

**FAUNAL AND FLORAL ECOLOGICAL ASSESSMENT AS
PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT
PROCESS FOR THE PROPOSED ERASMUS PARK PHASE
2 TOWNSHIP DEVELOPMENT, ERASMUSRAND,
GAUTENG.**

Prepared for

Nali Sustainability Solutions

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Section B: Floral Assessment

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EXECUTIVE SUMMARY

During the field assessment, four habitat units were identified within the study area, i.e. the *Senegalia caffra* – *Vachellia karroo* woodland, the Rocky Grassland, the Degraded Grassland, a Watercourse associated with Riparian Woodland and an Artificial Depression. Based on the field assessment it was determined that the watercourse habitat unit is the most sensitive in terms of floral ecological importance and is considered of intermediate sensitivity. The Rocky Grassland and *Senegalia caffra* – *Vachellia karroo* Woodland habitat units is of moderately low importance while the Degraded grassland habitat and the Artificial depression is of low importance.

Based on the existing layout, the freshwater resource is excluded from the development. The approved GDARD buffer zone must be implemented and form part of the green open space area for the development. It is proposed that rehabilitation measures such as erosion and floral alien invasive control take place within the freshwater feature to improve the overall function and sensitivity of the freshwater resource.

It was indicated on the Gauteng C-plan (v3.3, 2011) that the entire habitat unit of the Rocky grassland and the *Senegalia caffra* – *Vachellia karroo* Woodland falls within a CBA, considered important in terms of “Red” and “Orange” listed plant habitat and for Primary Vegetation. A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges. Urban expansion, anthropogenic activities and proliferation of alien plant species has resulted in the degradation of the available habitat and subsequent floral species loss. Therefore, these habitat units cannot be considered as primary grassland due to the level of degradation and vegetation transformation, thus lowering the level of conservation contribution to meet regional and provincial targets.

Based on the impact assessment, the impacts on floral habitat, diversity and SCC within the different habitat units varies from medium high to very low significance during the construction and the operational phase of the project prior to mitigation taking place. With effective mitigation implemented, all impacts may be reduced to low and very low levels during all phases, with the exception of the impact on the floral habitat and diversity of the Watercourse habitat during the operational phase, prior to mitigation measures being implemented.

It is therefore the opinion of the ecologists that the proposed development be considered favourably from a floral ecological perspective. However, it is essential that cogent, well-conceived and ecologically sensitive site development plans, and the mitigation measures provided in this report, as well as general good construction practice, are strictly adhered to. Of particular importance is the exclusion of the Freshwater Resource habitat units from the development footprint.

MANAGEMENT SUMMARY

Scientific Terrestrial Services (STS) was appointed to conduct a faunal and floral ecological assessment for the proposed Erasmus Park Phase 2 development on the remaining extent of the farm Waterkloof 378 JR, Erasmusrand, Gauteng Province (hereafter referred to as the ‘study area’).

Specific outcomes required from this report include the following:

- To provide inventories of floral species as encountered within the study area;
- 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 identify and consider all sensitive landscapes including rocky ridges, wetlands and/ or any other special features;
- To conduct a Red Data Listed (RDL) species assessment as well as an assessment of other Species of Conservation Concern (SCC), including potential for such species to occur within the study area;



- To provide detailed information to guide the activities associated with the proposed mining activities 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

The following general conclusions were drawn upon completion of the field assessment:

- During the field assessment, four habitat units were identified within the study area, i.e. the *Senegalia caffra* – *Vachellia karroo* woodland, the Rocky Grassland, the Degraded Grassland, a Watercourse with Riparian Woodland and an Artificial Depression;
- The *Senegalia caffra* – *Vachellia karroo* woodland habitat unit occurs as pockets within the study area to form mixed open woodlands. Edge effects from the urban area and anthropogenic activities such as harvesting of plant material, the collection of firewood, continuous pedestrian movement, as well as illegal disposal of rubble and household waste has resulted in the establishment of Alien Invasive Plant (AIP) species and has altered the floral community composition.
- This habitat unit is characterised by small rocky outcrops with gravelly soils in the north-eastern section of the study area. The herbaceous layer is still fairly intact, dominated by grass species such as *Themeda triandra*, *Melinis repens*, *Melinis nerviglumis* and *Sporobolus* species. Edge effects were noted within the habitat unit caused by vegetation clearing next to the road, informal vehicle tracks leading to the advertisement board and harvesting of indigenous species such as *Boophone disticha* and *Aloe davyana*.
- The Degraded Grassland habitat unit comprising *Hyparrhenia* and *Aristida*-dominated grassland, stretches throughout the study area and is interspersed with patches of tree clumps, stands of *Senegalia caffra*, *Vachellia karroo* and *Eucalyptus* trees. This habitat unit has been subjected to several historic and current anthropogenic-related impacts which has led to its current moderately modified state.
- The Freshwater Resource traverses the south-western portion of the study area and was classified as an unchanneled valley bottom wetland (Exigo Sustainability, 2016). The freshwater resource is currently subjected to extensive floral alien infestation, with species such as *Eucalyptus camaldulensis*, *Xanthium strumarium*, *Datura stramonium* and *Flaveris bidentis* being present.

From the GDARD conservation list, two floral SCC have an increased probability of utilising the study area, particularly the rocky grassland habitat. During the field assessment, no individuals of these species were observed. The absence of these species from the study area can be attributed to the plant species harvesting, as trading of plants adjacent to the study area was noticed, and both species are widely used in traditional medicine. Should these or any other floral SCC be encountered during any phase of the proposed development, a suitably qualified specialist is to be consulted in terms of the best way forward, and if necessary, the relevant provincial/national departments contacted in terms of acquiring the necessary plant relocation/removal permits.

Habitat Sensitivity:

From an ecological perspective, habitat sensitivities range from intermediate to low sensitivities. The table below indicates the sensitivity of the habitat units along with an associated conservation objective and implications for development.

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

Habitat Unit	Sensitivity	Conservation Objective	Development Implications
Watercourse with Riparian Woodland	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.	This habitat unit is of intermediate ecological sensitivity, predominantly due to the presence of this feature and the protection thereof. Based on the existing layout, the freshwater resource is excluded from the development. The approved GDARD buffer zone must be implemented and form part of the green open space area for the development. It is proposed that rehabilitation measures such as erosion and floral alien invasive control take place within the



Habitat Unit	Sensitivity	Conservation Objective	Development Implications
			freshwater feature to improve the overall function and sensitivity of the freshwater resource.
Rocky Grassland Senegalia caffra – Vachellia karroo Woodland	Moderately Low	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.	<p>It was indicated on the Gauteng C-plan (v3.3, 2011) that the entire habitat unit of the Rocky grassland and the <i>Senegalia caffra</i> – <i>Vachellia karroo</i> Woodland falls within a CBA, considered important in terms of “Red” and “Orange” listed plant habitat and for Primary Vegetation. A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges. Urban expansion, anthropogenic activities and proliferation of alien plant species has resulted in the degradation of the available habitat and subsequent floral species loss. Therefore, these habitat units cannot be considered as primary grassland due to the level of degradation and vegetation transformation, thus lowering the level of conservation contribution to meet regional and provincial targets.</p> <p>Development within this habitat unit will result in the loss of vegetation in the immediate area, but not on a regional scale. Although no floral SCC was noted within these habitat units, suitable habitat is available for floral SCC such as <i>Boophone disticha</i> and <i>Hypoxis hemerocallidea</i> to occur. Loss of individuals can, however, be mitigated should a thorough rescue and relocation plan be implemented and be overseen by a qualified specialist.</p> <p>With mitigation thoroughly implemented the proposed development is considered unlikely to have a significant impact on the floral ecology of the area nor the conservation objective for the province. The disturbance timeframes and footprint must be minimised, and care must be taken to limit edge effects on the more sensitive Carletonville Dolomite Grassland habitat units. During the construction phase, disturbance to the vegetation should be restricted to areas where development will take place – this will limit the potential for AIPs to spread.</p>
Degraded Grassland Artificial Depression	Low	Optimise development potential.	<p>This habitat unit is of low ecological sensitivity due to severe habitat transformation. The placement of infrastructure within the transformed areas will have no significant impacts on the floral ecology and conservation targets of the area. However, to reduce opportunities for AIPs to be exchanged between the Degraded Grassland habitat and artificial depression during construction activities, it is recommended that an AIP management plan is implemented for the clearance of listed alien species before construction commences. Indigenous forb species, although few, located within the Degraded Grassland can be removed and incorporated as part of the landscape layout plan.</p>

Floral Impact Assessment:

The tables below summarise the findings indicating the significance of the impact before mitigation takes place and the likely impact if management and mitigation takes place. The tables below indicate the significance of the perceived impacts prior to the implementation of mitigation measures and following the implementation of mitigation measures. As such the post mitigation impacts for the Freshwater Resource habitat units is therefore undertaken on the assumption that this habitat unit together with their recommended setback areas are excluded from the development footprint. Should such actions not be adhered to, it is highly likely that post mitigation impact scores will increase. In the consideration of mitigation, it is assumed that a high level of mitigation takes place, but which does not lead to prohibitive costs.

The impact of the proposed development of the floral habitat and diversity is considered to be of medium high significance for the Rocky grassland and Freshwater habitat and medium low significance for the



woodland habitat. The Degraded grassland is expected to have a low significance level due to the current and historic disturbance of this vegetation unit. The significance levels, as discussed above, are anticipated for the activities should no mitigation measures be implemented. The impact on the floral SCC without mitigation measure is considered to be of medium low significance, with the exception of the Rocky Grassland, where the probability of occurrence and suitable habitat for two floral SCC were higher.

With the implementation of mitigation measures during the construction phase, the significance level of habitat, diversity and floral SCC impacts are considered to be low to very low with the exception of the floral habitat and species diversity impact on the Rocky Grassland habitat unit to be medium low.

During the operation phase, all impacts associated with the remaining floral habitat and diversity are considered medium low, except for the impact on the Freshwater resources without the implementation of the mitigation measures. With the implementation of all the stipulated mitigation measures in the specialist reports, the significance level of the impacts on the remaining floral habitat and diversity is considered to be very low to low.

The following tables represent the findings of the impact assessment pertaining to the proposed layout projects.

Table B: A summary of the impact significance on floral resources in the construction phase

Site	Impact	Unmanaged	Mitigated
Senegalia caffra – Vachellia karroo Woodland	<i>Impact on floral habitat and species diversity</i>	Medium Low	Low
	<i>Impact on floral SCC</i>	Medium Low	Low
Rocky Grassland	<i>Impact on floral habitat and species diversity</i>	Medium High	Medium Low
	<i>Impact on floral SCC</i>	Medium High	Low
Freshwater Habitat	<i>Impact on floral habitat and species diversity</i>	Medium High	Low
	<i>Impact on floral SCC</i>	Medium Low	Very Low
Degraded Grassland	<i>Impact on floral habitat and species diversity</i>	Low	Very Low
	<i>Impact on floral SCC</i>	Very Low	Very Low

Table C: A summary of the impact significance on floral resources in the operational phase

Site	Impact	Unmanaged	Mitigated
Senegalia caffra – Vachellia karroo Woodland	<i>Impact on floral habitat and species diversity</i>	Medium Low	Low
	<i>Impact on floral SCC</i>	Medium Low	Low
Rocky Grassland	<i>Impact on floral habitat and species diversity</i>	Medium Low	Low
	<i>Impact on floral SCC</i>	Medium Low	Low
Freshwater Habitat	<i>Impact on floral habitat and species diversity</i>	Medium High	Low
	<i>Impact on floral SCC</i>	Low	Very Low
Degraded Grassland	<i>Impact on floral habitat and species diversity</i>	Very Low	Very Low
	<i>Impact on floral SCC</i>	Very Low	Very Low

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



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GLOSSARY OF TERMS

Alien and Invasive species	A species that is not an indigenous species; or an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention.
CBA (Critical Biodiversity Area)	A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges.
Endemic species	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.
ESA (Ecological Support Area)	An ESA provides connectivity and important ecological processes between CBAs and is therefore important in terms of habitat conservation.
Indigenous vegetation (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.
Invasive species	Means any species whose establishment and spread outside of its natural distribution range; they threaten ecosystems, habitats or other species or have demonstrable potential to threaten ecosystems, habitats or other species; and may result in economic or environmental harm or harm to human health
RDL (Red Data listed) species	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.
SCC (Species of Conservation Concern)	The term SCC in the context of this report refers to all RDL (Red Data) and IUCN (International Union for the Conservation of Nature) listed threatened species as well as protected species of relevance to the project.



ACRONYMS

AIP	Alien and Invasive Plants
CR	Critically Endangered
EAP	Environmental Assessment Practitioner
EIS	Ecological Importance and Sensitivity
EN	Endangered
EW	Extinct in the Wild
GIS	Geographic Information System
GPS	Global Positioning System
IEM	Integrated Environmental Management
NT	Near Threatened
P	Protected
PES	Present Ecological State
POC	Probability of Occurrence
QDS	Quarter Degree Square
SANBI	South Africa National Biodiversity Institute
SP	Specially Protected
STS	Scientific Terrestrial Services
SCC	Species of Conservation Concern
TOPS	Threatened or Protected Species
VU	Vulnerable



DOCUMENT GUIDE

The Document Guide below is for reference to the procedural requirements for environmental authorisation applications in accordance to GN267 of 24 March 2017, as it pertains to NEMA.

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Section A: Appendix D
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Section A: Appendix D
b)	A declaration that the specialist is independent	Section A: Appendix D
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
cA)	An indication of the quality and age of base data used for the specialist report	Section 2.1 and Section A: Section 3
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 2.1
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Appendix A and B
f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 3 and 4
g)	An identification of any areas to be avoided, including buffers	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	Section 4
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 1.2
j)	A description the findings and potential implication's of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Section 5
k)	Any mitigation measures for inclusion in the EMPr	Section 5
l)	Any conditions for inclusion in the environmental authorisation	Section 5
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 5
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section 6
(iA)	Regarding the acceptability of the proposed activity or activities	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	Section 5
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	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 faunal and floral ecological assessment for the proposed Erasmus Park Phase 2 development on the remaining extent of the Farm Waterkloof 378 JR, Erasmusrand, Gauteng Province (hereafter referred to as the 'study area').

The study area is situated approximately 9.5 km southeast of the Pretoria Central Business District and approximately 5 km due north of the Irene Farm Village Shopping Centre. The N1 National Highway forms the eastern boundary of the study area, the M10 forms the northern boundary, and the Albertina Sisulu (R21) Freeway is situated approximately 200 m west of the study area. The study area is located within a high residential urban setting.

The purpose of this report is to define the floral ecology of the study area as well as mapping and defining areas of increased Ecological Importance and Sensitivity (EIS) and to define the Present Ecological State (PES) of the study area. It is the objective of this study:

- To provide inventories of floral species as encountered within the study area;
- 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 identify and consider all sensitive landscapes including primary grassland, rocky ridges, wetlands and/ or any other special features;
- To conduct a Red Data Listed (RDL) species assessment as well as an assessment of other Species of Conservation Concern (SCC), including potential for such species to occur within the study area;
- To provide detailed information to guide the activities associated with the proposed development activities 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.



1.2 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 neighboring and adjacent properties; these were however considered as part of the desktop assessment as discussed in Section A;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most floral communities have been accurately assessed and considered and therefore the information provided in this report is considered sufficient to allow informed decision making to take place and 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 therefore have been missed during the assessment; and
- As part of the assessment, a field assessment was undertaken on the 14th of January 2019 (summer) to determine the ecological status of the study area, and to “ground-truth” the results of the desktop assessment. A more accurate assessment would require that assessments take place in all seasons of the year. On-site data was therefore significantly 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.



2 ASSESSMENT APPROACH

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

- Vegetation maps and digital satellite images were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. The results of this analyses were used to focus the field work on specific areas of concern and to identify areas where target specific investigations were required;
- All relevant information as presented in Section A by the South African National Biodiversity Institute (SANBI)'s Biodiversity Geographic Information Systems (BGIS) website (<http://bgis.sanbi.org>), including the Gauteng Conservation Plan (2011) was utilised to gain background information on the physical habitat and potential floral biodiversity associated with the study area;
- The results presented in this report form part of the field investigation undertaken on the 14th of January 2019, in order to determine the ecological status of the study area. The field investigation entailed a reconnaissance 'walkabout' to determine the general habitat types found throughout the study area. Following this, specific study sites were selected that were considered to be representative of the habitats found within the area, with special emphasis being placed on areas that may potentially support floral Species of Conservational Concern (SCC). These sites were further investigated in order to identify the occurrence of the dominant plant species and habitat diversities. A detailed explanation of the method of assessment is provided in **Appendix A** of this report; and
- For the methodologies relating to the impact assessment and development of the mitigation measure, please refer to **Appendix B** of this section of the report.

2.1 Sensitivity Mapping

All the ecological features of the study area were considered, and sensitive areas were assessed and mapped by means of a Global Positioning System (GPS). A Geographic Information System (GIS) was used to project these features onto satellite imagery. The sensitivity map should guide the final design and layout of the proposed development activities.



3 RESULTS OF FLORAL ASSESSMENT

It was noted that the study area has a history of disturbance, which were evident during the field assessment. No primary grassland¹ vegetation remained and a high abundance of alien vegetation was recorded throughout the study area. This alien vegetation proliferation is likely as a result of historical soil disturbance. Pedestrian movement, harvesting of plant material and illegal dumping of waste and building material have also contributed towards the degraded state of the vegetation.

During the field assessment, four habitat units were identified within the study area, i.e. the *Senegalia caffra* – *Vachellia karroo* woodland, the Rocky Grassland, the Degraded Grassland, a Watercourse with Riparian Woodland and an Artificial Depression. The latter two habitat units will be briefly discussed in the sub-sections below as this comprises a small portion of the site whilst the first two mentioned habitat units will be described in greater detail in sections 3.1 – 3.3.

***Senegalia caffra* – *Vachellia karroo* woodland**

The *Senegalia caffra* – *Vachellia karroo* woodland habitat unit occurs as pockets within the study area to form mixed open woodlands. Edge effects from the urban area and anthropogenic activities such as harvesting of plant material, the collection of firewood, continuous pedestrian movement, as well as illegal disposal of rubble and household waste has resulted in the establishment of Alien Invasive Plant (AIP) species and has altered the floral community composition. Levels of habitat degradation vary throughout the habitat unit, with degradation of the south-eastern section considered to be the most severe, where the majority of the tree layer is dominated by AIPs. Species composition entails *Senegalia caffra*, *Vachellia karroo*, *Searsia lancea* and *Ziziphus mucronata*. AIPs associated with the habitat unit include *Melia azedarach* and *Eucalyptus camaldulensis*. No floral SCC as listed in Section 3.4 were noted during the field assessment within this habitat unit.

Rocky Grassland

This habitat unit is characterised by small rocky outcrops with gravelly soils in the north-eastern section of the study area. The herbaceous layer is still fairly intact, dominated by grass species such as *Themeda triandra*, *Melinis repens*, *Melinis nerviglumis* and *Sporobolus* species. Edge effects were noted within the habitat unit as a result of vegetation clearing next to the road, informal vehicle tracks leading to a nearby advertisement board and harvesting of

¹ 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.



indigenous species such as *Boophone disticha* and *Aloe davyana* (evidence of harvesting activities were noted during the site visit).

Degraded Grassland

The Degraded Grassland habitat unit comprising *Hyparrhenia* and *Aristida*-dominated grassland, stretches throughout the study area and is interspersed with patches of tree clumps, stands of *Senegalia caffra*, *Vachellia karroo* and *Eucalyptus* trees. This habitat unit has been subjected to several historic and current anthropogenic-related impacts which has led to its current moderately modified state. A section located next to Solomon Mahlangu Road has been historically cultivated which has resulted in patches of secondary vegetation, often varying in ages and dominance of grass species.

Current impacts include informal roads and walkways from pedestrians. Vegetation clearance has also taken place on the northern boundary of the study area as part of edge effects from the road and surrounding developments. The vegetation cannot be considered as a primary grassland. Very few forb species were observed within the Degraded Grassland habitat unit with *Chironia purpurascens*, *Helichrysum cerestoides*, *Helichrysum nudifolium*, *Hermannia depressa* and *Hypoxis lanceolata*.

Watercourse with Riparian Woodland and an Artificial Depression Habitat

The watercourse traverses the south-western portion of the study area and was classified as an unchanneled valley bottom wetland (Exigo Sustainability, 2016). The freshwater resource is currently subjected to extensive floral alien infestation, with species such as *Eucalyptus camaldulensis*, *Xanthium strumarium*, *Datura stramonium* and *Flaveris bidentis* present. The approved 32m buffer zone must be implemented and form part of the green open space area for the proposed Erasmus Park development. It is proposed that rehabilitation measures such as erosion and floral alien invasive control take place within the freshwater feature to improve the overall function and sensitivity of the freshwater resource.



Figure 1: The freshwater feature located within the south-western section of the study area.



A single artificial feature was located next to the southern border, adjacent to the development wall, in the south of the study area (as noted by Exigo Sustainability, 2016). This feature is unlikely to have occurred as a result of earthworks associated with the adjacent property and the construction of the wall, resulting in a depression into which precipitation ponds. The presence of water within the depression likely created a hydroperiod, resulting in the presence of hydrophitic vegetation (such as *Imperata cylindrica* and *Typha capensis*). It is unlikely that this feature would have formed under normal circumstances and thus does not enjoy protection under the National Water Act, 1998 (Act 36 of 1998) (NWA).



Figure 2: The artificial feature recorded within the southern boundary of the study area.

The study area has also been affected by the discharge of stormwater into the *Senegalia caffra* – *Vachellia karroo* woodland and Degraded Grassland habitat units from the surrounding main roads and the highway. A stormwater discharge outlet (25°49'18.55"S 28°15'2.27"E) is located on the eastern boundary of the study area. This has created small channels or preferential pathways within the study area. These channels are noted to be driven by an artificial source and cannot be considered natural features as per the definition of a watercourse under the NWA. It is therefore recommended that stormwater within the study area be managed in such a way that the proposed Erasmus Park development does not degrade the freshwater resources and surrounding habitat, should stormwater be re-routed to discharge within the watercourse. It must be ensured that the hydrology, morphology, biological and the water quality of this system are not affected by any current or post development stormwater runoff.



Sections 3,1 – 3.3 below provides a summary of the findings of the main habitat units (excluding the Watercourse with Riparian Woodland and an Artificial Depression Habitat) while Figure 3 provides a conceptual illustration of the various habitat units.



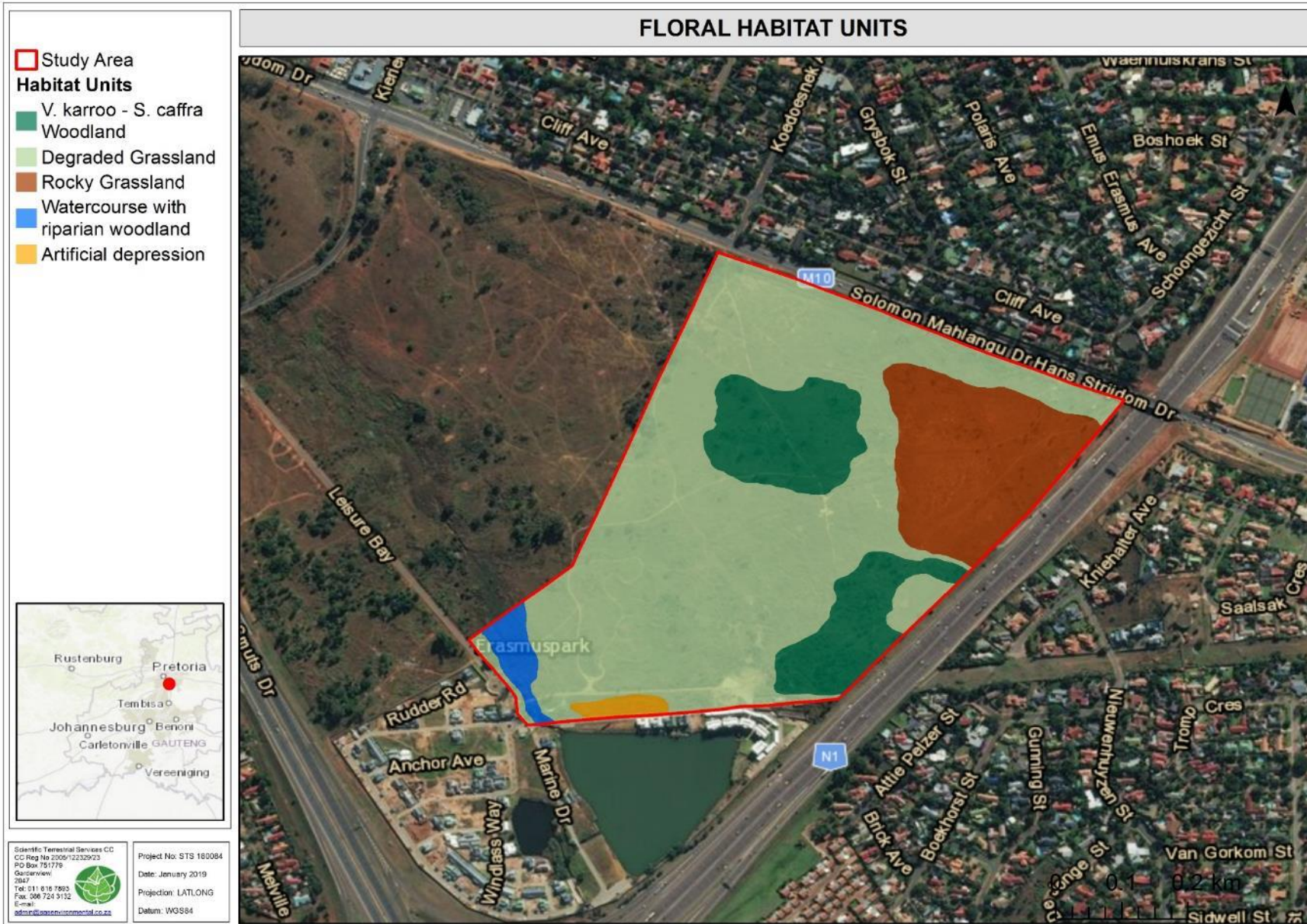

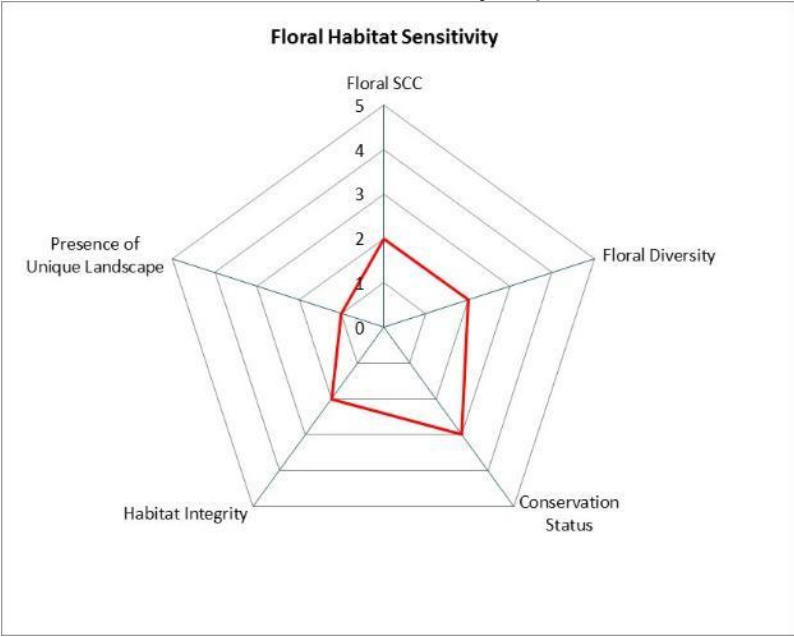


Figure 3: Conceptual illustration of the habitat units within the study area.



3.1 Habitat Unit 1: *Senegalia caffra* – *Vachellia karroo* Woodland Habitat Unit


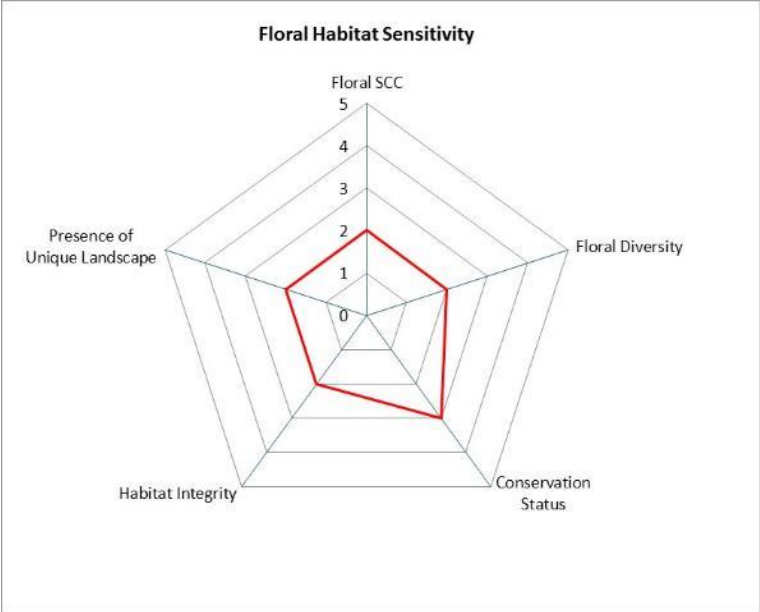
<p>Habitat Unit: <i>Senegalia caffra</i> – <i>Vachellia karroo</i></p>	<p>Floral Habitat Sensitivity</p>	<p>Moderately Low</p>	
<p>Notes on Photograph: Representative photographs of the <i>Senegalia caffra</i> – <i>Vachellia karroo</i> woodland habitat unit. The ecological state of this habitat unit is considered to be transformed due to historic soil disturbances, leading to alien floral proliferation.</p>			
<p style="text-align: center;">Floral Habitat Sensitivity Graph</p> 			
<p>Floral Species of Conservation Concern (SCC)</p>	<p>During the filed assessment, no floral SCC was recorded nor are any of the tree species occurring within this habitat unit listed as protected under the National Forest Act, 1998 (Act 84 of 1998), as amended in 2011. Of the listed tree species, none are known to occur naturally within grassland habitat. No important or medicinal forb species were found during the field assessment. Due to anthropogenic activities and proliferation of alien species, it is unlikely that any of the listed floral SCC (as listed by GDARD for the Quarter Degree Square [QDS] or SANBI Red List) will occur within the habitat unit. It was also noted that harvesting of medicinal species or species of landscape value were already removed and sold by residents in the area.</p>		



<p>Floral Ecological Discussion</p>	<p>The floral diversity for this habitat unit is considered to be moderately low. A low diversity of grass species were recorded at the time of assessment, where the graminoid composition was dominated by <i>Hyparrhenia hirta</i> and <i>H. tamba</i>.</p> <p>The <i>Senegalia caffra</i> – <i>Vachellia karroo</i> woodland habitat unit occurs as pockets within the study area, forming mixed open woodlands. Edge effects from the surrounding urbanised area and anthropogenic activities such as harvesting of plant material, the collection of firewood, continuous pedestrian movement, as well as illegal disposal of rubble and household waste, has resulted in the establishment of AIP species and has altered the floral community composition. Levels of habitat degradation vary throughout the habitat unit, with degradation of the south-eastern section considered to be the most severe, where the majority of the tree layer is dominated by AIP. Species composition entails <i>Senegalia caffra</i>, <i>Vachellia karroo</i>, <i>Searsia lancea</i> and <i>Ziziphus mucronata</i>. AIPs associated with the habitat unit includes <i>Melia azedarach</i> and <i>Eucalyptus camaldulensis</i>.</p> <p>For a full list of species encountered during the field assessment, refer to Appendix D.</p>	<p>Business Case, Conclusion and Mitigation Requirements:</p> <p>This habitat unit is of moderately low floral sensitivity. Urban expansion, anthropogenic activities and proliferation of alien plant species has resulted in the degradation of the available habitat and subsequent floral species loss.</p> <p>The vegetation type associated with the study area is listed as vulnerable (Mucina & Rutherford 2012). Furthermore, the study area falls within the Critically Endangered Pretoria Mountain Bushveld ecosystem according to the National Threatened Ecosystem Database (2011). The Gauteng Conservation Plan (C-Plan V3.3, 2011) indicates the habitat unit as a Critical Biodiversity Area (CBA), important for “Red and Orange” listed plant habitat and for primary vegetation. During the field assessment, no red or orange listed floral SCC was observed. Due to the degraded ecological state from soil disturbance (dumping) which has resulted in alien floral proliferation, the conservation importance of this habitat unit is considered to be moderately low.</p>
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3.2 Habitat Unit 2: Rocky Grassland Habitat Unit


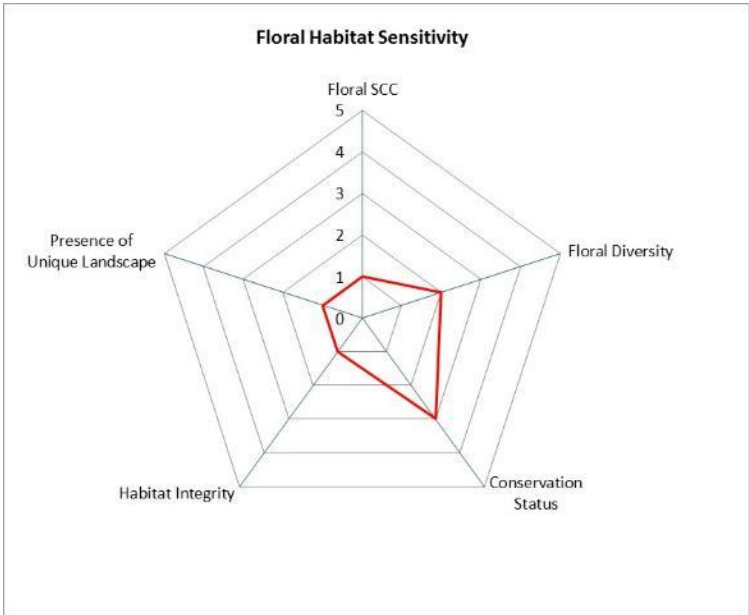
Habitat Unit: Rocky Grassland	Floral Habitat Sensitivity	Moderately Low	
Notes on Photograph: Representative photographs of the rocky grassland habitat associated with the upper north-eastern portion of the study area.			
<p style="text-align: center;">Floral Habitat Sensitivity Graph</p> 			<p>Floral Species of Conservation Concern (SCC)</p> <p>No floral SCC were observed within this habitat unit at the time of the assessment. The availability and suitability of the habitat for floral SCC is considered to be limited, with habitat transformation as a result of alien floral proliferation, edge effects, clearing of vegetation close to the main roads on the northern boundary of the habitat unit and harvesting of indigenous vegetation by residents prevalent.</p>



Floral Ecological Discussion	The floral diversity within this habitat unit is considered to be moderately low. The Rocky Grassland has a restricted range within the study area and is characterised by a low diversity of floral species. This habitat unit is characterised by small rocky outcrops with gravelly soils in the north-eastern section of the study area. The herbaceous layer is still fairly intact, dominated by grass species such as <i>Themeda triandra</i> , <i>Melinis repens</i> , <i>Melinis nerviglumis</i> and <i>Sporobolus</i> species. The integrity of this habitat unit has been compromised and therefore renders this habitat unit as somewhat transformed within the study area and the surrounding urban setting. Edge effects were noted within the habitat unit as a result of vegetation clearing next to the road, informal vehicle tracks leading to a nearby advertisement board and harvesting of indigenous species such as <i>Boophone disticha</i> and <i>Aloe davyana</i> (evidence of harvesting was noted during the site visit).
Business Case, Conclusion and Mitigation Requirements:	<p>This habitat unit is of moderately low floral sensitivity. Urban expansion, anthropogenic activities and proliferation of alien plant species has resulted in the degradation of the available habitat and subsequent floral species loss.</p> <p>The vegetation type associated with the study area is listed as vulnerable (Mucina & Rutherford 2012). Furthermore, the study area falls within the Critically Endangered Pretoria Mountain Bushveld ecosystem according to the National Threatened Ecosystem Database (2011). The Gauteng Conservation Plan (C-Plan V3.3, 2011) indicates the habitat unit as a CBA, important for "Red and Orange" listed plant habitat and for primary vegetation. During the field assessment, no red or orange listed floral SCC was observed. Due to the degraded ecological state from soil disturbance (dumping) which has resulted in alien floral proliferation, the conservation importance of this habitat unit is considered to be moderately low. It was also indicated by the Gauteng C-plan that the "ridge" habitat linked to this rocky grassland had been classified as transformed. The transformed state, with the low floral diversity and harvesting of indigenous vegetation, contributes to the lower sensitivity of this habitat unit.</p>



3.3 Habitat Unit 3: Degraded Grassland Habitat Unit

Habitat Unit: Secondary Grassland	Floral Habitat Sensitivity	Low	
<p>Notes on Photograph: Top: Representative photographs of the Degraded Grassland Habitat dominated by <i>Hyparrhenia</i> sp and <i>Aristida congesta</i> grass species. Bottom: Communities of <i>Hypoxis lanceolata</i> observed within the habitat unit.</p>			
<p style="text-align: center;">Floral Habitat Sensitivity Graph</p> 			
<p>Floral Species of Conservation Concern (SCC)</p>	<p>No floral SCC was noted during the field assessment. on review of the relevant literature, two floral SCC, <i>Boophone disticha</i> and <i>Hypoxis hemerocallidea</i>, are likely to occur within this habitat unit. Both species are considered to be of Least Concern (LC) nationally but are classified as declining within the Gauteng province, which can be attributed to the rapid urbanisation of the Province, as well as both plants being harvested extensively for the traditional medicine trade. Should these floral SCC be encountered during any phase of the proposed development, a suitably qualified specialist is to be consulted in terms of the best way forward, and if necessary, the relevant provincial/national departments contacted in terms of acquiring the necessary plant relocation/removal permits.</p>		



<p>Floral Ecological Discussion</p>	<p>The floral diversity for the Degraded Grassland Habitat Unit is considered to be low. The grass diversity is considered low for the vegetation type, as Carletonville Dolomite Grassland comprise predominantly of grass species with a limited diversity of herbs and woody species expected to occur. Grass species observed within this habitat unit are considered representative of the Carletonville Dolomite Grassland, namely <i>Hyparrhenia hirta</i>, <i>Melinis repens</i>, <i>Themeda triandra</i>, and <i>Aristida species</i>. The diversity of herbs within the habitat unit is considered moderate, with only a few species indigenous to the Carletonville Dolomite Grassland vegetation type observed, namely <i>Helichrysum nudifolium</i> and <i>Vernonia oligocephala</i>.</p> <p>AIP species had a low diversity and abundance within this habitat unit, except <i>Campuloclimium macrocephalum</i>, <i>Ipomoea purpurea</i> and <i>Verbena bonariensis</i>. For a full list of species encountered during the field assessment, please refer to Appendix D.</p> <p>A section located next to Solomon Mahlangu Road was noted to have been historically cultivated which has resulted in patches of secondary vegetation, often varying in ages and dominance of grass species.</p> <p>Current impacts include informal roads and walkways from pedestrians. Vegetation clearance has also taken place on the northern boundary of the study area as part of edge effects from the road and surrounding developments. As such, the vegetation within this habitat unit cannot be considered as a primary grassland.</p>	<p>Business Case, Conclusion and Mitigation Requirements:</p> <p>This habitat unit is of low floral sensitivity.</p> <p>The vegetation type (Carletonville Dolomite Grassland) associated with the study area is listed as vulnerable (Mucina & Rutherford 2012). Furthermore, the study area falls within the Critically Endangered Pretoria Mountain Bushveld ecosystem according to the National Threatened Ecosystem Database (2011). The Gauteng Conservation Plan (C-Plan V3.3, 2011), indicates the habitat unit as a CBA, important for “Red and Orange” listed plant habitat and for primary vegetation. Due to the degraded state of the habitat unit, and the area no longer being considered as a primary habitat, the proposed development is not considered to have a detrimental impact on the floral habitat and diversity of the area.</p> <p>Although no floral SCC was observed during the site assessment, suitable habitat is available within the habitat unit for the medicinally important species, <i>Boophone disticha</i> and <i>Hypoxis hemerocallidea</i>.</p> <p>If the proposed development continues, it is important to limit all construction work to the development footprint and to ensure that no additional AP species are introduced to the green open space areas or the surrounding areas. The current AIP species noted on site should be cleared prior to any development/construction and be disposed of at registered waste facilities. A walkthrough must be done before the commencement of construction to ensure that no SCC are present within the study area (this should ideally be undertaken during the flowering season). Should Floral SCC be found, they must be rescued and relocated to suitable habitat within designated open space areas within the study area. This mitigation measure will lower the loss of SCC impact.</p>
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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 IUCN categories Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) is considered to be a threatened species. Furthermore, 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.

An assessment considering the presence of any floral SCC, as well as suitable habitat to support any such species, was undertaken. The GDARD conservation list was acquired for the Quarter Degree Squares (QDS) 2528CC and 2528CD. All SCC listed for the QDSs, together with their calculated Probability of Occurrence (POC) ratings are tabulated in Appendix C. Table 5 below represent those species that obtained a POC score of 60% or more.

Table 1: Floral SCC with a high probability of occurrence score (POC) within the QDSs 2528CC and 2528CD. Refer to Appendix C for the full list of SCC with their POC scores.

FAMILY	SPECIES	THREAT STATUS	POC (%)	Motivation
Amaryllidaceae	<i>Boophane disticha</i>	LC (National); Declining (Provincial)	60	Suitable habitat within the rocky grassland habitat unit. The study area is situated within the known distribution range of the species.
Hypoxidaceae	<i>Hypoxis hemerocallidea</i>	LC (National); Declining (Provincial)	60	The study area is situated within the known distribution range of the species, and suitable habitat is available within the rocky grassland.

LC = Least Concern

From this list, two floral SCC have an increased probability of utilising the study area, particularly the rocky grassland habitat. During the field assessment, no individuals of these species were observed. The absence of these species from the study area can be attributed to the plant species having been harvested, as trading of plants adjacent to the study area was documented, and both species are widely used in traditional medicine.

Should these or any other floral SCC be encountered during any phase of the proposed development, a suitably qualified specialist is to be consulted in terms of the best way forward, and if necessary, the relevant provincial/national departments contacted in terms of acquiring the necessary plant relocation/removal permits.



3.5 Alien and Invasive Plant (AIP) Species

Alien and invasive floral species are floral species of exotic origin which are invading or have invaded 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. Therefore, they are often the most dominant and noticeable within an area. Disturbances of 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 that can out-compete their more aggressively growing exotic counterparts.

Alien vegetation invasion 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.

During the floral assessment, dominant alien and invasive floral species were identified and are listed in the table below.

Of the alien species recorded during the site visit (Table 2 below), eight are listed as National Environmental Management : Biodiversity Act (NEMBA) Category 1b and one as NEMBA Category. The majority of alien species encountered are woody tree species and herbaceous species associated with the degraded grassland habitat.

Alien species located within the study area need to be removed on a regular basis as part of maintenance activities according to Government Notice R864 of 2016 as it relates to the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Alien and Invasive Species Regulations..



Table 2: 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.

TREES AND SHRUBS				
Species	English name	Country of Origin	Category*	Habitat Unit
<i>Acacia decurrens</i>	Green Wattle	Australia	2	Degraded Grassland
<i>Melia azedarach</i>	Syringa	China	1b	Degraded Grassland
<i>Datura stramonium</i>	Common Thorn Apple	North America	1b	Degraded Grassland
<i>Eucalyptus camaldulensis</i>	Red River Gum	Australia	1b	V. karroo – S. caffra Woodland
FORBS AND GROUNDCOVERS				
Species	English name	Country of Origin	Category*	Habitat Unit
<i>Campuloclinium macrocephalum</i>	Pompom weed	Central & South America (Mexico to Argentina)	1b	Degraded Grassland
<i>Cirsium vulgare</i>	Spear Thistle	Europe and Asia	1b	Rocky Grassland
<i>Ipomoea purpurea</i>	Common Morning Glory	Tropical and Subtropical America	1b	Degraded Grassland
<i>Verbena bonariensis</i>	Tall verbena,	South America	1b	Degraded Grassland
GRASSES AND SEDGES				
Species	English name	Country of Origin	Category*	Habitat Unit
<i>Arundo donax</i>	Giant Reed	Eurasia	1b	Degraded Grassland

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** – Ornementally 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).

3.6 Medicinal Floral Species

Medicinal plant species are not necessarily indigenous species, with many of them regarded as alien invasive weeds. The table below presents a list of dominant plant species identified during the field assessment which are known to have traditional medicinal value, the plant parts traditionally used and their main applications.

Table 3: Dominant traditional medicinal floral species identified during the field assessment. Medicinal applications and application methods are also presented (van Wyk, Oudtshoorn, Gericke, 2009).

Species	Name	Plant parts used	Medicinal uses
<i>Helichrysum nudifolium</i>	Everlasting	Leaves and twigs, sometimes the roots	Used in the treatment of coughs, cold, fever, infections, headache, and menstrual pain. Also, a popular ingredient for wound dressing. <i>H. nudifolium</i> tea is an old Cape remedy for colds and chest ailments.
<i>Hilliardiella oligocephala</i>	Bicoloured-leaved Vernonia	Leaves and twigs, rarely the roots	Infusions are taken as stomach bitters to treat abdominal pain and colic. Other ailments treated include rheumatism, dysentery and diabetes. The roots have been used to treat ulcerative colitis.



Species	Name	Plant parts used	Medicinal uses
<i>Datura stramonium</i> *	Common thorn apple	Leaves and Seed (rarely the green fruit)	Traditionally used to relieve asthma and relieve pain. The elderly also use the plant as a hypnotic, where adults use it as an aphrodisiac. <i>This is a toxic plant.</i>
<i>Xerophyta retinervis</i>	Monkey's tail	Roots, while plant or stems	Dried parts are smoked as relief from asthma or smoke is used to stop nose bleeding. The stem is used to treat general aches of the body, as an anti-inflammatory and for post-partum haemorrhage.
<i>Ziziphus mucronata</i>	Buffalo thorn	Roots, bark or leaves used separately or in combination.	Warm bark infusions (sometimes together with roots or leaves added) are used as expectorants (also as emetics) in cough and chest problems, while root infusions are a popular remedy for diarrhoea and dysentery. Decoctions of roots and leaves (or chewed leaves) are applied externally to boils, sores and glandular swellings, to promote healing and as an analgesic.
<i>Vachellia karroo</i>	Sweet Thorn	Bark, leaves and gum	Bark and leaves are used as a remedy for diarrhoea and dysentery. The gum, bark and leaves have also been used as an emollient and astringent for colds, conjunctivitis and haemorrhage. The gum is also used as food and taken for oral trush.

The species listed in the table above are common, widespread species and not confined to the study area nor are they unique within the region. *Hypoxis hemerocallidea* and *Boophane disticha* are classified as Declining in the Gauteng Province, mainly due to the rapid urbanisation in Gauteng, which has caused a decline in available natural habitat. No *H. hemerocallidea* and *Boophane disticha* species were found in Carletonville Dolomite Grassland associated with the study area.

4 SENSITIVITY MAPPING

The figure below conceptually illustrates the areas considered to be of increased 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. The table 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 the development.

Habitat Unit	Sensitivity	Conservation Objective	Development Implications
Watercourse with Riparian Woodland	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.	<p>This habitat unit is of intermediate ecological sensitivity, predominantly due to the presence of this feature and the protection thereof.</p> <p>Based on the existing development layout provided by the proponent (refer to Section 5 of this report), the freshwater resource is excluded from the development. The approved 32m buffer zone must be implemented and form part of the green open space area for the development. It is proposed that rehabilitation measures such as erosion and floral alien invasive control take place within the freshwater feature to improve the overall function and sensitivity of the freshwater resource.</p>
Rocky Grassland Senegalia caffra – Vachellia karroo Woodland	Moderately Low	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.	<p>It was indicated on the Gauteng C-plan (v3.3, 2011) that the entire habitat unit of the Rocky grassland and the <i>Senegalia caffra</i> – <i>Vachellia karroo</i> Woodland falls within a CBA, considered important in terms of “Red” and “Orange” listed plant habitat and for Primary Vegetation. A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges. Urban expansion, anthropogenic activities and proliferation of alien plant species have resulted in the degradation of the available habitat and subsequent floral species loss. Therefore, these habitat units cannot be considered as primary grassland due to the level of degradation and vegetation transformation, thus lowering the level of conservation contribution to meet regional and provincial targets.</p> <p>Development within this habitat unit will result in the loss of vegetation in the immediate area, but not on a regional scale. Although no floral SCC was noted within these habitat units, suitable habitat is available for floral SCC such as <i>Boophone disticha</i> and <i>Hypoxis hemerocallidea</i> to occur. Loss of individuals can, however, be mitigated should a thorough rescue and relocation plan be implemented and be overseen by a qualified specialist.</p> <p>With mitigation thoroughly implemented the proposed development is considered unlikely to have a significant impact on the floral ecology of the area nor the conservation objective for the province. The disturbance timeframes and footprint must be minimised, and care must be taken to limit edge effects on the more sensitive Carletonville Dolomite Grassland habitat units on the western portion of the greater study area, located within phase 1 of the development. During the construction phase, disturbance to the vegetation should be restricted to areas where development will take place – this will limit the potential for AIPs to spread.</p>
Degraded Grassland Artificial Depression	Low	Optimise development potential.	<p>This habitat unit is of low ecological sensitivity due to severe habitat transformation. The placement of infrastructure within the transformed areas will have no significant impacts on the floral ecology and conservation targets of the area. However, to reduce opportunities for AIPs to be exchanged between the Degraded Grassland habitat and artificial depression during construction activities, it is recommended that an AIP management plan is implemented for the clearance of listed alien species before construction commences. Indigenous forb species, although few, located within the Degraded Grassland can be removed and incorporated as part of the landscape layout plan.</p>



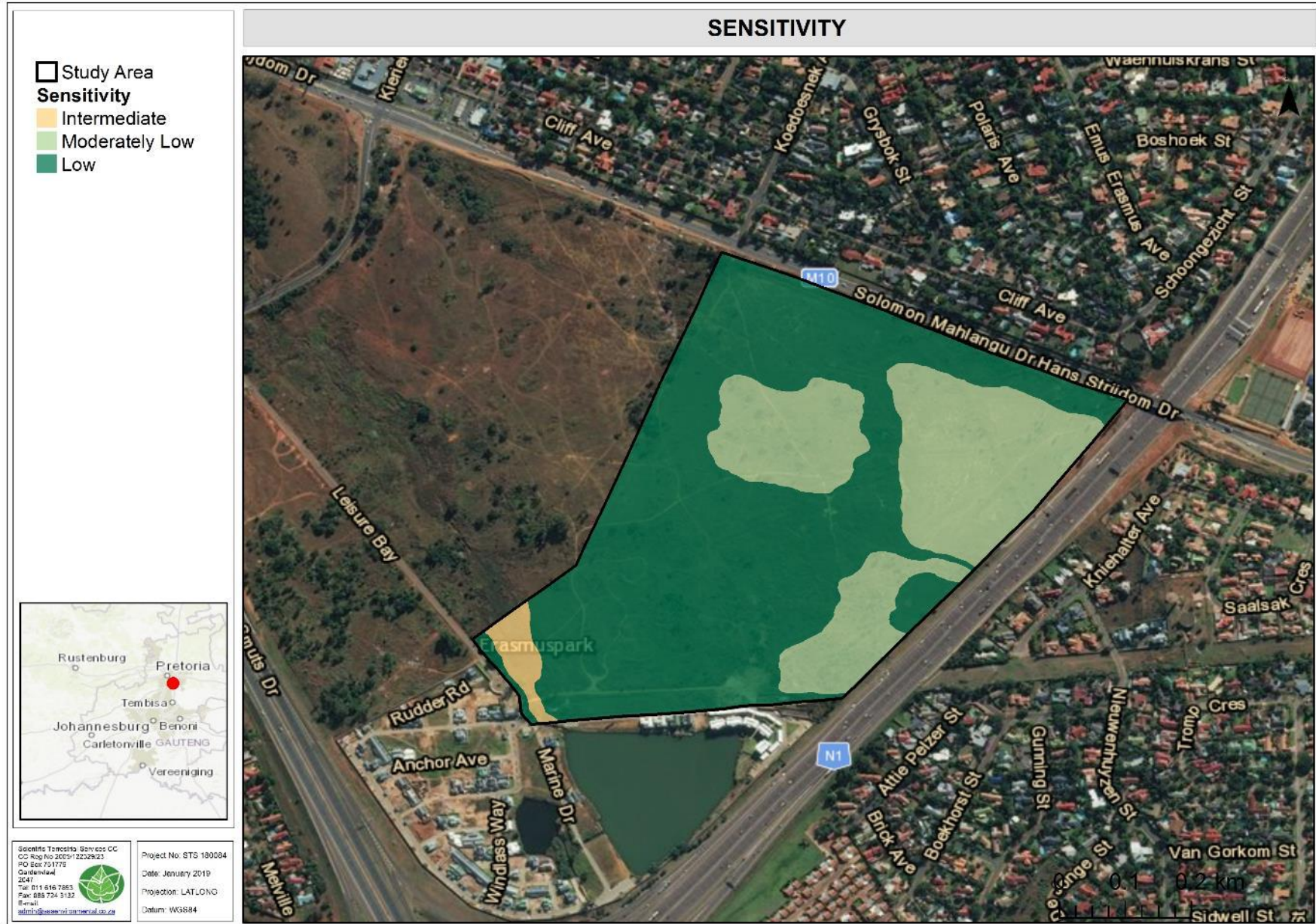


Figure 4: Sensitivity map for the study area.



5 FLORAL IMPACT ASSESSMENT

The table below serves to summarise the significance of the perceived impacts on the floral ecology of the proposed development. Individual impacts identified are presented in Section below and Appendix E of this report. A summary of all potential construction and operational phase impacts are provided in Section 5.1. All the required mitigatory measures needed to minimise the impact is presented in Section 5.2.

The diagram below illustrates the proposed preliminary layout of the development. The freshwater resource and allocated GDARD setback area of 32m (as per the freshwater assessment undertaken by Exigo Sustainability, 2016) is indicated and will form part of the open space area of the development. A portion of the degraded grassland and woodland area will also be excluded from development as part of the open space development. The remainder of the study area is proposed to be developed.



Figure 5: Proposed layout plan for the Erasmus Park development.

Activities and aspects register

The table below identifies potential activities that might take place during the various phases of the proposed development, which could impact on the floral ecology of the area. It should



be noted that these activities listed in the table below were utilised during the impact assessment as pre-mitigated impacts to ascertain the significance of the perceived impacts prior to mitigation measures.

Pre-Construction	Construction	Operational and Maintenance Phases
<p>Poor planning of infrastructure placement and design leading to loss of indigenous floral species and habitat, associated with the watercourse habitat and associated buffer area, located within the study area (other habitat units will unavoidably be lost as a result of the development).</p>	<p>Site clearing and the removal of habitat within the watercourse habitat and associated buffer zones, which is to remain as part of the proposed open space area.</p>	<p>Increased introduction and proliferation of alien plant species leading to further transformation of remaining natural vegetation.</p>
<p>Failure to rescue and relocate floral SCC to suitable habitat outside the development footprint that could be present within the study area, leading to permanent loss of these individuals.</p>	<p>Construction of the proposed development resulting in the removal and destruction of the potential floral SCC occurring within the study area.</p>	<p>Increased littering as a result of more human activity, further altering floral habitat and diversity.</p>
	<p>Vegetation clearance and construction activities could lead to disturbance and compaction of soils in close proximity of the watercourse habitat and associated buffer and outside of the footprint area and, hence, a decreased potential for indigenous floral species to re-establish, and AIP proliferation to occur. Increased sediment and pollutant loads entering into the watercourse may also alter the indigenous diversity within the watercourse and result in a monoculture habitat.</p>	<p>Inadequate rehabilitation of compacted soil areas leading to limited vegetation regrowth.</p>
	<p>Failure to implement an alien floral control plan, resulting in a spread of alien invasive species to areas outside the development footprint, particularly to the watercourse habitat and associated buffer, resulting in further loss of floral habitat and biodiversity.</p>	<p>Inadequate implementation of a rehabilitation, management and maintenance plan leading to increased alien invasive plant proliferation and further loss of natural vegetation.</p>
	<p>Increased human movement and hardened infrastructure surfaces within the study area leading to soil compaction, erosion and sediment run-off, thereby impacting floral re-establishment.</p>	
	<p>Disturbance caused to vegetation and soils, as well as increased human-related activities during construction, resulting in alien and invasive plant species proliferation - leading to loss of floral biodiversity.</p>	



Pre-Construction	Construction	Operational and Maintenance Phases
	Potential dumping of material outside designated areas leading to loss of terrestrial habitat. This, in turn, may lead to alien species colonising open and disturbed patches.	
	Potential further harvesting of terrestrial plant species and increased fire risk due to an increase of personnel in the area.	
	Inappropriate or lack of dust suppression methods during construction potentially affecting the further growth of indigenous floral species.	
	Decreased ecoservice provision & decreased ability to support biodiversity by the remaining grassland and freshwater resource habitat due to vegetation and soil disturbance.	

Impact on Floral Diversity and Habitat

Based on the current layout, the development footprint will span the entire study area with the exception of the freshwater resource and associated buffer, which is zoned as Private Open Space.

During the field assessment, the western portion of the study area was identified as a watercourse habitat associated with woodland species, and subsequently deemed to be of Intermediate sensitivity. The floral habitat, diversity and integrity for this habitat unit was also considered to be of intermediate significance. The freshwater resource habitat unit is furthermore considered a unique landscape, particularly within an urban setting. It is therefore recommended that the Freshwater Resource, together with the recommended Setback area of 32 m as stipulated by GDARD and the freshwater specialist (Exigo Sustainability, 2016) be excluded from development.

Habitat transformation and species diversity degradation of the Rocky Grassland and the *Senegalia caffra* – *Vachellia karroo* Woodland has occurred as a result of harvesting of indigenous vegetation, development and regular use of informal roads within the habitat units and edge effects from the surrounding developments and road construction. This has led to an increase in floral AIP proliferation within the study area. The floral habitat integrity of these above-mentioned habitat units is therefore considered to be of low significance.

It is further considered imperative that impacts are mitigated as efficiently and effectively as possible through all phases of the development, to limit the impact on the floral habitat and diversity of the area. Failure to implement mitigation measures will result in a decrease and



alteration as well as permanent loss of floral habitat and diversity associated with open space areas as well as the introduction and proliferation of alien and invasive plant species which will further contribute to habitat loss. At present, alien plant diversity is deemed to be moderate throughout the study area, and in order to continue maintaining the current levels of floral diversity and habitat, particularly within the Watercourse feature and associated woodlands, it must be ensured that these existing alien and invasive plant species are monitored and controlled.

Impact on Floral SCC

No floral SCC was encountered in the study area during the field assessment. From the POC list in Section 3.4, two floral SCC (*Boophone disticha* and *Hypoxis hemerocallidea*) have an increased probability of occurring in the study area, particularly within the rocky grassland habitat. During the field assessment, no individuals of these species were observed. The absence of these species from the study area can be attributed to the plant species harvesting, as trading of plants adjacent to the study area was noticed, and both species are widely used in traditional medicine.

Should these or any other floral SCC be encountered during any phase of the proposed development, a suitably qualified specialist is to be consulted in terms of the best way forward, and if necessary, the relevant provincial/national departments contacted in terms of acquiring the necessary plant relocation/removal permits.

Probable Latent Impacts

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

- Continued loss of Grassland habitat;
- Continued loss of and altered floral species diversity;
- Alien and invasive plant proliferation;
- Permanent loss of potential floral SCC and suitable habitat; and
- Loss of freshwater habitat from edge effects giving rise to further floral alien proliferation.

Cumulative Impacts

The study area, although situated within a low to medium density area, is still situated within an urban setting. As such the majority of the surrounding area has been transformed to residential small holdings, utilised for agricultural practices, as well as other anthropogenic related infrastructure such as roads. The floral ecology of the area has therefore been under



severe pressure from urbanisation, which has resulted in the degradation and transformation of large portions of the Carletonville Dolomite Grassland Vegetation type. The proposed development will, therefore, result in the further transformation of the floral ecology, habitat and diversity of the area.

Should the proposed development not commence, the current ecological status and sensitivity of the receiving environment cannot be guaranteed to persist, as a result of ongoing anthropogenic activities such as indigenous plant harvesting and urban expansion. Should the Watercourse habitat unit and associated setback area as described in Section 3 of this report, however, be excluded from the development, and the proponent commit to continue to manage, monitor and improve these areas into perpetuity, the likelihood of these habitat units to persist and remain within a good ecological condition within the urban landscape can be significantly improved, which will further contribute to conservation targets of the province.

5.1 Assessment Summary

The tables below serve to summarise the findings of the impact study undertaken with reference to the perceived impacts stemming from the proposed development activities as found in Appendix E. The tables below indicate the significance of the perceived impacts prior to the implementation of mitigation measures and following the implementation of mitigation measures. As such the post mitigation impacts for the Freshwater Resource habitat units is therefore undertaken on the assumption that this habitat unit together with their recommended setback areas are excluded from the development footprint (as recommended in the freshwater assessment (Exigo Sustainability, 2016). Should such actions not be adhered to, it is highly likely that post mitigation impact scores will increase.

The unmitigated impact of the proposed development of the floral habitat and diversity is considered to be of medium high significance for the Rocky grassland and Freshwater habitat and medium low significance for the woodland habitat. The Degraded grassland is expected to have a low significance level due to the current and historic disturbance of this vegetation unit..

The mitigated impact on the floral SCC are considered to be of medium low significance, with the exception of the Rocky Grassland which was considered to be a medium low due to the probability of occurrence and suitable habitat for two floral SCC. It is thus considered imperative that all mitigation measures as stipulated in the tables below are implemented as part of the proposed development. During the operation phase, all impacts associated with the remaining floral habitat and diversity are considered medium low, except for the impact on the Freshwater resources without the implementation of the mitigation measures. With the implementation of all the stipulated mitigation measure in the specialist reports, the significance



level of the impacts on the the remaining floral habitat and diversity is considered to be very low to low.

The following tables represent the findings of the impact assessment pertaining to the proposed layout projects.



Table 5: A summary of the impact significance on floral resources in the construction phase.

Site	Impact	Unmanaged	Mitigated
Senegalia caffra – Vachellia karroo Woodland	<i>Impact on floral habitat and species diversity</i>	Medium Low	Low
	<i>Impact on floral SCC</i>	Medium Low	Low
Rocky Grassland	<i>Impact on floral habitat and species diversity</i>	Medium High	Medium Low
	<i>Impact on floral SCC</i>	Medium High	Low
Freshwater Habitat	<i>Impact on floral habitat and species diversity</i>	Medium High	Low
	<i>Impact on floral SCC</i>	Medium Low	Very Low
Degraded Grassland	<i>Impact on floral habitat and species diversity</i>	Low	Very Low
	<i>Impact on floral SCC</i>	Very Low	Very Low

Table 6: A summary of the impact significance on floral resources in the operational phase.

Site	Impact	Unmanaged	Mitigated
Senegalia caffra – Vachellia karroo Woodland	<i>Impact on floral habitat and species diversity</i>	Medium Low	Low
	<i>Impact on floral SCC</i>	Medium Low	Low
Rocky Grassland	<i>Impact on floral habitat and species diversity</i>	Medium Low	Low
	<i>Impact on floral SCC</i>	Medium Low	Low
Freshwater Habitat	<i>Impact on floral habitat and species diversity</i>	Medium High	Low
	<i>Impact on floral SCC</i>	Low	Very Low
Degraded Grassland	<i>Impact on floral habitat and species diversity</i>	Very Low	Very Low
	<i>Impact on floral SCC</i>	Very Low	Very Low

5.2 Integrated Impact Mitigation

The table below highlights the key integrated mitigation measures that are applicable to the proposed development in order to suitably manage and mitigate the ecological impacts that are associated with the construction and operation phases of the proposed development activities. 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 adequately mitigated and minimised.



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

Project phase	Construction Phase
Impact Summary	<i>Loss of floral habitat, species and SCC</i>
	<ul style="list-style-type: none"> - Any disturbances to the intermediate sensitive floral habitat must be actively avoided. As such the the Freshwater Resource and its associated regulatory zones should be excluded from the development, in order to conserve the ecology of the area, and help meet the conservation targets of the province. This area must be cordoned off during the construction phase; - Although no floral SCC was recorded during the site assessment, the following is recommended: <ul style="list-style-type: none"> • During the surveying and site-pegging phase of surface infrastructure, a walkdown of the area must be done to ensure that any floral SCC, if encountered, be rescued and relocation outside of the development footprint; • All possible SCC individuals situated within the development footprint should be rescued and either relocated to: <ul style="list-style-type: none"> ○ Suitable similar habitat within the study area but outside the development footprint, should this habitat unit be excluded from the development, ○ Used within the landscaping plan of the development or ○ Relocated to a registered nursery, the ARC or SANBI; • It should be noted that should SCC individuals be removed from the study area to an area not listed above, permits might be required from the GDARD, and • The rescue and relocation plan should be overseen by a suitably qualified specialist; - No collection of indigenous or medicinal floral species must be allowed by construction personnel. - Edge effect control needs to be implemented to ensure no further degradation and potential loss of vegetation outside of the proposed development footprint area occurs; - Appropriate sanitary facilities must be provided during the construction phase and all waste must be removed to an appropriate waste facility; - No dumping of waste on site should take place. As such it is advised that waste disposal containers and bins be provided during the construction phase for all construction rubble and general waste; - If any spills occur, they should be immediately cleaned up. In the event of a breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced preventing the ingress of hydrocarbons into the topsoil. It should be ensured that no spills leak into the Freshwater resource associated with the central portion of the study area, - Informal fires by construction personnel should be prohibited, and no uncontrolled fires whatsoever should be allowed; - Removal of vegetation should be restricted to what is absolutely necessary; - Alien vegetation, as listed in section 3.5 of this report, must be removed from the study area during both the construction and operational phases, with specific mention of Category 1b and 2 species in line with the NEMBA Alien and Invasive Species Regulations (2016); - Edge effects of all construction activities, such as erosion and alien and invasive plant species proliferation, which may affect the sensitive habitat areas as stipulated in this report, as well as adjacent grassland and freshwater resource habitat within surrounding areas, need to be strictly managed adjacent to the proposed development footprint areas. Specific mention in this regard is made to Category 1b and Category 2 species identified within the development footprint areas (refer to section 3.5 of this report); and - Upon completion of construction activities, it must be ensured that no bare areas remain, and that indigenous grassland species be used to revegetate the disturbed area. Recommended seed mix: Mayfort Biosome Grassland seed mix: http://mayford.co.za/veld-grass.
Project phase	Operational and Closure Phase
Impact Summary	<i>Loss of floral habitat, species and SCC</i>
	<ul style="list-style-type: none"> - All sensitive habitat excluded from the development, should remain demarcated for the life of the operation, and no entry of unauthorised personnel should be allowed; - Ongoing alien and invasive plant monitoring and eradication/control should take place throughout the operational phase of the development, and the project perimeters should be regularly checked during the operational phase for alien and invasive plant proliferation as well as bush encroachment to prevent spread into surrounding natural areas. Specific mention in this regard is made to Category 1b and Category 2 species identified within the development footprint areas (refer to section 3.5 of this report); - Indigenous vegetation should be used during the landscaping of the project, maintenance and monitoring of garden ornamentals used in the landscaping should be included in the monitoring and maintenance plan to prevent the spread of such species to the sensitive habitat units excluded from the development; - No indiscriminate disposal of waste must be permitted. Bins should be provided along the open space areas, to allow for disposal of waste. Bins should be emptied twice weekly and disposed of registered waste facilities; - The rehabilitation of natural vegetation should proceed in accordance with a landscape plan compiled by a suitable specialist. This plan should consider all development phases of the project indicating rehabilitation actions to be undertaken during and once construction has been completed, ongoing rehabilitation during the operational phase of the project; - Monitor the success of rehabilitation efforts seasonally; and - Continue with, and update, the alien and invasive plant control plan accordingly.



6 CONCLUSION

Scientific Terrestrial Services (STS) was appointed to conduct a faunal and floral ecological assessment for the proposed Erasmus Park Phase 2 development on the remaining extent of the farm Waterkloof 378 JR, Erasmusrand, Gauteng Province (hereafter referred to as the 'study area').

During the field assessment, four habitat units were identified within the study area, i.e. the *Senegalia caffra* – *Vachellia karroo* woodland, the Rocky Grassland, the Degraded Grassland, a Watercourse with Riparian Woodland and an Artificial Depression.

- The *Senegalia caffra* – *Vachellia karroo* woodland habitat unit occurs as pockets within the study area to form mixed open woodlands. Edge effects from the urban area and anthropogenic activities such as harvesting of plant material, the collection of firewood, continuous pedestrian movement, as well as illegal disposal of rubble and household waste has resulted in the establishment of Alien Invasive Plant (AIP) species and has altered the floral community composition.
- The Rocky Grassland habitat unit is characterised by small rocky outcrops with gravelly soils in the north-eastern section of the study area. The herbaceous layer is still fairly intact, dominated by grass species such as *Themeda triandra*, *Melinis repens*, *Melinis nerviglumis* and *Sporobolus* species. Edge effects were noted within the habitat unit caused by vegetation clearing next to the road, informal vehicle tracks leading to a nearby advertisement board and harvesting of indigenous species such as *Boophone disticha* and *Aloe davyana*.
- The Degraded Grassland habitat unit comprising *Hyparrhenia* and *Aristida*-dominated grassland, stretches throughout the study area and is interspersed with patches of tree clumps stands of *Senegalia caffra*, *Vachellia karroo* and *Eucalyptus* trees. This habitat unit has been subjected to several historic and current anthropogenic-related impacts which has led to its current moderately modified state.
- The Freshwater Resource traverses the south-western portion of the study area and was classified as an unchanneled valley bottom wetland (Exigo Sustainability, 2016). The freshwater resource is currently subjected to extensive floral alien infestation, with species such as *Eucalyptus camaldulensis*, *Xanthium strumarium*, *Datura stramonium* and *Flaveris bidentis* being present.

From the GDARD conservation list, two floral SCC have an increased probability of utilising the study area, particularly the rocky grassland habitat. During the field assessment, no individuals of these species were observed. The absence of these species from the study area can be attributed to the plant species harvesting, as trading of plants adjacent to the study



area was noticed, and both species are widely used in traditional medicine. Should these or any other floral SCC be encountered during any phase of the proposed development, a suitably qualified specialist is to be consulted in terms of the best way forward, and if necessary, the relevant provincial/national departments contacted in terms of acquiring the necessary plant relocation/removal permits.

The objective of this study was to provide sufficient information on the floral ecology of the area, together with other studies on the physical and socio-cultural environment for the Environmental Assessment Practitioner (EAP) and the relevant authorities to apply the principles of Integrated Environmental Management (IEM) and the concept of sustainable development. The needs for conservation as well as the risks to other spheres of the physical and socio-cultural environment need to be compared and considered along with the need to ensure economic development of the country.

It is recommended that, from a floral ecological perspective, the proposed development activity be considered acceptable, provided that the recommended mitigation measures for the identified impacts (as outlined in Section 5.2 of this report) are adhered to.

It is the opinion of the ecologists that this study provides the relevant information required in order to implement an Integrated Environmental Management (IEM) plan 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

[Distribution + Habitat availability + Habitat disturbance] / 15 x 100 = 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> and <2	Low	Optimise development potential.
2> and <3	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
3> and <4	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.
4> and <5	Moderately high	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance.
5	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.



APPENDIX B: Impact Assessment Methodology

Ecological Impact Assessment Method

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

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

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'². The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the Table D1. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance-rating matrix and are used to determine whether mitigation is necessary³.

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

² The definition has been aligned with that used in the ISO 14001 Standard.

³ Some risks/impacts that have low significance will however still require mitigation.



The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act, 1998 (No. 107 of 1998) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

Table B1: Criteria for assessing significance of impacts

LIKELIHOOD DESCRIPTORS

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

CONSEQUENCE DESCRIPTORS

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



Table B2: Significance Rating Matrix.

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

Table B3: Positive/Negative Mitigation Ratings.

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

The following points were considered when undertaking the assessment:

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



-
- Particular attention was paid to describing any residual impacts that will occur after rehabilitation.

Mitigation measure development

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

- *Mitigation and performance improvement measures* and actions that address the risks and impacts⁴ are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation.
- Desired outcomes are defined, and have been developed in such a way as to be *measurable events with performance indicators, targets and acceptable criteria* that can be tracked over *defined periods*, with estimates of the *resources* (including human resource and training requirements) *and responsibilities for implementation*.

Recommendations

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

⁴ *Mitigation measures should address both positive and negative impacts*



APPENDIX C: Floral SCC

Table C1: Floral SCC for the 2528CC and 2528CD 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	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	0
Fabaceae	<i>Argyrolobium campicola</i>	NT	NT	Highveld Grassland	0
Amaryllidaceae	<i>Boophone disticha</i>	LC	Declining	Dry grassland and rocky areas.	60
Hyacinthaceae	<i>Bowiea volubilis</i> subsp. <i>volubilis</i>	VU	VU	Low and medium altitudes, usually along mountain ranges and in thickly vegetated river valleys, often under bush clumps and in boulder screens, 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	0
Orchidaceae	<i>Brachycorythis conica</i> subsp. <i>transvaalensis</i> .	CR	CR	Short, open grassland and wooded grassland, on sandy gravel overlying dolomite, sometimes also on quartzite, 1 000-1 705 m.	0
Asteraceae	<i>Callilepis leptophylla</i>	LC	Declining	Grassland or open woodland, often on rocky outcrops or rocky hill slopes	40
Apocynaceae	<i>Ceropegia decidua</i> subsp. <i>pretoriensis</i>	VU	VU	Associated with ridges and quartzitic rocky outcrops in pockets of soil among rocks in direct sunshine or shaded areas	20
Pteridaceae	<i>Cheilanthes deltoidea</i> subsp. <i>silicicola</i>	VU	VU	Southwest-facing soil pockets and rock crevices in chert rock	0
Capparaceae	<i>Cleome conrathii</i>	NT	NT	Stony quartzite slopes, usually in red sandy soil, grassland or deciduous woodland, all aspects.	0
Amaryllidaceae	<i>Crinum macowanii</i>	LC	Declining	Mountain grassland and stony slopes in hard dry shale, gravelly soil or sandy flats	40
Aizoaceae	<i>Delosperma gautengense</i>	VU	VU	Amongst rocks on south-facing slopes	20
Aizoaceae	<i>Delosperma leendertziae</i>	VU	VU	Steep, south-facing slopes of quartzite in mountain grassland.	0



Family	Species	National Threat status	Provincial Status	Habitat	POC %
Acanthaceae	<i>Dicliptera magaliesbergensis</i>	VU	VU	Forest, savanna (Riverine forest and bush).	0
Hyacinthaceae	<i>Drimia sanguinea</i>	NT	NT	Open veld and scrubby woodland in a variety of soil types.	20
Hyacinthaceae	<i>Eucomis autumnalis</i>	LC	Declining	Damp, open grassland and sheltered places from the coast to 2450 m	40
Orchidaceae	<i>Eulophia coddii</i>	VU	VU	Steep slopes, growing on sandstone-derived soils in grassland or bushveld.	0
Asteraceae	<i>Gnaphalium nelsonii</i>	NT	NT	Seasonally wet places in grassland and savanna, and along dry watercourses	20
Gunneraceae	<i>Gunnera perpensa</i>	LC	Declining	Damp marshy area and vleis from coast to 2400 m	0
Orchidaceae	<i>Habenaria barbertoni</i>	NT	NT	Rocky hillsides, in bushveld in association with acacias, 1000-1500 m	40
Orchidaceae	<i>Habenaria kraenzliniana</i>	NT	NT	Stony, grassy hillsides, 1000-1400 m	20
Orchidaceae	<i>Habenaria mossii</i>	EN	EN	Open grassland on dolomite or in black, sandy soil.	20
Orchidaceae	<i>Holothrix randii</i>	NT	NT	Grassy slopes and rock ledges, usually southern aspects	0
Hypoxidaceae	<i>Hypoxis hemerocallidea</i>	LC	Declining	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	60
Aquifoliaceae	<i>Ilex mitis. var. mitis</i>	LC	Declining	Along rivers and streams in forest and thickets, sometimes in the open. Found from sea level to inland mountain slopes	0
Fabaceae	<i>Indigofera hybrida</i>	VU	VU	Dry Highveld grassland.	20
Mesembryanthemaceae	<i>Lithops lesliei. subsp. lesliei</i>	NT	NT	Primarily in arid grasslands, usually in rocky places, growing under the protection of forbs and grasses.	20
Fabaceae	<i>Melolobium subspicatum</i>	VU	VU	Grassland.	0
Fabaceae	<i>Pearsonia bracteata</i>	NT	NT	Plateau grassland	0
Anacardiaceae	<i>Searsia gracillima var. gracillima</i>	NT	NT	Rocky quartzitic outcrops in bushveld.	20

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



APPENDIX D: Floral Species List

Table D1: Dominant floral species encountered within the study area. Alien species are indicated with an asterisk (*). Protected species as indicated in Bold.

Species *Alien **Succulent	Habitat Unit		
	<i>V. karroo</i> – <i>S. caffra</i> Woodland	Rocky Grassland	Degraded Grassland
TREES AND SHRUBS			
* <i>Acacia decurrens</i> 2			X
* <i>Datura stramonium</i> 1b			X
* <i>Eucalyptus camaldulensis</i> 1b	X		
* <i>Melia azedarach</i> 3			X
<i>Leonotis dysophylla</i>			X
<i>Searsia lancea</i>	X		
<i>Senegalia caffra</i>	X		
<i>Seriphium plumosum</i>			X
<i>Vachellia karroo</i>	X		
<i>Ziziphus macronata</i>	X		
FORBS AND GROUNDCOVERS			
* <i>Campuloclinium macrocephalum</i> 1b			X
* <i>Cirsium vulgare</i> 1b		X	
* <i>Ipomoea purpurea</i> 1b			X
* <i>Verbena bonariensis</i> 1b			X
<i>Aloe transvaalensis</i>		X	
<i>Asclepias mellodora</i>			X
<i>Chironia purpurascens</i>			X
<i>Gladiolus</i> sp.			X
<i>Helichrysum cerestoides</i>			X
<i>Helichrysum harveyanum</i>			X
<i>Helichrysum nudifolium</i>			X
<i>Hermannia depressa</i>			X
<i>Hilliardiella oligocephala</i>			X
<i>Hypoxis lanceolata</i>			X
<i>Hypoxis rigida</i>			X
<i>Indigofera</i> sp.		X	
<i>Ledebouria cooperi</i>		X	X
<i>Ledebouria ovatifolia</i>		X	
<i>Oxalis depressa</i>			X
<i>Senecio consanguineous</i>			X
<i>Xerophyta retinervis</i>		X	
GRASSES/ REEDS AND SEDGES			
* <i>Arundo donax</i> 1b			X
<i>Aristida congesta</i>	X		X
<i>Cymbopogon</i> sp.			X
<i>Elionurus muticus</i>		X	
<i>Eragrostis capensis</i>		X	
<i>Eragrostis chloromelas</i>			X
<i>Eragrostis curvula</i>			X
<i>Hyparrhenia hirta</i>			X
<i>Hyparrhenia tamba</i>			X
<i>Hyperthelia dissoluta</i>	X		
<i>Loudetia simplex</i>		X	
<i>Melinis repens</i>		X	
<i>Melinis nerviglumis</i>		X	
<i>Panicum maximum</i>	X		X
<i>Pennisetum thunbergii</i>		X	
<i>Schizachyrium sanguineum</i>		X	
<i>Sporobolus africanus</i>		X	
<i>Themeda triandra</i>		X	X



APPENDIX E: Floral Impact Assessment Tables

E1. Impact assessment pertaining to the proposed development activities

The following tables highlight the perceived impact pertaining to the relevant habitats affected by the proposed development, namely the *Senegalia caffra* – *Vachellia karroo* woodland, the Rocky Grassland, the Degraded Grassland, a Watercourse with Riparian Woodland.

Table E1: Impact on floral habitat and species diversity of the *Senegalia caffra* – *Vachellia karroo* woodland Habitat Unit.

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	4	3	4	3	3	7	10	70 (Medium Low)
Operational phase	4	3	3	2	3	7	8	56 (Medium Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	2	2	3	6	7	42 (Low)
Operational phase	3	2	3	2	3	5	8	40 (Low)

Table E2: Impact on Impact on floral SCC within the *Senegalia caffra* – *Vachellia karroo* woodland Habitat Unit.

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	4	3	3	3	3	7	9	63 (Medium Low)
Operational phase	4	4	3	2	3	8	8	64 (Medium Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	2	2	3	6	7	42 (Low)
Operational phase	2	4	2	1	4	6	7	42 (Low)

Table E3: Impact on floral habitat and species diversity of the Rocky Grassland Habitat Unit.

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	3	3	3	9	9	81 (Medium High)
Operational phase	4	3	3	2	4	7	9	63 (Medium Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	3	2	2	3	8	7	56 (Medium Low)
Operational phase	2	3	2	1	4	5	7	35 (Low)

Table E4: Impact on Impact on floral SCC within the Rocky Grassland Habitat Unit.

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	3	4	3	3	8	10	80 (Medium High)
Operational phase	4	3	3	2	4	7	9	63 (Medium Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	2	2	3	6	7	42 (Low)
Operational phase	3	3	2	1	4	6	7	42 (Low)

Table E5: Impact on floral habitat and species diversity of the Freshwater Resource Habitat Unit.

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	3	3	3	9	9	81 (Medium High)
Operational phase	5	3	3	3	4	8	10	80 (Medium high)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	2	3	2	2	3	5	7	35 (Low)
Operational phase	3	3	2	1	4	6	7	42 (Low)

Table E6: Impact on Impact on floral SCC within the Freshwater Resource Habitat Unit.

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	4	3	3	2	3	7	8	56 (Medium Low)
Operational phase	2	3	2	2	4	5	8	40 (Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	1	3	1	1	3	4	5	20 (Very Low)
Operational phase	1	3	1	1	4	4	6	24 (Very Low)

Table E7: Impact on floral habitat and species diversity of the Degraded Grassland Habitat Unit.

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	1	2	2	3	6	7	42 (Low)
Operational phase	2	1	2	2	4	3	8	24 (Very Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	4	1	1	1	3	5	5	25 (Very Low)
Operational phase	1	1	1	1	4	2	6	41 (Very Low)

Table E8: Impact on Impact on floral SCC within the Degraded Grassland Habitat Unit

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	2	1	2	2	3	3	7	21 (Very Low)
Operational phase	2	1	2	2	4	3	8	24 (Very Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	1	1	1	1	3	2	5	10 (Very Low)
Operational phase	1	1	1	1	4	2	6	12 (Very Low)