact:</b> Loss of floral habitat, diversity and potentially occurring floral SCC.
-	Potential failure to monitor the success of relocated floral SCC.
-	<b>Impact:</b> Loss of SCC individuals.
-	Proliferation of AIP species that colonise in areas of increased disturbances and that outcompete native species, including the further transformation of adjacent natural habitat such as open grasslands to the north-east of the study area.
-	<b>Impact:</b> Loss of favourable floral habitat outside of the direct development footprint, including a decrease in species diversity and a potential loss of floral SCC.
-	Dumping of construction material within areas where no construction is planned, thereby leading to further habitat disturbance - allowing the establishment and spread of AIPs.
-	<b>Impact:</b> Loss of favourable floral habitat, diversity and SCC as AIPs outcome and replace these species.
-	Potentially poorly managed edge effects: <ul style="list-style-type: none"> <li>• Ineffective rehabilitation of compacted areas, bare soils, or eroded areas leading to ongoing proliferation of AIP species in disturbed areas and subsequent spread to surrounding natural areas altering the floral habitat; and</li> <li>• Compaction of soils outside of the study area due to indiscriminate driving of construction vehicles through natural vegetation.</li> </ul>





ACTIVITIES AND ASPECTS REGISTER	
-	<b>Impact:</b> Loss of floral habitat, diversity and SCC within the direct footprint of the proposed development. Loss of surrounding floral diversity and floral SCC through the displacement of indigenous flora by AIP species - especially in response to disturbance in natural areas.
-	Possible increased fire frequency during construction.
-	<b>Impact:</b> Loss or alteration of floral habitat and species diversity.
-	Dust generated during construction and operational activities accumulating on the surrounding floral individuals, altering the photosynthetic ability of plants <sup>7</sup> and potentially further decreasing optimal growing/re-establishing conditions.
-	<b>Impact:</b> Declines in plant functioning leading to loss of floral species and habitat for optimal growth.
-	Decreased ecoservice provision & decreased ability to support biodiversity by wetlands due to vegetation and soil disturbance.
-	<b>Impact:</b> Loss or alteration of Wetland Habitat and associated species diversity.
Operational and Maintenance Phases	
-	Increased introduction and proliferation of alien plant species due to a lack of maintenance activities, or poorly implemented and monitored AIP Management programme, leading to ongoing displacement of natural vegetation outside of the footprint area.
-	<b>Impact:</b> Ongoing or permanent loss of floral habitat, diversity and potentially occurring SCC.
-	Increased human presence in the area once operational, potentially leading to illegal harvesting/ collection of medicinal plants or an increased risk of fire frequency impacting on floral communities outside of the development footprint.
-	<b>Impact:</b> Loss of floral habitat, medicinal flora and SCC, as well as overall species diversity within the local area.
-	On-going disturbance during operational phase may lead to erosion and sedimentation of surrounding floral habitat.
-	<b>Impact:</b> Degradation of favourable habitat and limited potential for floral re-establishment leading to loss of floral habitat and diversity within the local area.

## 5.2 Floral Impact Assessment Results

The below table indicates the perceived risks to the floral ecology associated with all phases of the proposed development. The table also provides the findings of the impact assessment undertaken with reference to the perceived impacts prior to the implementation of mitigation measures and following the implementation of mitigation measures. The mitigated results of the impact assessment have been calculated on the premise that all mitigation measures as stipulated in this report are adhered to and implemented. Should such actions not be adhered to, it is highly likely that post-mitigation impact scores will increase.

<sup>7</sup> Sett, R. (2017). Responses in plants exposed to dust pollution. Horticulture International Journal, 1(2), 00010.).



**Table 6: Impact on the floral habitat, diversity and SCC from the proposed development activities.**

Habitat Unit	UNMANAGED							Significance	MANAGED							Significance
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial Scale	Duration of Impact	Likelihood	Consequence		Probability of Impact	Sensitivity of receiving environment	Severity	Spatial Scale	Duration of Impact	Likelihood	Consequence	
<b>PRE-CONSTRUCTION PHASE</b>																
<b>Impact of floral Habitat and Diversity</b>																
Grassland Habitat	4	3	4	3	4	7	11	77 Medium-high	2	3	3	2	1	5	6	30 Low
Wetland Habitat	4	3	3	3	4	7	10	70 Medium-low	2	3	3	2	1	5	6	30 Low
Degraded Habitat	4	2	2	2	3	6	7	42 Low	1	2	1	1	1	3	3	9 Very low
<b>Impact on Floral SCC</b>																
Grassland Habitat	3	3	3	3	4	6	10	60 Medium-low	2	3	2	2	2	5	6	30 Low
Wetland Habitat	2	3	2	2	2	5	6	30 Low	2	3	1	2	2	5	5	25 Very low
Degraded Habitat	1	2	1	2	2	3	5	15 Very low	1	2	1	1	1	3	3	9 Very low
<b>CONSTRUCTION PHASE</b>																
<b>Impact of floral Habitat and Diversity</b>																
Grassland Habitat	5	3	4	3	5	8	12	96 Medium-high	5	3	4	2	5	8	11	88 Medium-high
Wetland Habitat	5	3	4	3	5	8	12	96 Medium-high	4	3	2	3	5	7	10	70 Medium-low
Degraded Habitat	3	2	2	2	2	5	6	30 Low	2	2	1	1	2	4	4	16 Very low
<b>Impact on Floral SCC</b>																
Grassland Habitat	4	3	3	3	4	7	10	70 Medium-low	3	3	2	2	3	6	7	42 Low
Wetland Habitat	3	3	2	3	3	6	8	48 Low	2	3	2	2	2	5	6	30 Low
Degraded Habitat	1	2	1	1	2	3	4	12 Very low	1	2	1	1	1	3	3	9 Very low



Habitat Unit	UNMANAGED							Significance	MANAGED							Significance
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial Scale	Duration of Impact	Likelihood	Consequence		Probability of Impact	Sensitivity of receiving environment	Severity	Spatial Scale	Duration of Impact	Likelihood	Consequence	
<b>OPERATIONAL AND MAINTENANCE PHASE</b>																
<b>Impact of floral Habitat and Diversity</b>																
Grassland Habitat	4	3	3	3	4	7	10	70 Medium-low	3	3	2	2	4	6	8	48 Low
Wetland Habitat	4	3	2	3	4	7	9	63 Medium-low	3	3	2	2	4	6	8	48 Low
Degraded Habitat	3	2	1	2	2	5	5	25 Very low	1	2	1	1	2	3	4	12 Very low
<b>Impact on Floral SCC</b>																
Grassland Habitat	3	3	3	3	4	6	10	60 Medium-low	2	3	3	2	4	5	9	45 Low
Wetland Habitat	3	3	2	3	4	6	9	54 Medium-low	2	3	1	2	4	5	7	35 Low
Degraded Habitat	1	2	1	1	2	3	4	12 Very low	1	2	1	1	1	3	3	9 Very low



### **5.3 Impact Discussion**

The direct impact of the proposed Modderfontein Township development on the floral ecology of the study area is anticipated to be unfavourable, with impact significance varying between medium-high and medium-low for the Grassland Habitat prior to mitigation measures implemented, with medium-high to low impact significance anticipated for Wetland Habitat and low to very low impact significance anticipated for the Degraded Habitat. With mitigation measures implemented, the direct and indirect impacts on the floral ecology for the study area can mostly be reduced to low and very-low levels, with impacts on Grassland Habitat remaining medium-high. Impact on floral SCC can be reduced to low and very low levels.

As part of the rehabilitation actions, disturbed areas not within the development footprint must be rehabilitated appropriately and AIP establishment controlled within such areas.

#### **5.3.1 Impact on Floral Habitat and Diversity**

The impact assessment was undertaken on all aspects of floral ecology deemed likely to be affected by the proposed Modderfontein Township Development. The proposed development will result in the clearance of vegetation, which will lead to a loss of floral habitat and diversity within the Grassland Habitat and Wetland Habitat.

No significant loss of floral habitat and diversity is anticipated for the Degraded Habitat as the remaining vegetation has already been altered and mainly consists of alien vegetation or species associated with disturbed habitat.

The Grassland Habitat is intact and supports a moderate diversity of floral species, many of which are characteristic of the reference vegetation type. The proposed development will directly impact on this habitat unit and will result in unfavourable loss of species within the study area. The Grassland Habitat also meet the definition of primary grassland (SANBI, 2013) and includes indigenous vegetation (NEMA), which means that the loss of this habitat unit, especially within a predominantly urban setting, will negatively impact on floral communities on a local to regional scale.

The habitat integrity of the Wetland Habitat is greatly compromised by the presence of alien vegetation; however, this habitat unit provides unique habitat for several indigenous flora dependant on soil-saturated conditions and further serve as an important dispersal corridor. The proposed development will directly impact on these floral communities and result in the loss of floral diversity in the study area. The floral species associated with the Wetland Habitat within the study area comprised floral species that associate with increased soil saturated conditions but most of these species were not uniquely wetland species. The proposed



development will thus not result in the loss of unique species and the negative impacts on the Wetland Habitat is unlikely to extend to floral communities on a local to regional scale.

### 5.3.2 Impacts on Floral SCC

No floral SCC were recorded for the study area during the field investigation. The Grassland Habitat and, to a lesser degree, the Wetland Habitat provide suitable conditions to support several floral SCC, including Red List plants *Habenaria bicolor* (NT) and *Habenaria mossii* (EN). Several Orange List plants within the Gauteng Province were also determined to have suitable habitat within the Grassland and Wetland Habitat, including *Callilepis leptophylla* (Declining), *Eucomis autumnalis* (Declining), *Gunnera perpensa* (Declining) and *Hypoxis hemerocallidea* (Declining). The proposed development will result in the loss if favourable for these species.

If a walkdown of the footprint area is conducted prior to construction activities commencing, where these species are rescued and relocated (if encountered), the anticipated impact on their populations will be minimal. However, during the operational phase it is anticipated that the increased presence of humans in the area will result in harvesting of these species in adjacent natural habitat and thus the impact on floral SCC remains of medium-low significance.

### 5.3.3 Probable Latent Impacts

Even with extensive mitigation, residual impacts on the receiving floral ecological environment are deemed likely. The following points highlight the key residual impacts that have been identified:

- Destruction of ecologically intact, irreplaceable habitat associated with the Grassland Habitat;
- Permanent loss of and altered floral species diversity outside of the footprint area, including loss of favourable habitat for floral SCC; and
- Continued alien and invasive plant proliferation to adjacent natural vegetation communities.

### 5.3.4 Cumulative Impacts

Apart from urban expansion, the greatest threat to the floral ecology within the study area is the continued proliferation of AIP species, resulting in the overall loss of native floral communities within the local area. The proposed development will increase the movement of humans within the area and could lead to increased harvesting of floral SCC and / or the degradation of suitable floral habitat for SCC due to continued exposure to anthropogenic disturbances.



## 5.4 Integrated Impact Mitigation

The table below highlights the key, general integrated mitigation measures that are applicable to the proposed development in order to suitably manage and mitigate the ecological impacts that are associated with all phases of the proposed development. Provided that all management and mitigation measures are implemented, as stipulated in this report, the overall risk to floral and faunal diversity, habitat and SCC can be mitigated and minimised.

**Table 7: A summary of the mitigatory requirements for floral resources.**

<b>Project phase</b>	Planning Phase
<b>Impact Summary</b>	Loss of floral habitat, species and SCC
<b>Proposed mitigation and management measures:</b>	
<b>Floral Habitat and Diversity</b>	
<ul style="list-style-type: none"> <li>- Minimise loss of indigenous vegetation where possible through adequate planning and, where necessary, by incorporating the sensitivity of the biodiversity report as well as other specialist studies; and</li> <li>- Prior to the commencement of construction activities, an AIP Management/Control Plan should be compiled for implementation:                         <ul style="list-style-type: none"> <li>- Removal of alien invasive species should preferably commence during the pre-construction phase and continue throughout the construction and operational phases. AIPs should be cleared within the study area before any vegetation clearing activities commence, thereby ensuring that no AIP propagules are spread with construction rubble, or soils contaminated with AIP seeds during the construction phase; and</li> <li>- An AIP Management/Control Plan should be implemented by a qualified professional. No chemical control of AIPs to occur without a certified professional or within the Wetland Habitat.</li> </ul> </li> </ul>	
<b>Floral SCC</b>	
<ul style="list-style-type: none"> <li>- No floral SCC were recorded during the once-off site visit. Suitable habitat for such species is present, especially in the Grassland Habitat. A walkdown of the footprint area is required before construction activities commence where anticipated floral SCC are searched and marked (if encountered); and</li> <li>- If SCC are encountered and will be affected by the construction activities, these species must be marked and where possible, relocated to suitable habitat surrounding the disturbance footprint. Suitable habitat is available northeast of the study area. Permits might be required from GDARD for Orange List species. Further consultation with GDARD will be required to determine whether a permit process needs to be followed.</li> </ul>	
<b>Project phase</b>	Construction Phase
<b>Impact Summary</b>	Loss of floral habitat, species and SCC
<b>Proposed mitigation and management measures:</b>	
<b>Development footprint</b>	
<ul style="list-style-type: none"> <li>• The construction footprint must be kept as small as possible in order to minimise impact on the surrounding environment (edge effect management);</li> <li>• Removal of vegetation must be restricted to what is absolutely necessary and should remain within the approved development footprint. Where possible / feasible, any remaining natural areas should be utilised as part of the landscaping of the proposed development;</li> <li>• Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the construction activities. Additional road construction should be limited to what is absolutely necessary, and the footprint thereof kept to a minimal;</li> <li>• No collection of indigenous floral species must be allowed by construction personnel, especially with regards to floral SCC (if encountered);</li> <li>• Care should be taken during the construction and operation of the proposed development to limit edge effects to surrounding natural habitat. This can be achieved by:                         <ul style="list-style-type: none"> <li>- Demarcating all footprint areas during construction activities;</li> <li>- No construction rubble or cleared alien invasive species are to be disposed of outside of demarcated areas, and should be taken to a registered waste disposal facility;</li> <li>- All soils compacted as a result of construction activities should be ripped and profiled and reseeded;</li> </ul> </li> </ul>	



<ul style="list-style-type: none"> <li>- Manage the spread of AIP species, which may affect remaining natural habitat within surrounding areas. Specific mention in this regard is made to Category 1b and 2 species identified within the development footprint areas (refer to section 3.6 of this report); and</li> <li>• No dumping of litter, rubble or cleared vegetation on site should be allowed. Infrastructure and rubble removed as a result of the construction activities should be disposed of at an appropriate registered dump site away from the development footprint. No temporary dump sites should be allowed in areas with natural vegetation. Waste disposal containers and bins should be provided during the construction phase for all construction rubble and general waste. Vegetation cuttings must be carefully collected and disposed of at a separate waste facility;</li> <li>• If any spills occur, they should be immediately cleaned up to avoid soil contamination that can hinder floral rehabilitation later down the line. Spill kits should be kept on-site within workshops. In the event of a breakdown, maintenance of vehicles must take place with care, and the recollection of spillage should be practised, preventing the ingress of hydrocarbons into the topsoil; and</li> <li>• Upon completion of construction activities, it must be ensured that no bare areas remain, and that indigenous species be used to revegetate the disturbed area.</li> </ul>	
<b>Alien Vegetation</b>	
<ul style="list-style-type: none"> <li>• Edge effects arising from the proposed development, such as erosion and alien plant species proliferation, which may affect adjacent natural areas, need to be strictly managed. Specific mention in this regard is made of Category 1b and 2 AIP species (as listed in the NEMBA Alien species lists, 2016), in line with the NEMBA Alien and Invasive Species Regulations (2014) (section 3.6 of this report);</li> <li>• Ongoing alien and invasive plant monitoring and clearing/control should take place throughout the construction and operational phase of the development, and a 30m buffer surrounding the study area should be regularly checked for AIP proliferation and to prevent spread into surrounding natural areas; and</li> <li>• Alien vegetation that is removed must not be allowed to lay on unprotected ground as seeds might disperse upon it. All cleared plant material to be disposed of at a licensed waste facility which complies with legal standards.</li> </ul>	
<b>Floral SCC</b>	
<ul style="list-style-type: none"> <li>• No collection of floral SCC or medicinal floral species must be allowed by construction personnel; and</li> <li>• Edge effect control needs to be implemented to prevent further degradation and potential loss of floral SCC outside of the proposed development footprint area.</li> </ul>	
<b>Fire</b>	
<ul style="list-style-type: none"> <li>• No illicit fires must be allowed during the construction of the proposed development.</li> </ul>	
<b>Rehabilitation</b>	
<ul style="list-style-type: none"> <li>• Any areas that have been left bare as a result of the construction activities should be rehabilitated using indigenous species.</li> </ul>	
<b>Project phase</b>	Operational Phase
<b>Impact Summary</b>	Loss of floral habitat, species and SCC
<b>Proposed mitigation and management measures:</b>	
<b>Development footprint</b>	
<ul style="list-style-type: none"> <li>• Where formal landscaped gardens are envisioned, use should be made of indigenous species or ornamental alien species that are not listed within the NEMBA Alien Species List (2016); and</li> <li>• No dumping of litter or garden refuse must be allowed on-site. As such it is advised that vegetation cuttings from landscaped areas be carefully collected and disposed of at a separate waste facility.</li> </ul>	
<b>Alien Vegetation</b>	
<ul style="list-style-type: none"> <li>• Edge effects arising from the proposed development, such as erosion and alien plant species proliferation, which may affect adjacent natural areas, need to be strictly managed. Specific mention in this regard is made of Category 1b and 2 AIP species (as listed in the NEMBA Alien species lists, 2016), in line with the NEMBA Alien and Invasive Species Regulations (2014) (section 3.6 of this report);</li> <li>• Ongoing alien and invasive plant monitoring and clearing/control should take place throughout the operational phase, and the project perimeters should be regularly checked for AIP establishment to prevent spread into surrounding natural areas; and</li> <li>• Alien vegetation that is removed must not be allowed to lay on unprotected ground as seeds might disperse upon it. All cleared plant material to be disposed of at a licensed waste facility, which complies with legal standards.</li> </ul>	
<b>Floral SCC</b>	
<ul style="list-style-type: none"> <li>• As far as possible, no collection of floral SCC or medicinal floral species within the study area or adjacent natural habitat must be allowed during the operational phase of the Modderfontein Township development; and</li> <li>• Edge effect control needs to be implemented to prevent further degradation and potential loss of floral SCC or suitable habitat for such species outside of the proposed development footprint.</li> </ul>	



## 6 CONCLUSION

Scientific Terrestrial Services (STS) was appointed to conduct a biodiversity assessment as part of the Environmental Impact Assessment and Authorisation process for proposed Modderfontein Township Development, within the Gauteng Province.

During the field assessment, three habitat units were identified within the study area, namely the Grassland Habitat, Wetland Habitat and Degraded Habitat. The study area is situated in a predominantly urban landscape where the broader landscape primarily comprises urban built-up areas in all directions; natural veld is however present to the northeast of the study area. Within the study area, no areas are built-up, however, several sections within the Degraded Habitat shows evidence of historic disturbance which has resulted in the floral communities comprising an abundance of AIPs as well as homogenous stretches of grass species such as *Cymbopogon pospischilii*, *Hyparrhenia hirta* and *Hyparrhenia tamba*. This habitat unit is therefore of moderately low ecological sensitivity and importance.

The Grassland Habitat was least affected by the disturbances present within the surrounding habitat units and the habitat was largely intact. The floral species are representative of the reference vegetation type, i.e. the Carletonville Dolomite Grassland, and contributes most to the floral diversity within the study area. Development activities within this habitat unit will negatively impact on floral communities within the study area and will result in the loss of primary grassland and indigenous vegetation within the broader region.

The Wetland Habitat is considered to be of intermediate ecological sensitivity and importance as several sections have been degraded by the presence of AIP species. This habitat unit remains important for supporting species associated with wetland or soil saturated conditions. Development activities within this habitat unit will impact unfavourably on floral diversity and habitat within the study area but is unlikely to have a significant impact<sup>8</sup> on the floral communities on a local to regional scale.

From a conservation perspective, the study area is located in a CBA (Gauteng C-Plan v3.3, 2011) and the critically endangered Rietvleiriver Highveld Grassland ecosystem (National Threatened Ecosystems, 2011). Due to the extent of habitat degradation within the section of the study area that falls within the critically endangered Rietvleiriver Highveld Grassland

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<sup>8</sup> **Significant impact:** An impact that may have a notable effect on one or more aspects of the environment or may result in non-compliance with accepted environmental quality standards, thresholds or targets (DEA et. Al, 2017).





ecosystem, it is no longer considered representative. The Grassland Habitat and adjoining Wetland Habitat remains important for reaching biodiversity targets associated the CBA.

Following the assessment of the floral communities within the study area, the impacts associated with the proposed development activities were determined. The impacts on the floral habitat, diversity and SCC are considered to range from low (Degraded Habitat) to medium-high (Grassland Habitat) significance impacts prior to the implementation of mitigation measures. With mitigation fully implemented most impacts can be reduced to very low (Degraded Habitat) and low to medium-low (Wetland Habitat) significance impacts. The impacts on the Grassland Habitat will remain medium-high to low despite fully implementing mitigation measures.

No floral SCC were recorded during the field assessment, but the Grassland Habitat provides suitable conditions to support two Red Listed plant species, namely *Habenaria bicolor* (NT) and *Habenaria mossii* (EN). Several Orange List plants were also determined to have suitable habitat within the Grassland Habitat and Wetland Habitat, including *Callilepis leptophylla* (Declining), *Eucomis autumnalis* (Declining), *Gunnera perpensa* (Declining) and *Hypoxis hemerocallidea* (Declining) – All listed as declining within the Gauteng Province according to the GDARD red an orange plant list (Compaan, 2011), although they are considered to be of least concern on a National level. Impacts on floral SCC ranged from medium-low (Grassland Habitat) to very low (Degraded Habitat) significance impacts prior to the implementation of mitigation measures. With mitigation measures fully implemented, these impacts can be reduced to low and very low levels. Despite these species not found on site during the field investigation, it by no means suggests that they do not occur there and a thorough walk-down of any area to be impacted by future development will be necessary within the correct flowering season.

It is the opinion of the ecologists that this study provides the relevant information required in order to implement Integrated Environmental Management (IEM) and to ensure that the best long-term use of the ecological resources in the study area will be made in support of the principle of sustainable development.



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## APPENDIX A: Floral Method of Assessment

### *Floral Species of Conservational 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 A1: Floral habitat sensitivity rankings and associated land-use objectives.**

Score	Rating significance	Conservation objective
1 < 1.5	Low	Optimise development potential.
≥1.5 <2.5	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
≥2.5 <3.5	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimizing development potential.
≥3.5 <4.5	Moderately high	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance.
≥4.5 ≤5.0	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.



## APPENDIX B: Floral SCC

South Africa uses the internationally endorsed IUCN Red List Categories and Criteria in the Red List of South African plants. This scientific system is designed to measure species' risk of extinction. The purpose of this system is to highlight those species that are most urgently in need of conservation action. For the POC assessment, a list of Red Data Listed (RDL) species previously recorded within the QDS 2628AA was obtained from Gauteng Department of Agriculture and Rural Development (GDARD), comprising SANBI Red Data Listed species. The below table presents the results of the POC assessment.

**Table B1: Floral SCC for the 2628AA as obtained from GDARD, with additional information on their threat status as defined in The Red List of South African Plants (<http://redlist.sanbi.org/index.php>). The Potential of Occurrence (POC) of these floral SCC within the study area is also provided.**

Family	Species	National Threat status	Provincial Status	Habitat	POC %
Crassulaceae	<i>Adromischus umbraticola</i> subsp. <i>umbraticola</i>	NT	NT	<b>Range:</b> Potchefstroom and Zeerust to Cullinan. <b>Major habitats:</b> Savanna. <b>Description:</b> 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	33
Hyacinthaceae	<i>Bowiea volubilis</i> subsp. <i>volubilis</i>	VU	VU	<b>Range:</b> Eastern Cape to Limpopo Province. Widespread elsewhere in southern and eastern Africa. <b>Major habitats:</b> Gamtoos Thicket, Ohrigstad Mountain Bushveld, Pong Dolomite Mountain Bushveld, Southern Mistbelt Forest, Andesite Mountain Bushveld, Gauteng Shale Mountain Bushveld, Northern Mistbelt Forest, Great Fish Thicket, East Griqualand Grassland, Carletonville Dolomite Grassland, Drakensberg Foothill Moist Grassland, Thukela Thornveld, Queenstown Thornveld, Midlands Mistbelt Grassland, Soutpansberg Mountain Bushveld, Egoli Granite Grassland, Zastron Moist Grassland, Amathole Montane Grassland, Pondoland-Ugu Sandstone Coastal Sourveld, Gabbro Grassy Bushveld, Groot Thicket. <b>Description:</b> Low and medium altitudes, usually along mountain ranges and in thickly vegetated river valleys, often under bush clumps and in boulder scree, sometimes found scrambling at the margins of karroid, succulent bush in the Eastern Cape. Occurs in bushy kloofs at the coast and inland in KwaZulu-Natal. In Gauteng, Mpumalanga and North West Province 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	33
Asteraceae	<i>Callilepis leptophylla</i>	LC	Declining	<b>Range:</b> Widespread in eastern half of South Africa. Also in Swaziland. <b>Major habitats:</b> Grassland, Savanna. <b>Description:</b> Grassland or open woodland, often on rocky outcrops or rocky hill slopes.	60



Family	Species	National Threat status	Provincial Status	Habitat	POC %
Asteraceae	<i>Cineraria austrotransvaalensis</i>	NT	NT	<b>Range:</b> Scattered throughout Gauteng and the North West Province and at Standerton in southern Mpumalanga. <b>Major habitats:</b> Grassland, Savanna. <b>Description:</b> Amongst rocks on steep hills and ridges, at the edge of thick bush or under trees on a range of rock types: quartzite, dolomite and shale, 1400-1700 m.	0
Asteraceae	<i>Cineraria longipes</i>	VU	VU	<b>Range:</b> Klipriviersberg and Suikerbosrand. <b>Major habitats:</b> Andesite Mountain Bushveld, Gold Reef Mountain Bushveld, Soweto Highveld Grassland. <b>Description:</b> Grassland, amongst rocks and along seepage lines, exclusively on basalt koppies on south-facing slopes.	20
Aizoaceae	<i>Delosperma purpureum</i>	EN	EN	<b>Range:</b> Witwatersrand. <b>Major habitats:</b> Soweto Highveld Grassland, Andesite Mountain Bushveld. <b>Description:</b> South-facing slopes, in shallow soils among crystalline or conglomerate quartzitic rocks, in sun or in partial shade, rarely in shade, in grassland with some trees.	33
Hyacinthaceae	<i>Eucomis autumnalis</i>	LC	Declining	<b>Range:</b> South Africa, Swaziland, Lesotho, Botswana, Zimbabwe and Malawi. <b>Major habitats:</b> Grassland. <b>Description:</b> Damp, open grassland and sheltered places from the coast to 2450 m	73
Gunneraceae	<i>Gunnera perpensa</i>	LC	Declining	<b>Range:</b> Western Cape to Ethiopia. <b>Major habitats:</b> Albany Thicket, Fynbos, Grassland, Indian Ocean Coastal Belt, Nama Karoo, Savanna <b>Description:</b> Damp marshy area and vleis from coast to 2400 m.	73
Orchidaceae	<i>Habenaria bicolor</i>	NT	NT	<b>Range:</b> Gauteng and near Middelburg in Mpumalanga. Also known from two records from Zimbabwe. <b>Major habitats:</b> Grassland. <b>Description:</b> Well-drained grasslands at around 1600 m in South Africa.	60
Orchidaceae	<i>Habenaria mossii</i>	EN	EN	<b>Range:</b> Johannesburg, Pretoria and Krugersdorp. <b>Major habitats:</b> Carletonville Dolomite Grassland, Andesite Mountain Bushveld. <b>Description:</b> Open grassland on dolomite or in black, sandy soil.	60
Orchidaceae	<i>Holothrix micrantha</i>	CR PE	CR	<b>Range:</b> Gauteng, Johannesburg to Heidelberg. <b>Major habitats:</b> Gold Reef Mountain Bushveld, Egoli Granite Grassland. <b>Description:</b> Grassy cliffs, 1500-1800 m.	20
Orchidaceae	<i>Holothrix randii</i>	NT	NT	<b>Range:</b> Gauteng and Limpopo Province, Zimbabwe, Tanzania and Kenya. <b>Major habitats:</b> Grassland. <b>Description:</b> Grassy slopes and rock ledges, usually southern aspects	40
Hypoxidaceae	<i>Hypoxis hemerocallidea</i>	LC	Declining	<b>Range:</b> Widespread in the eastern part of southern Africa from the Eastern Cape to Botswana and Mozambique. <b>Major habitats:</b> Albany Thicket, Grassland, Indian Ocean Coastal Belt, Savanna. <b>Description:</b> Occurs in a wide range of habitats, including sandy hills on the margins of dune forests, open, rocky grassland, dry, stony, grassy slopes, mountain slopes and plateaus. Appears to be drought and fire tolerant	73



Family	Species	National Threat status	Provincial Status	Habitat	POC %
Aizoaceae	<i>Khadia beswickii</i>	VU	VU	<b>Range:</b> Nigel. <b>Major habitats:</b> Tsakane Clay Grassland, Soweto Highveld Grassland, Carletonville Dolomite Grassland, Andesite Mountain Bushveld, Gauteng Shale Mountain Bushveld. <b>Description:</b> Open shallow soil over rocks in grassland.	40
Apocynaceae	<i>Stenostelma umbelluliferum</i>	NT	NT	<b>Range:</b> Pretoria North and adjacent areas in North West Province. <b>Major habitats:</b> Savanna. <b>Description:</b> Deep black turf in open woodland mainly in the vicinity of drainage lines.	40

CR = Critically Endangered; EN = Endangered; LC = Least Concern; NT = Near Threatened; VU = Vulnerable; PE = Possibly Extinct, POC = Probability of Occurrence.



## APPENDIX C: Floral Species List

**Table C1: Dominant woody floral species encountered during the field assessment. Alien species are indicated with an asterisk (\*).**

Scientific Name	Grassland Habitat	Wetland Habitat	Degraded Habitat
* <i>Acacia dealbata</i>	X		X
* <i>Melia azedarach</i>			X
* <i>Schinus terebinthifolia</i>			X
* <i>Solanum mauritianum</i>			
<i>Anthospermum rigidum</i> subsp. <i>pumilum</i>	X		
<i>Celtis africana</i>			X
<i>Crotalaria distans</i>			X
<i>Diospyros lycioides</i> subsp. <i>sericea</i>			X
<i>Elephantorrhiza elephantina</i>	X		
<i>Gymnosporia buxifolia</i>	X		
<i>Indigophera zeyheri</i>	X	X	
<i>Searsia leptodictya</i>	X		
<i>Searsia rigida</i>			X
<i>Senegalia caffra</i>			X
<i>Seriphium plumosum</i>	X	X	X
<i>Solanum panduriforme</i>	X		X
<i>Vachellia karroo</i>		X	X
<i>Waltheria indica</i>			X
<i>Ziziphus zeyheriana</i>	X		

**Table C2: Dominant forb species encountered during the field assessment. Alien species are indicated with an asterisk (\*).**

Scientific Name	Grassland Habitat	Wetland Habitat	Degraded Habitat
* <i>Achyranthes aspera</i>			X
* <i>Amaranthus hybridus</i>			X
* <i>Bidens pilosa</i>		X	X
* <i>Campuloclinium macrocephalum</i>			X
* <i>Canna indica</i>			X
* <i>Cosmos bipinnatus</i>			X
* <i>Hibiscus trionum</i>			X
* <i>Ipomoea purpurea</i>	X	X	X
* <i>Melilotus albus</i>			X
* <i>Melilotus indicus</i>		X	X
* <i>Oenothera rosea</i>		X	X
* <i>Physalis peruviana</i>			X
* <i>Schkuhria pinnata</i>			X
* <i>Tagetes minuta</i>		X	X
* <i>Verbena bonariensis</i>		X	X
<i>Berkheya radula</i>		X	
<i>Cheilanthes viridis</i>	X		
<i>Chironia purpurascens</i>	X	X	
<i>Chlorophytum transvaalense</i>	X		X
<i>Cleome rubella</i>			X
<i>Cyanotis speciosa</i>	X		
<i>Euphorbia striata</i>	X		X





Scientific Name	Grassland Habitat	Wetland Habitat	Degraded Habitat
<i>Geigeria burkei</i>	X		
<i>Gladiolus crassifolius</i>	X		X
<i>Gladiolus elliotii</i>	X		
<i>Helichrysum nudifolium</i>	X	X	
<i>Helichrysum rugulosum</i>	X	X	X
<i>Helichrysum setosum</i>	X	X	X
<i>Hermannia depressa</i>	X	X	
<i>Hilliardiella oligocephala</i>	X	X	X
<i>Hypoxis obtusa</i>		X	
<i>Ipomoea ommaneyi</i>	X		
<i>Ipomoea sinensis</i>	X		
<i>Kniphofia species</i>		X	
<i>Ledebouria asperifolia</i>	X		X
<i>Ledebouria revoluta</i>	X		
<i>Ledebouria species</i>		X	
<i>Macledium zeyheri subsp. zeyheri</i>	X		
<i>Nemesia fruticans</i>	X		
<i>Nesaea schinzii</i>		X	
<i>Nidorella anomala</i>	X	X	
<i>Nidorella hottentotta</i>	X		
<i>Nidorella podocephala</i>	X		X
<i>Pachycarpus schinzianus</i>	X		X
<i>Plantago lanceolata</i>			X
<i>Polygala hottentotta</i>	X		
<i>Pulicaria scabra</i>		X	
<i>Scabiosa columbaria</i>	X		
<i>Senecio inornatus</i>		X	X
<i>Senecio scitus</i>	X		
<i>Sida dregei</i>			X
<i>Striga elegans</i>	X		
<i>Tephrosia capensis</i>	X		
<i>Vernonia natalensis</i>	X		
<i>Wahlenbergia undulata</i>	X	X	

**Table C3: Succulent species encountered during the field assessment. Alien species are indicated with an asterisk (\*).**

Scientific Name	Grassland Habitat	Wetland Habitat	Degraded Habitat
* <i>Opuntia ficus-indica</i>		X	X
<i>Aloe greatheadii var. davyana</i>	X		X
<i>Crassula capitella</i>	X		
<i>Euphorbia clavarioides</i>	X		

**Table C4: Graminoid species encountered during the field assessment. Alien species are indicated with an asterisk (\*).**

Scientific Name	Grassland Habitat	Wetland Habitat	Degraded Habitat
* <i>Arundo donax</i>			X
* <i>Paspalum urvillei</i>		X	
<i>Andropogon appendiculatus</i>		X	
<i>Aristida congesta subsp. barbicollis</i>			
<i>Aristida congesta subsp. congesta</i>	X		
<i>Bewisia biflora</i>	X		



Scientific Name	Grassland Habitat	Wetland Habitat	Degraded Habitat
<i>Brachiaria serrata</i>	X		X
<i>Calamagrostis epigejos</i>		X	
<i>Chloris gayana</i>		X	
<i>Cymbopogon caesius</i>	X		X
<i>Cymbopogon pospischilii</i>			X - (d)
<i>Cynodon dactylon</i>	X	X	X
<i>Cyperus eragrostis</i>		X	
<i>Diheteropogon amplexans</i>	X		
<i>Enteropogon macrostachys</i>	X		
<i>Eragrostis capensis</i>	X		
<i>Eragrostis chloromelas</i>	X	X	X
<i>Eragrostis gummiflua</i>	X	X	
<i>Eragrostis plana</i>	X		
<i>Eragrostis racemosa</i>	X		
<i>Hyparrhenia hirta</i>			X
<i>Hyparrhenia tamba</i>		X - (d)	X
<i>Hyperthelia dissoluta</i>			X
<i>Imperata cylindrica</i>		X	
<i>Melinis repens</i>	X		X
<i>Panicum natalensis</i>	X		
<i>Schizachyrium jeffreysii</i>	X		
<i>Setaria sphacelata var sericea</i>		X	
<i>Sporobolus africanus</i>			X
<i>Themeda triandra</i>	X	X	X
<i>Trachypogon spicatus</i>	X	X	
<i>Tristachya leucothrix</i>	X		
<i>Urochloa panicoides</i>			X

