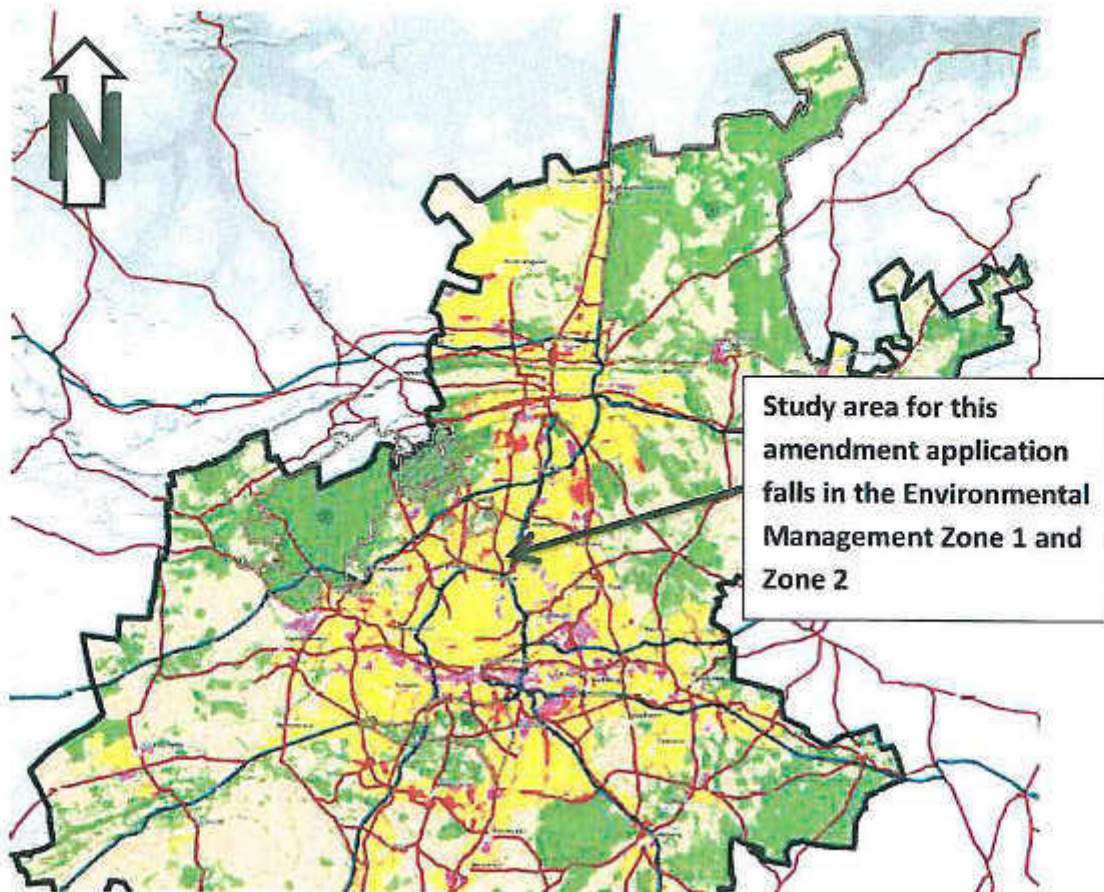


# **Annexure L**

Locality of Study Area  
According to GPEMF





**MAP LEGEND:**

**ENVIRONMENTAL MANAGEMENT ZONES**

- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5
- Special Control Zones
- Special Control Zone for Conservation, Recreation and Tourism

Gauteng Provincial Boundary

**Roads**

- National Road
- Arterial Road

**Special Control Zones:**  
 (a) Dinokeng  
 (b) CoHWS  
 (c) Vaaldam  
 (d) Jhb South  
 (e) Jhb North



# **Annexure M**

Flora and Fauna Reports



**FLORA ASSESSMENT  
OF THE  
REMAINING EXTENT OF PORTION 1 OF THE FARM  
WATERFALL 5-IR**



**May 2016**

**Landscape Architects &**

**Environmental Consultants: Specialist Division**

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**Reviewed by: J.V. van Greuning (Pri. Sci. Nat. reg. no. 400168/08)**

## Specialist

Specialist investigator: Mr. C. Niemandt (*M.Sc. Plant Science*)

### **Declaration of independence:**

I, the above mentioned specialist investigator responsible for conducting this particular specialist flora study, declare that:

- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);
- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development, except for financial compensation for work done in a professional capacity;
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part;
- I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse the proposed development, but aim to present facts, findings and recommendations based on relevant professional experience, guidance from professional experts and scientific data;
- I do not have any influence over decisions made by the governing authorities;
- I have the necessary qualifications and guidance from professional experts (registered Pr. Nat. Sci.) in conducting specialist reports relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- This document and all information contained herein are and will remain the intellectual property of Bokamoso Environmental: Specialist Division. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigator.

  
\_\_\_\_\_  
Corné Niemandt

## VERIFICATION STATEMENT

This communication serves to verify that the flora report compiled by Corné Niemandt has been prepared under my supervision, and I have verified the contents thereof.

**Declaration of independence:** I, Dr. J.V. van Greuning (Pr. Sci. Nat. reg. no. 400168/08) declare that I:

- am committed to biodiversity conservation but concomitantly recognise the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them;
- abide by the Code of Ethics of the S.A. Council of Natural Scientific Professions;
- act as an independent specialist consultant in the field of Botany;
- am subcontracted as specialist consultant by Bokamoso Environmental Consultants for the proposed Mixed Use development of the remaining extent of portion 1 of the farm Waterfall 5-IR described in this report;
- have no financial interest in the proposed development other than remuneration for work performed;
- have or will not have any vested or conflicting interests in the proposed development;
- undertake to disclose to Bokamoso Environmental Consultants and its client as well as the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations, 2014.



---

Dr. J. V. van Greuning

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## **1. INTRODUCTION**

Bokamoso Environmental: Specialist Division was commissioned to conduct a flora assessment for the proposed mixed used development on the remaining extent of portion 1 of the farm Waterfall 5-IR. The objective was to conduct plant species survey to determine which species occur in the site of the proposed mixed used development. Special attention was given to possible habitats for the recording of Red and Orange List plant species that may occur in the area. Furthermore, the ecological status and sensitive habitats of the site were investigated.

## **2. OBJECTIVES OF THE STUDY**

- To assess the habitat component and current ecological status of the area;
- To identify and list the plant species occurring on the site and indicate whether they are Red and Orange List species;
- Make recommendations if any Red and Orange List species are found;
- To indicate the sensitive habitats of the area;
- To highlight the current impacts on the flora of the site; and
- Provide recommendations to mitigate negative impacts and enhance positive impacts on the current flora should the proposed development be approved.

## **3. SCOPE OF STUDY**

This report:

- Lists all plant species, including alien species, recorded during the flora survey;
- Provide recommendations on Red and Orange List plant species;
- Indicate medicinal plant species recorded;
- Comments on ecological sensitive areas;
- Comments on current impacts affecting the flora of the site;
- Evaluates the conservation importance and significance of the area in and adjacent to the proposed development, with special emphasis on the current status of threatened species; and
- Provides recommendations to mitigate or reduce negative impacts, should the proposed development be approved.

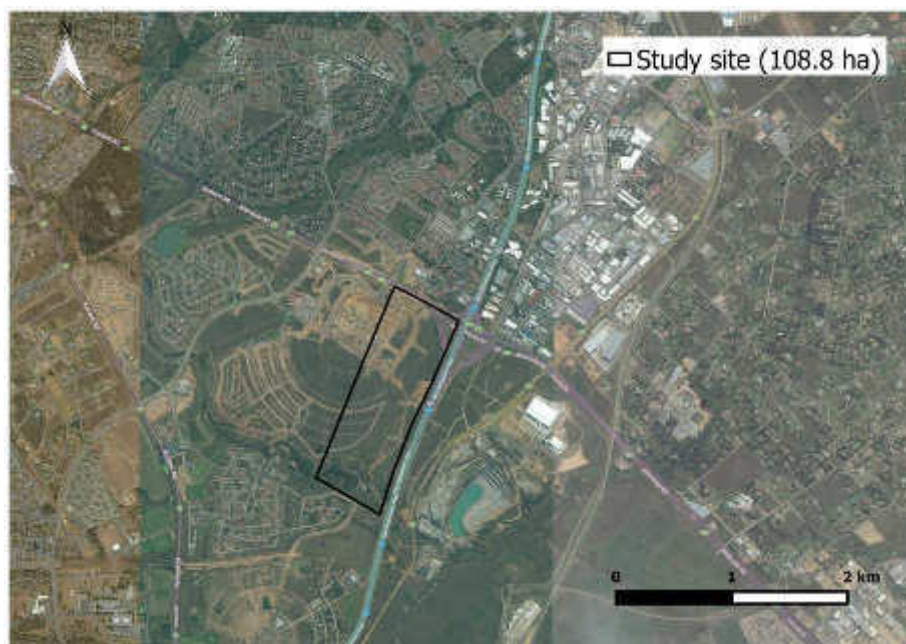
## 4. STUDY AREA

### 4.1 Regional vegetation

The study site lies in the quarter degree square (QDS) 2628AA. The site falls in the Egoli Granite Grassland vegetation unit (Mucina and Rutherford, 2006). This vegetation unit is considered Endangered according to the National list of threatened terrestrial ecosystems for South Africa, 2011 (National Gazette no. 34809, 2011). 38% is still in a natural state with only 3% protected in Diepsloot and Melville Koppies Nature Reserves (National Gazette no. 34809, 2011; Mucina and Rutherford, 2006). The landscape is described as moderately undulating plains and low hills supporting tall, *Hyparrhenia hirta*-dominated grassland, with some woody species on rocky outcrops or rock sheets (National Gazette no. 34809, 2011). The rocky habitats show a high diversity of woody species, which occur in the form of scattered shrub groups or solitary small trees (National Gazette no. 34809, 2011). No serious alien infestation occurs within this vegetation unit, although *Eucalyptus* species are common (Mucina and Rutherford, 2006).

### 4.2 The study site

The proposed mixed used development is situated in Midrand, Gauteng, on the remaining extent of portion 1 of the farm Waterfall 5-IR. The extent of the study site is approximately 108.8 ha. This site is located west of the N1 highway, east of The Mall of Africa and south of Allendale road (Figure 1). Towards the south of the study site flows the Jukskeiriver.



**Figure 1** Aerial map to indicate the locality.

## 5. METHODS

The study site was visited on the 7<sup>th</sup> of April 2016. A species list was compiled for all plants recorded within each study unit by means of a 100 x 100 m rectangular plot. The drainage line vegetation was sampled by recording species within a 100 x 50 m rectangular plot. Field guides such as those by Germishuizen & Meyer (2003), Koekemoer *et al.* (2014), Pooley (1998), van Ginkel *et al.* (2011), van Oudtshoorn *et al.* (2014), van Wyk & Malan (1998) and van Wyk & van Wyk (2013) were used to identify the species. Species which could not be identified in the field were taken for identification to the H.G.W.J. Schweickerdt Herbarium (PRU), University of Pretoria. Each study unit was further assessed for the occurrence of alien plant species (Bromilow, 2010; Henderson 2001, 2007).

The survey also included information about the occurrence of Red and Orange List plant species obtained from GDARD (Pfab, 2002; Pfab and Victor, 2002; Annexure A). The *Red List Plant Species Guidelines and Requirements for Biodiversity Assessments v3* issued by GDARD (2014) were consulted. A desktop study was done, indicating suitable habitats for the Red and Orange List plant species known to occur in the QDS 2628AA (Annexure A). The plant species list for this QDS obtained from SANBI (Plants of Southern Africa: an online checklist) was consulted to verify the record of occurrence at the proposed township development site. In addition to identifying Red and Orange List species in the defined study units (Figure 2), a 200 m zone outside the boundary of the study site was also scrutinised where possible, therefore excluding residential and recreational areas. The Gauteng Conservation Plan v3.3 (GDARD, 2014) was used to evaluate Critical Biodiversity Areas which is based on numerous criteria, such as Red List species.

For each plant species, the medicinal properties were assessed (van Wyk *et al.*, 2013). Medicinal plants are marked with an asterisk (\*) in the respective tables (Tables 3 – 7). Harvesting of medicinal plants causes a decline of the particular species and, therefore, threatens the conservation of these species.

## 6. RESULTS

### 6.1 Study units

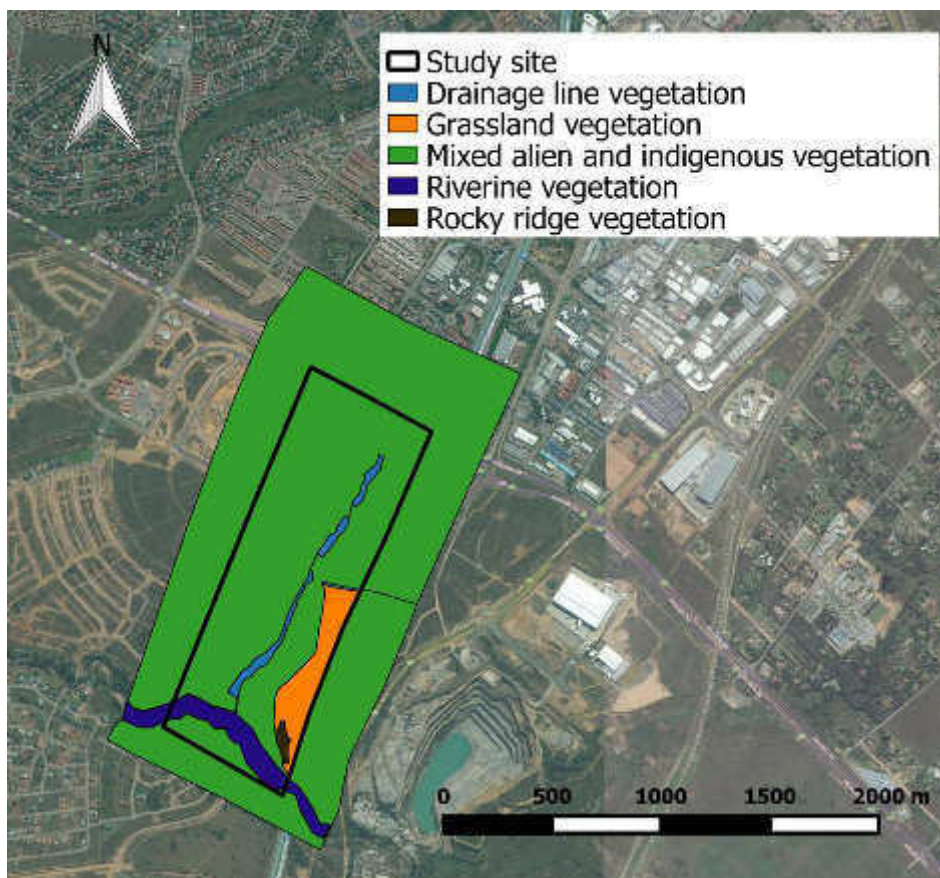
Five study units were identified (Figure 2):

1. Drainage line vegetation
2. Grassland vegetation
3. Rocky ridge vegetation
4. Riverine vegetation
5. Mixed alien and indigenous vegetation

The total numbers of plant species per study unit are listed in Table 1.

**Table 1** The number of plant species recorded per study unit, including the total number of medicinal and alien plant species.

Study unit	Total number of species per unit
Drainage line vegetation	21
Grassland vegetation	39
Rocky ridge vegetation	60
Riverine vegetation	30
Mix alien and indigenous vegetation	50



**Figure 2** Study units identified in the site for the proposed residential development.

## 6.2 Alien plants

The total number of alien plants per Category is indicated in Table 2. For each alien species the Category is indicated according to the Alien and Invasive species lists (2014) amended in NEMBA (National Environmental Management: Biodiversity Act (ACT NO, 10 OF 2004).

For Category 1a declared weeds removal is compulsory in terms of the regulations formulated under “The Conservation of Agricultural Resources Act” (Act No. 43 of 1983), as amended. Alien invasive species in this Category may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway.

Category 1b alien species are major invaders that may need government assistance to remove (Act No. 43 of 1983), as amended. These alien species must be contained, and in many cases they already fall under a government sponsored management programme such as Working for Water. Alien invasive species in this Category may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway.

All Category 2 declared weeds should likewise be removed (Act No. 43 of 1983), as amended, unless a permit is obtained to control it in a demarcated area or a biological control reserve.

Category 3 declared weeds may not occur on any land or inland water surface other than in a biological control reserve. However, these provisions shall not apply if plants listed in Category 3 are already in existence at the time of the commencement of said regulations. In such cases, a land user must take all reasonable steps to restrict the spreading of propagating material of Category 3 plants.

Alien plants within the species lists are indicated in bold (Tables 4-6) as they suggest the particular state of each vegetation community. The respective Category is also indicated (Tables 4-6).

**Table 2** Number of alien plant species per study unit

<b>Study unit</b>	<b>Total species</b>	<b>CAT 1a</b>	<b>CAT 1b</b>	<b>CAT 2</b>	<b>CAT 3</b>	<b>Not declared</b>
Drainage line vegetation	8	0	4	0	0	4
Grassland vegetation	8	0	3	0	0	5
Rocky ridge vegetation	9	0	7	0	0	2
Riverine vegetation	22	0	8	6	2	6
Mixed alien and indigenous vegetation	22	0	6	1	1	14

### 6.3 Medicinal plant species

Medicinal plant species (Table 3) are marked with an asterisk \* in Tables 4 to 7. For the entire study site, eight plant species with medicinal properties were recorded, mainly in the rocky ridge vegetation. Of these, *Hypoxis hemerocallidea* is the most threatened species (Annexure A).

**Table 3** Number of medicinal plant species per study unit

Study unit	Total number of species per unit	No. of medicinal species per unit
Drainage line vegetation	21	2
Grassland vegetation	39	2
Rocky ridge vegetation	60	5
Riverine vegetation	30	5
Mix alien and indigenous vegetation	50	3

### 6.4 Red and Orange List species

Red and Orange List species occur within the QDS 2628AA (Annexure A). The Orange List species *Hypoxis hemerocallidea* was recorded in this study site. Although not recorded in any study unit, *Boophone disticha* and *Crinum cf. bulbispermum* were found in plastic containers between the trees at the rocky ridge. These species, amongst others, were probably collected to be sold and/or used for their medicinal properties.

### 6.5 Drainage line vegetation

#### 6.5.1 Composition and Connectivity

This study unit has been rehabilitated by means of gabion structures and culverts (Figure 3 and 4), and is therefore not natural. The species recorded are typically found in drainage lines, with some alien encroaching plant species (Figure 4). Dominant species recorded include *Cyperus* sp., *Fuirena* sp., *Imperata cylindrica*, *Schoenoplectus* sp., and *Typha capensis* (Figure 5). Indigenous trees such as *Celtis africana*, *Combretum erythrophyllum*, *Olea europaea* subsp. *africana*, *Searsia lancea* and *Vachellia karroo* were planted on the embankments of the drainage line (Figure 5). A wetland specialist should be consulted to delineate and determine the extent of the buffer zone for this drainage line. Connectivity

between the constructed drainage line and the Jukskeiriver needs to be maintained in order to ensure sustainability of all biota relying on the drainage line.

### 6.5.2 Red and Orange List species

No Red or Orange List species have been recorded in the Drainage Line vegetation study unit. The probability of finding a Red or Orange List species in this study unit is low, but as this constructed drainage line matures in age, Red or Orange List plant species might establish in the Drainage Line vegetation study unit.

### 6.5.3 Medicinal and Alien species

Four of the alien species are Category 1b invaders and needs to be eradicated. Two medicinal species (Table 4) are listed for this study unit.

### 6.5.4 Sensitivity

The Drainage line vegetation study unit is highly sensitive (Figure 15), but requires no buffers prior to construction, as this study unit is man-made and transformed.

**Table 4** Species list for the drainage line vegetation.

Growth form	Invasive Category
<b>SHRUBS</b>	
<i>Gomphocarpus fruticosus</i> subsp. <i>fruticosus</i> *	
<b>SEDGES</b>	
<i>Cyperus esculentus</i> var. <i>esculentus</i>	
<i>Cyperus obtusiflorus</i> var. <i>obtusiflorus</i>	
<i>Fuirena</i> cf. <i>pubescens</i>	
<i>Juncus</i> sp.	
<i>Schoenoplectus</i> sp.	
<b>GRASSES</b>	
<i>Cynodon hirsutus</i>	
<i>Imperata cylindrica</i>	
<i>Melinis repens</i>	
<i>Panicum</i> sp.	
<b><i>Paspalum dilatatum</i></b>	
<b><i>Paspalum urvillei</i></b>	
<b>FORBS</b>	
<b><i>Ipomoea purpurea</i></b>	<b>1b</b>
<b><i>Persicaria lapathifolia</i></b>	
<i>Persicaria limbata</i>	
<i>Ranunculus multifidus</i>	
<b><i>Tagetes minuta</i></b>	
<i>Typha capensis</i> *	

<i><b>Verbena bonariensis</b></i>	<b>1b</b>
<i><b>Verbena brasiliensis</b></i>	<b>1b</b>
<i><b>Xanthium spinosum</b></i>	<b>1b</b>

---

Alien species are indicated in **bold**; medicinal species are indicated with \*.



**Figure 3** Gabion and culverts used to rehabilitate the drainage line.





**Figure 4** The drainage line with indigenous and alien species.



**Figure 5** The drainage line vegetation with indigenous trees planted on the embankments.

## 6.6 Grassland vegetation

### 6.6.1 Composition and Connectivity

Although this grassland (Figure 6) is still in a natural state, it is isolated by the N1 freeway towards the southeast, Allendale road towards the north, the Kliprivier towards the south and development towards the west. Dominant grass species include *Aristida congesta*, *Cynodon dactylon*, *Digitaria eriantha*, *Eragrostis* spp., and *Paspalum* spp. Forbs dominating the study unit include *Commelina africana*, *Gerbera ambigua*, *Helichrysum rugulosum*, *Hypoxis* spp., *Polygala hottentotta*, *Tagetes minuta* and *Verbena* spp. (Table 5).

### 6.6.2 Red and Orange List species

The Orange List species *Hypoxis hemerocallidea* was recorded in this study unit. Although not recorded in the field, *Boophone disticha* was found in a plastic container close to the study unit (Figure 7). This plant was probably harvested from the study unit, but as it was not recorded there and was omitted from the species list.

### 6.6.3 Medicinal and Alien species

Two medicinal and nine alien plant species have been listed for this study unit (Table 5). *Verbena* spp. and *Cortaderia selloana* are 1b invaders and needs to be eradicated in order to protect the indigenous vegetation.

### 6.6.4 Sensitivity

This study unit has a medium sensitivity status, due to its natural condition (Figure 15). It is already isolated from other similar study units and will ultimately be transformed as no movement of species to other grasslands is possible.

**Table 5** Species list for the grassland vegetation.

Growth form	Invasive Category
<b>Trees and shrubs</b>	
<i>Searsia lancea</i>	
<i>Seriphium plumosum</i>	
<i>Vachellia karroo</i> *	
<b>Grasses</b>	
<i>Aristida congesta</i> subsp. <i>barbicollis</i>	
<b><i>Cortaderia selloana</i></b>	<b>1b</b>
<i>Cymbopogon</i> sp.	
<i>Cynodon dactylon</i>	
<i>Dactyloctenium giganteum</i>	
<i>Digitaria eriantha</i>	

*Eragrostis curvula*  
*Eragrostis gummiflua*  
*Hyparrhenia hirta*  
***Paspalum dilatatum***  
***Paspalum urvillei***  
*Setaria sphacelata* var. *torta*  
*Sporobolus africanus*

**Forbs**

*Commelina africana*  
*Cucumis zeyheri*  
*Eriosema* cf. *salignum*  
*Gerbera ambigua*  
*Gladiolus crassifolius*  
***Gomphrena celosioides***  
*Helichrysum rugulosum*  
***Hibiscus trionum***  
*Hilliardiella hirsuta*  
*Hypoxis hemerocallidea*\*  
*Hypoxis iridifolia*  
*Hypoxis rigidula*  
*Ledebouria revoluta*  
*Macledium zeyheri*  
*Nidorella podocephala*  
*Oxalis obliquifolia*  
*Polygala hottentotta*  
***Richardia brasiliensis***  
*Selago densiflora*  
***Tagetes minuta***  
*Tephrosia capensis*  
***Verbena aristigera*** 1b  
***Verbena bonariensis*** 1b

---

Alien species are indicated in **bold**; medicinal species are indicated with \*.



**Figure 6** The grassland vegetation.



**Figure 7** *Boophone disticha* found in a plastic container on site.

## 6.7 Rocky ridge vegetation

### 6.7.1 Composition and Connectivity

Numerous trees occur in this unit, and herbaceous species not found elsewhere in the study site (Table 6; Figure 8). Species dominant in the unit include *Aloe greatheadii* var. *davyana*, *Andropogon schirensis*, *Celtis africana*, *Diheteropogon amplexans*, *Diospyros lycioides*, *Kalanchoe rotundifolia*, *Ledebouria revoluta*, *Pygmaeothamnus zeyheri*, *Searsia pyroides*, *Themeda triandra* and *Ziziphus mucronata*. The Orange List species *Hypoxis hemerocallidea* was recorded in this study unit. Between the trees, plastic containers were found of species presumably harvested from the surrounding study site (Figure 9).

### 6.7.2 Red and Orange List species

The Orange List species *Hypoxis hemerocallidea* was recorded in this study unit (Annexure A).

### 6.7.3 Medicinal and Alien plant species

Five medicinal and nine alien species were recorded for this study unit (Table 6).

### 6.7.4 Sensitivity

This study unit has a medium sensitivity status, due to its natural condition (Figure 15). It is already small and isolated from other similar study units and will ultimately be transformed as no movement of species to other grasslands is possible.

**Table 6** Species recorded in the rocky ridge vegetation.

Growth form	Invasive Category
<b>Trees and shrubs</b>	
<i>Asparigus larisinus</i>	
<i>Asparagus suaveolens</i>	
<i>Canthium</i> cf. <i>inermis</i>	
<i>Celtis africana</i>	
<i>Combretum erythrophyllum</i> *	
<i>Diospyros lycioides</i> subsp. <i>guerkei</i>	
<i>Elephantorrhiza elephantina</i> *	
<i>Euclea crispa</i>	
<b><i>Lantana camara</i></b>	<b>1b</b>
<b><i>Olea europaea</i> subsp. <i>africana</i>*</b>	
<i>Pygmaeothamnus zeyheri</i>	
<b><i>Pyracantha coccinea</i></b>	<b>1b</b>
<i>Searsia pyroides</i>	
<i>Ziziphus mucronata</i> *	
<i>Ziziphus zeyheriana</i>	

**Grasses**

*Andropogon schirensis*  
*Brachiaria cf. serrata*  
*Cymbopogon caesius*  
*Cynodon dactylon*  
*Diheteropogon amplexans* var. *amplexans*  
*Eragrostis chloromelas*  
*Hyparrhenia hirta*  
*Melinis repens*  
*Panicum sp.*  
*Schizachyrium sanguineum*  
*Themeda triandra*  
*Trichoneura grandiglumis*  
*Urochloa panicoides*

**Forbs/Succulents**

*Aloe greatheadii* var. *davyana*

***Bidens bipinnata***

*Cephalaria zeyheriana*  
*Cleome maculata*  
*Commelina africana*  
*Commelina benghalensis*  
*Crabbea angustifolia*  
*Cyanotis speciosa*

***Datura ferox***

1b

*Delospermum sp.*

*Dicoma zeyheri*

*Eucomis sp.*

*Gladiolus crassifolius*

*Hilliardiella hirsuta*

*Hypoxis hemerocallidea*\*

*Hypoxis rigidula*

***Ipomoea purpurea***

1b

*Kalanchoe rotundifolia*

*Ledebouria inquinata*

*Ledebouria ovatifolia*

*Ledebouria revoluta*

*Macledium anamala*

***Opuntia cf. stricta***

1b

*Pentanisia angustifolia*

*Solanum panduriforme*

*Stachys hyssopoides*

*Tephrosia elongata* var. *elongata*

*Trachyandra sp.*

*Tritonia nelsonii*

***Verbena bonariensis***

1b

***Verbena brassiliensis***

1b

**Ferns**

*Cheilanthes sp.*

---

Alien species are indicated in **bold**; medicinal species are indicated with \*.



**Figure 8** The rocky ridge vegetation.



**Figure 9** Containers with plant species found between the trees in the rocky ridge vegetation.

## 6.8 Riverine vegetation

### 6.8.1 Composition and Connectivity

This site is highly disturbed due rubbish flushed down the river (Figure 10), storm water outflow into the river (Figure 11) and the presence of 22 alien plant species dominating in abundance (Table 7; Figure 12). Indigenous trees that occur in this unit include *Celtis africana*, *Combretum erytrophillum*, *Gymnosporia buxifolia* and *Vachellia karroo*. Connectivity of this study unit is very important as biota depends on the water movement for seed dispersal and migration (Table 7).

### 6.8.2 Red and Orange List species

No Red List species were recorded for this site.

### 6.8.3 Medicinal and Alien species

Of the 22 alien species, eight are listed as Category 1b invaders, six species as Category 2 invaders and two species as Category 3 invaders. Five medicinal species were listed for this study unit.

### 6.8.4 Sensitivity

Although this area of the Jukskeiriver is disturbed and polluted, the status still remains sensitive. Rehabilitation of this study unit is critically important to ensure sustainability of the riverine system.

**Table 7** Species recorded for the riverine vegetation.

Growth form	Invasive Category
<b>TREES and SHRUBS</b>	
<i>Acacia mearnsii</i>	2
<i>Acacia dealbata</i>	2
<i>Celtis africana</i>	
<i>Celtis australis</i>	3
<i>Combretum erytrophillum</i> *	
<i>Gomphocarpus fruticosus</i> subsp. <i>fruticosus</i> *	
<i>Gymnosporia buxifolia</i>	
<i>Morus alba</i>	3
<i>Platanus wrightii</i>	
<i>Populus alba</i>	2
<i>Populus x canescens</i>	2
<i>Ricinus communis</i> var. <i>communis</i> *	2
<i>Salix babylonica</i>	2
<i>Solanum mauritianum</i>	1b
<i>Vachellia karroo</i> *	



**GRASSES**

<b><i>Arundo donax</i></b>	<b>1b</b>
<i>Cymbopogon nardus</i>	
<i>Cynodon dactylon</i>	
<i>Eragrostis curvula</i>	
<b><i>Paspalum dilatatum</i></b>	
<b><i>Pennisetum clandestinum</i></b>	

**FORBS**

<b><i>Amaranthus hybridus</i> subsp. <i>hybridus</i> var. <i>hybridus</i></b>	
<b><i>Datura stramonium</i>*</b>	<b>1b</b>
<b><i>Flaveria bidentis</i></b>	<b>1b</b>
<b><i>Ipomoea pupurea</i></b>	<b>1b</b>
<b><i>Mirabilis jalapa</i></b>	<b>1b</b>
<b><i>Persicaria lapathifolia</i></b>	
<b><i>Tagetes minuta</i></b>	
<b><i>Verbena bonariensis</i></b>	<b>1b</b>
<b><i>Xanthium spinosum</i></b>	<b>1b</b>

---

Alien species are indicated in **bold**; medicinal species are indicated with \*.



**Figure 10** Rubbish dumping in the riverine vegetation.



**Figure 11** Possible polluted outflow into the Jukskeiriver.



**Figure 12** Alien species such as *Populus* sp. and *Salix babylonica* dominating the riverine vegetation.

## 6.9 Mixed alien and indigenous vegetation

### 6.9.1 Composition and Connectivity

This study unit covers the largest part of the study site (Figure 2, 13). Dominant species include *Datura stramonium*, *Digitaria eriantha*, *Gerbera ambigua*, *Ledebouria revoluta*, *Seriphium plumosum*, *Setaria sphacelata*, *Tagetes minuta*, *Verbena* spp., and *Zinnia peruviana* (Table 8).

### 6.9.2 Red and Orange List species

The Orange List species *Hypoxis hemerocallidea* was recorded in this study unit.

### 6.9.3 Medicinal and Alien species

21 of the 50 species recorded are alien species. Only three medicinal plant species have been recorded in this study unit.

### 6.9.4 Sensitivity

This study unit is not considered ecologically sensitive due to the high number of alien species found and their extensive coverage across the site.

**Table 8** Species recorded for the mixed alien and indigenous vegetation.

Growth form	Invasive Category
<b>TREES and SHRUBS</b>	
<i>Acacia mearnsii</i>	2
<i>Gomphocarpus fruticosus</i> subsp. <i>fruticosus</i> *	
<i>Melia azedarach</i>	3
<i>Pinus</i> sp.	
<i>Seriphium plumosum</i>	
<b>GRASSES</b>	
<i>Aristida congesta</i> subsp. <i>barbicollis</i>	
<i>Cortaderia selloana</i>	1b
<i>Cymbopogon</i> sp.	
<i>Cynodon dactylon</i>	
<i>Dactyloctenium giganteum</i>	
<i>Digitaria eriantha</i>	
<i>Eragrostis curvula</i>	
<i>Eragrostis gummiflua</i>	
<i>Hyparrhenia hirta</i>	
<i>Paspalum dilatatum</i>	
<i>Paspalum urvillei</i>	
<i>Setaria sphacelata</i> var. <i>torta</i>	
<i>Sporobolus africanus</i>	

**FORBS*****Alternanthera pungens******Amaranthus hybridus* subsp. *hybridus* var. *hybridus******Bidens bipinnata******Bidens pilosa******Campuloclinium macrocephalum*** 1b*Commelina africana****Conyza bonariensis****Conyza podocephala**Cucumis zeyheri****Datura stramonium* \*** 1b*Eriosema* cf. *salignum**Gerbera ambigua****Gomphrena celosioides****Helichrysum rugulosum****Hibiscus trionum****Hilliardiella hirsuta**Hypoxis hemerocallidea*\**Hypoxis iridifolia**Hypoxis rigidula****Ipomoea purpurea*** 1b*Ledebouria revoluta**Oxalis obliquifolia**Pachycarpus schinzianus**Polygala hottentotta****Richardia brasiliensis****Selago densiflora****Tagetes minuta****Tephrosia capensis****Verbena aristigera******Verbena bonariensis*** 1b***Xanthium spinosum*** 1b***Zinnia peruviana***

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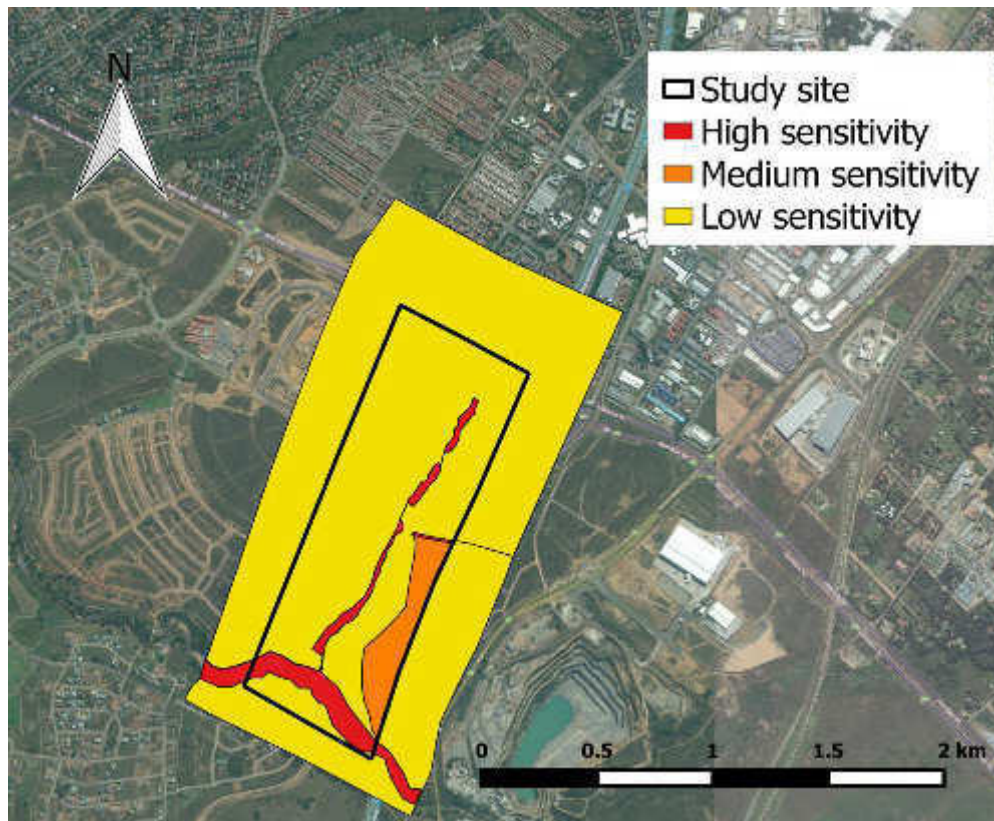
Alien species indicated in **bold**; Medicinal species indicated with \*.



**Figure 13** Mixed alien and indigenous vegetation.

## **7. FINDINGS AND POTENTIAL IMPLICATIONS**

The drainage line vegetation and the riverine vegetation are considered ecologically sensitive. The drainage line has been altered and is not considered natural. Dumping occurs in the riverine vegetation and there is a high presence of alien species in the riverine vegetation, which needs to be rehabilitated. An alien species clearance management plan should be implemented throughout the study site. The Jukskeiriver is in need of a clean-up and possible rehabilitation. The grassland and rocky ridge are considered medium to low ecologically sensitive (Figure 15) as they are in good ecological states, but are highly fragmented with minimal connectivity to similar vegetation units.



**Figure 14** Map indicating the sensitive areas of the study site.

## 8. DISCUSSION, RECOMMENDATIONS AND MITIGATION IMPLICATIONS

Competent and appropriate management authority should be appointed to implement the Ecological Management Plan (EMP) and Environmental Impact Assessment (EIA) conditions throughout all phases of development, including the operational phase. The EMP should comply with the *Minimum Requirements for Ecological Management Plans* according to GDARD. The EMP and EIA should take into account all recommendations and mitigation measures as outlined by all vegetation assessments conducted for the EIA process. The following recommendations and mitigation measures are proposed:

- The attached sensitivity map should be used as a decision tool to guide the layout design.
- All areas designated as sensitive in the attached sensitivity map should be incorporated into an open space system. Development should be located on the areas of lowest sensitivity.

- The open space system should be managed in accordance with the EMP that complies with the *Minimum Requirements for Ecological Management Plans* and forms part of the EMP.
- Before construction is initiated, the open space system should be fenced-off from ecologically sensitive areas, and all construction-related impacts must be contained within the fenced-off development areas. These areas should be demarcated on site layout plans. All construction-related impacts (including service roads, temporary housing, temporary ablution, disturbance of natural habitat, storing of equipment/building materials/vehicles or any other activity) should be excluded from the open space system. An overspill of construction activities into areas outside of the study area is permitted within designated non-sensitive areas. No personnel or vehicles may be permitted in ecologically sensitive areas except for those authorised to do so.
- A pre- and post-construction alien and invasive control, monitoring, and eradication programme must be implemented along with an ongoing programme to ensure persistence of indigenous species, especially in the drainage line vegetation and the surrounding areas. A qualified botanist/ecologist should compile and supervise the implementation of this programme.
- Rehabilitation of natural vegetation should proceed in accordance with a rehabilitation plan compiled by a specialist registered in terms of the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science.
- Where active rehabilitation or restoration is mandatory for terrestrial systems, it should make use of indigenous plant species native to the study area, but would otherwise be destroyed during clearing for development purposes, for example *Celtis africana*, *Vachellia karroo*, and *Hypoxis hemerocallidea*. The species selected should strive to represent habitat types typical of the ecological landscape prior to construction. Forage and host plants required by pollinators should also be planted in landscaped areas.
- It is strongly prohibited for Red List species to be relocated, but should be protected *in situ*. This means that if any Red List species is recorded on site, all development activity should be stopped, a qualified botanist should be consulted and the relevant buffers should be applied. No construction may take place within a buffered area of a Red List species.

## 9. CONCLUSIONS

It is recommended that sensitive areas (Figure 14) be excluded from construction, including the drainage line and riverine vegetation. The above mitigation measures and recommendations should be included in the EMP for this study site. Dumping of builders' rubble and other waste must be prevented in ecologically sensitive areas. All alien species, especially in Category 1 and 2 must be eradicated as a matter of urgency to preclude their spreading during the construction phase.

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**The following information is to remain confidential and is not meant for the general public. Please do not distribute under any circumstances without the permission from GDARD.**

**Annexure A: Red List Species (confidential)**

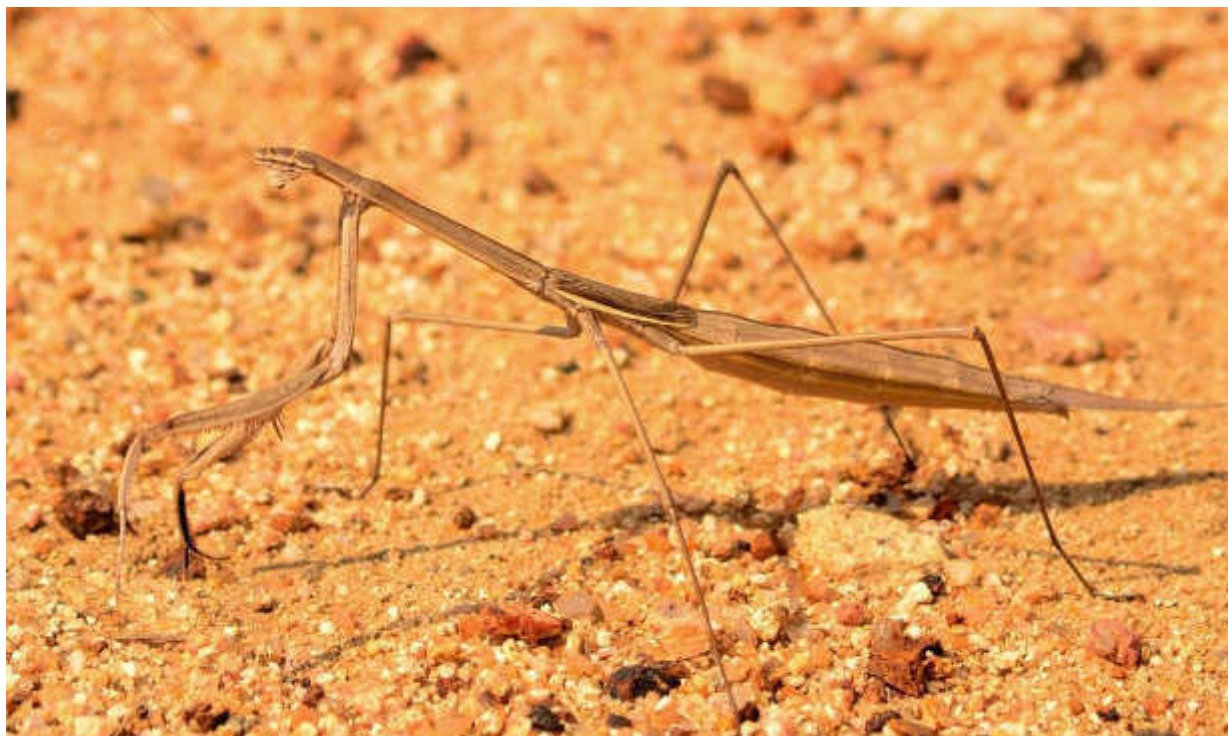
The following Red and Orange List species are listed for the quarter degree square 2628AA. An indication is also provided if the species was recorded on site and whether suitable habitat occurs in the study site.

<b>SPECIES</b>	<b>FLOWERING SEASON</b>	<b>SUITABLE HABITAT</b>	<b>CONSERVATION STATUS</b> ( <sup>1</sup> global; <sup>2</sup> national)	<b>RESIDENT AT THE SITE</b>
<i>Adromischus umbraticola</i> subsp. <i>umbraticola</i>	September-January	Rocky crevices on rocky ridges, usually south-facing, or in shallow gravel on top of rocks, but often in shade of other vegetation.	Near Threatened <sup>1</sup>	Not found – Suitable habitat
<i>Bowiea volubilis</i> subsp. <i>volubilis</i>	September-April	Shady places, steep rocky slopes and in open woodland, under large boulders in bush or low forest.	Vulnerable <sup>2</sup>	Not found - Suitable habitat
<i>Callilepis leptophylla</i>	August-January & May	Grassland or open woodland, often on rocky outcrops or rocky hillslopes.	Declining <sup>2</sup>	Not found – Suitable habitat
<i>Cineraria austrotransvaalensis</i>	March - June	Amongst rocks on steep slopes of hills and ridges, as well as at the edge of thick bush or under trees; on all aspects and on a range of	Near Threatened <sup>1</sup>	Not found

		rock types: quartzite, dolomite and shale; 1400 – 1700 m		
<i>Cineraria longipes</i>	March - May	Grassland, on koppies, amongst rocks and along seepage lines, exclusively on basalt on south-facing slopes	Vulnerable <sup>1</sup>	Not found
<i>Delosperma purpureum</i>	November-April	South facing slopes grows in shallow soils among quartzitic rocks of crystalline or conglomerate type, in open or in broken shade, rarely in shade, in grassland with some trees.	Endangered <sup>1</sup>	Not found
<i>Eucomis autumnalis</i>	November-April	Damp, open grassland and sheltered places	Declining <sup>2</sup>	Not found – Suitable habitat
<i>Gunnera perpensa</i>	October-March	In cold or cool, continually moist localities, mainly along upland streambanks.	Declining <sup>2</sup>	Not found
<i>Habenaria bicolor</i>	January - April	Well-drained grasslands at around 1600m.	Near Threatened <sup>2</sup>	Not found
<i>Habenaria mossii</i>	March-April	Open grassland on dolomite or in black	Endangered <sup>1</sup>	Not found

		sandy soil.		
<i>Holothrix micrantha</i>	October	Terrestrial on grassy cliffs, recorded from 1500 to 1800m.	Endangered <sup>1</sup>	Not found
<i>Holothrix randii</i>	September-October	Grassy slopes and rock ledges, usually southern aspects.	Near Threatened <sup>2</sup>	Not found
<b><i>Hypoxis hemerocallidea</i></b>	September-March	Occurs in a wide range of habitats, from sandy hills on the margins of dune forests to open rocky grassland; also grows on dry, stony, grassy slopes, mountain slopes and plateaux; appears to be drought and fire tolerant.	Declining <sup>2</sup>	<b>Found on site</b>
<i>Khadia beswickii</i>	July-April	Open areas on shallow surfaces over rocks in grassland.	Vulnerable <sup>1</sup>	Not found
<i>Stenostelma umbelluliferum</i>	September-March	Deep black turf in open woodland mainly in the vicinity of drainage lines.	Near Threatened <sup>1</sup>	Not found

## Fauna Habitat Assessment for the remaining extent of Portion 1 of the Farm Waterfall 5-IR, Gauteng Province



**March 2016**



**Landscape Architects &**

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**Reviewed by:**        **Reinier F. Terblanche**

## **Review of**

### **Fauna Habitat Assessment for the remaining extent of Portion 1 of the Farm Waterfall 5-IR, Gauteng Province of March 2016**

**Review: May 2016**

**Reviewer: Reinier F. Terblanche**

(M.Sc, *Cum Laude*; Pr.Sci.Nat, Reg. No. 400244/05)

#### **APPROACH OF REVIEWER TO ECOLOGICAL REVIEWS**

Ecological studies and applied ecology comprise the consideration of a diversity of factors, even more so in South Africa with its exceptional high floral and faunal diversities, various soil types, geological formations and diversity of habitats in all its biomes. Therefore it would be easy to add onto or show gaps in any ecological impact assessment, rehabilitation actions or management plans stemming from ecological assessments. The approach followed here is to review the ecological study in a reasonable context and focus on the successful fulfillment of the aims of the study within the limits of cost and time.

## Fauna Assessment Report: LP 10

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### ECOLOGICAL REVIEW: FAUNA HABITAT ASSESSMENT FOR THE REMAINING EXTENT OF PORTION 1 OF THE FARM WATERFALL 5-IR, GAUTENG PROVINCE OF MARCH 2016

#### Findings of the review

- The report contains details of the expertise of the persons who prepared the report and a declaration that the person who prepared the report is acting independently.
- The aims of the report are clear.
- The report provides references and descriptions of the principles and guidelines to be taken into account for fauna habitat assessment.
- Acceptable methods and limitations have been given in detail to reach the goal of the assessment.
- Relevant laws and guidelines have been mentioned and integrated.
- The report gives a clear assessment of the status fauna at the site and also added an extensive literature survey and existing knowledge survey.
- The recommendations and the conclusion are consistent with the aims of the report.
- It is to be commended that the report is economical and practical so that it adds value to the team effort of addressing the management and future of the habitats at the site, in this case in particular noting the drainage line sensitivity in a mostly disturbed and modified area.

Overall the report appears to be relevant, detailed enough for the purposes of this study and complete and finally addressing the key issues at stake.



Reinier F. Terblanche M.Sc. Ecology; Pr.Sci.Nat, Reg. No. 400244/05



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## 1. INTRODUCTION

Bokamoso Environmental Consultants CC; Specialist Division was appointed to conduct a Basic Faunal Assessment for the proposed mixed used development on the remaining extent of Portion 1 of the Farm Waterfall 5-IR, Gauteng Province, also known as Land Parcel 10 (hereafter referred to as the study area).

This report is based on the faunal species present on the study area as well as species that could potentially occur. The report acts as an overview of the probable and/or known occurrence for following faunal groups; Mammals, Reptiles, Amphibians and Invertebrates. Avifauna is not included in this report, as a separate avifaunal assessment was conducted for the study area. The primary focus of this report falls on Red Data species and other species with conservation importance occurring on or near the study area to ensure that, should any such species exists, the appropriate actions are taken to guarantee the well-being of these species.

## 2. SCOPE AND OBJECTIVE OF ASSESSMENT

- To qualitatively and quantitatively assess the significance of the mammal habitat components and current general conservation status of the property
- Comment on ecological sensitive areas within the study area
- Comment on connectivity with natural vegetation and habitats on adjacent site
- To provide a list of mammals which occur or might occur, and to identify species of conservation importance
- To highlight potential impacts of the proposed development on the mammals of the study site, and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.

## 3. STUDY AREA

The study area is situated on the remaining extent of Portion 1 of the farm Waterfall 5-IR, Gauteng Province and also known as Land Parcel 10. The size of the property is approximately 103 ha and is located within the 2628AA quarter degree square (QDS) ( $26^{\circ}01'24.74''S$ ;  $28^{\circ}06'35.73''E$ ). The study area is located within the Soweto Highveld Grassland vegetation unit (Mucina and Rutherford, 2006) and the Klipriver Highveld Grassland (GP5; SANBI, 2011). The study area is located north of the N1 highway and west of Allandale road. The study area largely consists of open grassland with small scattered trees and a drainage line cutting through the center, flowing from the north to the south. A small rocky outcrop is situated on the South-eastern part of the study area. The Jukskei River directly borders the study area on the most Southerly border. The property is located approximately 1468 meters above sea level and slopes gently to the South-west (Figures 1 and 2).

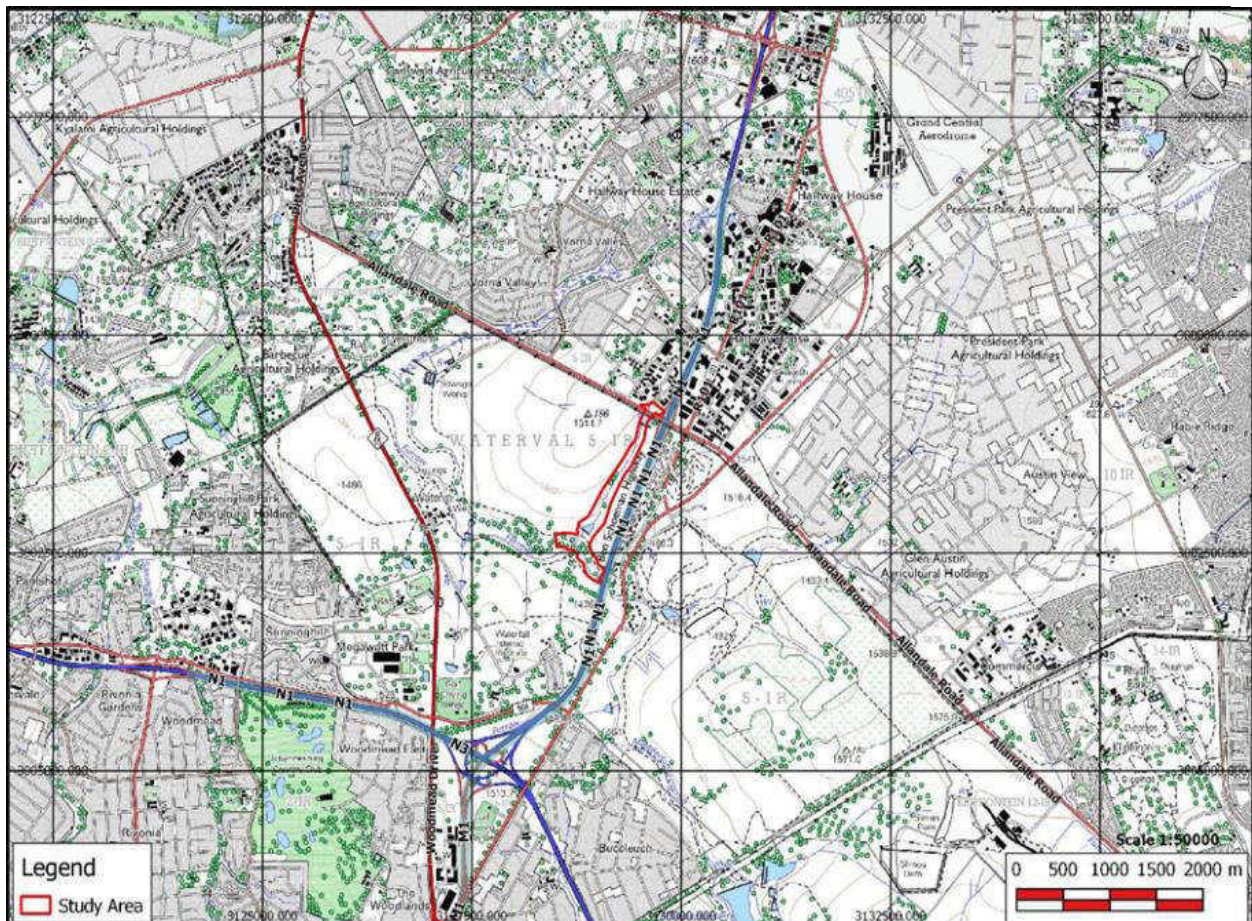


Figure 1: Locality Map



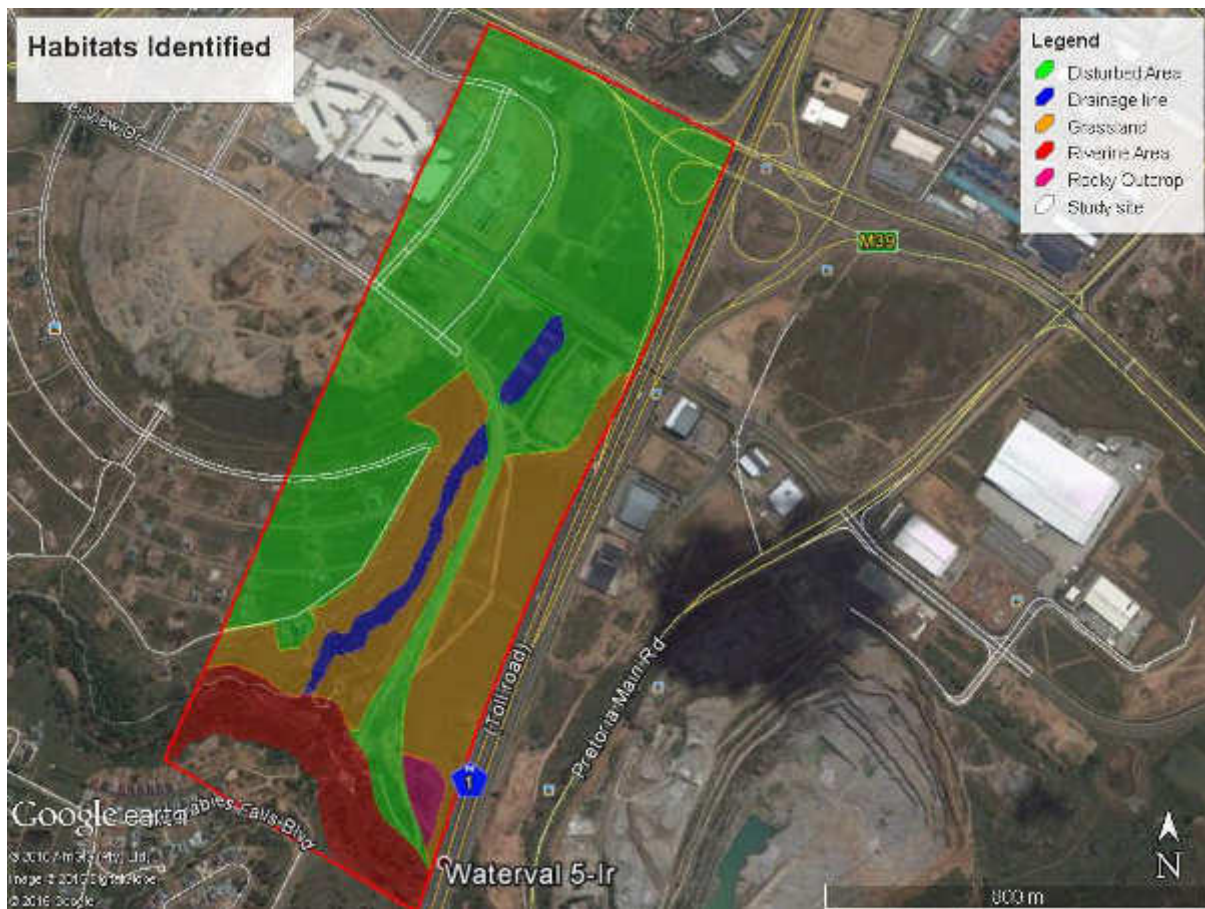
Figure 2: Aerial photo of study area

## 4. METHODS

Before conducting a field survey on the study area a desktop assessment was conducted to note the prevalent faunal species occurring on or near the site. A list of expected species was compiled and used as a reference during the field survey to ensure that species that should theoretically occur were not overlooked. All distinct faunal habitats were identified on site, after which each habitat was assessed to record the associated faunal species for each of the respective faunal group (Herpetofauna, Invertebrates and Mammals) present in that specific habitat.

## 5. RESULTS

During the habitat assessment five distinct habitats were identified within the study area. These habitats include: Disturbed Area, Drainage Line, Grassland, Rocky Outcrop, and Riverine Area (Figure 3).



**Figure 3: Different habitats in the study area**

## 5.1 Drainage Line

A drainage line cuts through the center of the study area from the North to the South. The Drainage Line area encompasses the ideal habitat for wetland-associated fauna (**Figure 4**). The largest part of this area has been transformed as a result of bank stabilization and erosion protection through the use of gabions, berms and stilling basins in order to control and channel the flow of water. It is evident that rehabilitation of the drainage line is still an ongoing process and that this habitat will gradually improve over time. Although the current state of this area as a sensitive faunal habitat can be debated owing to its fairly recent completion, the evidence of a potentially ideal wetland/drainage line habitat is apparent when attention is paid to the wetland vegetation and faunal species currently present. Over time this area should provide the preferred habitat for various fauna species once the current vegetation proliferates and connectivity to the natural drainage network is restored.



Figure 4: Drainage Line

### 5.2 Disturbed Area

This area contains various disturbances in the form of roads, degraded grassland and general disturbances as a result of trampling and degradation as result of heavy vehicle activity. Large parts of this area have been transformed by means of trampling, to such an extent that only bare ground remains (**Figure 5**). Further disturbance in the form of alien vegetation encroachment is also evident. The area contains a limited amount of natural vegetation; instead a large number of invasive plants including herbaceous plants (*Verbena bonariensis*) and alien trees (*Acacia mearnsii*). The reason for the inclusion of this area as a habitat in its own right is due to the large number of faunal species that have adapted to this unique environment.



**Figure 5: Disturbed Area**

### 5.3 Grassland

The Grassland habitat contains two distinct floristic compositions (**Figure 6**). The Eastern grassland contains a well established population of various grass species and grassland vegetation communities, whereas the Western grassland contains large numbers of alien vegetation and other disturbances such as trampling and evidence of heavy vehicle activity. The Eastern grassland is thought to supports a few widespread fauna species. As a result of the current near natural state of the Eastern part of the grassland habitat, this section of the grassland was deemed moderately sensitive from a faunal perspective as it is likely to support a number of widespread species. The rest of the grassland habitat (Western part of grassland) is already degraded and was deemed to have a low faunal sensitivity.





Figure 6: Grassland

### 5.4 Riverine Area

The southernmost part of the study area borders the Jukskei River (**Figure 7**). Due to large number of faunal species preferring this unique habitat type, the riverine area was expected to produce the highest species richness in comparison with the other habitats within the study area. The state of the riverine habitat was however very poor on account of the high amount of alien vegetation encroachment as well as the highly polluted river water (both chemical and solid waste) (**Figure 8**). The low species richness of this habitat is a direct result of the polluted river. While the riverine area provides the optimal habitat for a few Red-Data faunal species, the polluted state of the river compromises the probable occurrence of these species. If this section of the river is to be properly rehabilitated it could potentially be a highly diverse habitat and would most probably support a number of sensitive fauna. Due to the afore mentioned reasons this habitat is deemed highly sensitive, not on account of faunal species present within the habitat, but rather as a result of its connectivity functions and the potential that this area holds if proper rehabilitation thereof is implemented.



Figure 7: Riverine Area



Figure 8: Highly polluted section of the Jukskei River.

### 5.5 Rocky Outcrop

This habitat is situated on the South-eastern side of the study area and is directly adjacent the Eastern grassland habitat (**Figure 9**). Although it encompasses a fairly small part of the larger study area, it is expected to support a large number of faunal species. The reason for the expected high species richness in this small area is a direct result of the occurrence of a number of large indigenous trees (mainly *Vachellia karroo* and *Celtis africana*), which provides foraging and roosting habitat for a variety of arboreal, grassland and savanna species. The rocky outcrop itself also provides all the desirable nooks and crannies which will favor rupicolous faunal species.



**Figure 9: Rocky Outcrop.**

## **6. MAMMAL HABITAT ASSESSMENT**

**This part of the report focuses on the probable and/or known occurrence of Threatened mammal species as well as mammal species with conservation concern based on the habitats present on the study area.**

Special attention was paid to the evaluation of the quantitative and qualitative habitat conditions of Red Data species judged to have a probable occurrence on the site. Mitigation measures to lessen the impacts and effects of the proposed development were suggested where applicable. The secondary objective of this investigation was to gauge which mammals might still reside in the study area and to compile a complete list of mammal diversity.

### **6.1 Methods**

A three and a half hour field survey was conducted on the 23<sup>rd</sup> of April 2016 during which all observed mammal species as well as all the potential mammal habitats on the study site were identified. Following the field survey a desktop assessment was conducted to add additional mammal species expected to occur on the study site on account of their individual habitat preferences in accordance with the habitats identified on the study area. Mammal occurrence probability can be attributed to the well recorded and known distributions of South African mammals as well as the quantitative and qualitative nature of the habitats present on site. Moreover the 500 meters surrounding the study area were scanned for any additional faunal habitats.

#### **Field Survey**

Before the commencement of the field survey a list of expected mammal species was compiled to use as a reference in the field. All the threatened and sensitive mammals with distribution ranges overlapping the study area were included in the afore mentioned reference list. These species were prioritized and special attention was paid in terms of identifying their associated habitat preferences and noting signs of their occurrence. The field survey was conducted by means of random transect walks within each habitat. During the field survey mammal species were identified in accordance with individual habitat preferences as well as actual observations and signs such as; spoor, droppings, burrows and roosting sites indicating their presents (Chris & Tilde Stuart, 2011).

## Desktop Survey

Due to the fact that the majority of mammals are either nocturnal, hibernators, secretive and/or seasonal it is increasingly difficult to confirm their presence or absence by means of actual observations alone. Therefore a number of authoritative tomes such as field guides, databases and scientific literature were utilized to deduce the probable occurrence of mammal species. The Animal Demography Unit: Virtual Museum (<http://vmus.adu.org.za/>) was consulted to verify the records and occurrence of recorded mammal species within the QDS 2628AA. The Gauteng Conservation Plan (C-plan v3.3) was consulted to evaluate ecologically sensitive areas associated with mammals. A comprehensive list of probable mammalian occurrence with reference to the study area was compiled on account of the well-known and documented distributions of mammals in South Africa, especially in the Gauteng province.

The occurrence probability of mammal species was deduced in accordance with a species' distribution and habitat preferences. Where a species' distribution range was found to overlap with the study area and its preferred habitat was present, the applicable species was deemed to have a high occurrence probability on or near the study area.

In the case where the preferred habitat of a species' were found to be suboptimal on the study area however its distribution range still overlapped the study area, the applicable species' occurrence probability was deemed to be medium.

When the habitat preferences of a species were absent from the site, the applicable species was deemed to have a low occurrence probability regardless of its distribution range.

## 6.2 Specific Requirements

During the field survey attention was paid to note any signs of potential occurrence of threatened and sensitive species as well as species associated with wetlands and ridges.

These species include:

Vlei rat (*Otomys irroratus*), Angoni vlei rat (*Otomys angoniensis*), African march rat (*Dasymys incomtus*), Water mongoose (*Atilax paludinosus*), African clawless otter (*Aonyx capensis*), Spotted-necked otter (*Lutra maculicollis*), Juliana's golden mole (*Neamblysomus julianae*), Rough-haired golden mole (*Chrysospalax villosus*), Highveld golden mole (*Amblysomus septentrionalis*), Rock dormouse (*Graphiurus murinus*), Forest shrew (*Myosorex varius*), other

shrew species, White-tailed rat (*Mystromys albicaudatus*), Short-eared trident bat (*Cloeotis percivali*) and other cave-dwelling bats.

### 6.3 Results

#### 6.3.1 Mammal habitats identified

During the habitat assessment four distinct mammalian habitats were identified within the study area. These habitats include: Drainage Line, Grassland, Rocky Outcrop, and Riverine Area (**Figure 4**).

The majority of the drainage line is artificial and was constructed during 2014 to control and channel the flow of storm water through the use of berms, stilling basins and gabion walls. As a result of the relatively recent construction that took place within the drainage line no mammal species with conservation concerns are expected to occur due to their reliance on permanent wetland conditions. Due to the ongoing rehabilitation of the drainage line, it contains clusters of dense vegetation stands in the form of *Typha capensis* beds and other palustrine vegetation such as sedges and rushes. These dense vegetation stands (**Figure 4**) provide excellent refuge and nourishment for a number of robust small mammals such as Marsh Mongoose, marsh rats and cane rats. Small interconnected man-made pools (stilling basins) within the drainage line provide an excellent source of food for wetland bound mammals in the form of nutritious vegetation, various aquatic invertebrates and amphibians. Although no sensitive mammal species are currently thought to occur in this habitat, the ongoing rehabilitation could provide the optimal habitat for sensitive species such as Vlei Rats in the near future.

The Rocky Outcrop on the study area could potentially provide the preferred habitat for a number of small mammals such as elephant shrews and rock mice as it contains large boulders with suitable crevices as well as being situated next to undisturbed grassland (Stuart *et al.*, 2015). No pockets of deep sand were found to be present on the study area; as such the occurrence of golden moles is highly unlikely. Due to the isolated nature and small surface area of the rocky outcrop it was not deemed to be an area of high ecological sensitivity.

The grassland habitat provides excellent habitat for smaller rodents and insectivorous mammals such as shrews. No robust terrestrial mammals are expected to occur in the grassland habitat due to the fact that it is highly isolated with very little to no connectivity to similar grasslands.

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The aforementioned, together with the small surface area of the grassland, drastically lowers the occurrence probability of nomadic mammal species such as the African Hedgehog. None of the small mammals expected to occur in the grassland habitat were observed during the field survey. Species such as Slender and Yellow Mongoose, which could potentially prey on these smaller mammals, were however observed.

The riverine area was found to be highly polluted with both solid and chemical waste (**Figure 9**). The entire riverbank was scoured for signs of otter presence but no such signs were observed. This could be as a result of the lack of their primary food source (fish and crabs) on account of the polluted state of the Jukskei River (Sibali *et al.*, 2008). The associated riparian vegetation mainly consists of large alien trees with a dense undergrowth of invasive weeds. No threatened mammals can be expected to occur within this habitat. The riverine area was deemed to be highly sensitive in terms of a mammalian habitat due to its potential to provide the preferred habitat for threatened mammals, one of which is the Spotted-necked Otter. Although no Red Data species were found to be present in this habitat, the river still provides the necessary connectivity for species such as otters to move from one stretch of the river to another. As a result of the important connectivity function, the entire riverine habitat was deemed to be highly sensitive despite its polluted state.

### 6.3.2 Expected and observed Mammal species

**Table 1:** Mammals observed or expected to occur.

	<i>Scientific Name</i>	Common Name	Red List Category	Occurrence Probability
1.	<i>Cryptomys hottentotus</i>	Common African Mole-rat	Least Concern	5
2.	<i>Sylvicapra grimmia</i>	Common Duiker	Least Concern	1
3.	<i>Galago moholi</i>	Southern Lesser Bushbaby	Least Concern	2
4.	<i>Atilax paludinosus</i>	Marsh Mongoose	Least Concern	5
5.	<i>Galerella sanguineus</i>	Slender Mongoose	Least Concern	5
6.	<i>Cynictis penicillata</i>	Yellow Mongoose	Least Concern	5
7.	<i>Hystrix africaeaustralis</i>	Cape Porcupine	Least Concern	3
8.	<i>Lepus saxatilis</i>	Scrub Hare	Least Concern	5
9.	<i>Neoromicia capensis</i>	Cape serotine bat	Least Concern	4
10.	<i>Crocidura cyanea</i>	Reddish-grey musk shrew	Data Deficient	3
11.	<i>Crocidura hirta</i>	Lesser musk shrew	Data Deficient	3
12.	<i>Scotophilus dinganii</i>	African Yellow house bat	Least Concern	4
13.	<i>Scotophilus viridis</i>	Greenish yellow house bat	Least Concern	3
14.	<i>Dendromus melanotis</i>	Grey pygmy climbing mouse	Least Concern	3
15.	<i>Dendromus mystacalis</i>	Chestnut climbing mouse	Least Concern	3
16.	<i>Aethomys ineptus</i>	Tete Veld Rat	Least Concern	2
17.	<i>Gerbilliscus brantsii</i>	Highveld Gerbil	Least Concern	3

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18.	<i>Rhabdomys pumilio</i>	Four-striped grass mouse	Least Concern	4
19.	<i>Mastomys coucha</i>	Southern Multimammate Mouse	Least Concern	3
20.	<i>Mus minutoides</i>	Pygmy mouse	Least Concern	3
21.	<i>Mastomys natalensis</i>	Natal multimammate mouse	Least Concern	3
22.	<i>Aethomys namaquensis</i>	Namaqua rock mouse	Least Concern	3
23.	<i>Elephantulus myurus</i>	Eastern Rock Sengi	Least Concern	2
24.	<i>Otomys angoniensis</i>	Angoni vlei rat	Least Concern	3
25.	<i>Otomys irroratus</i>	Southern African Vlei Rat	Least Concern	3
26.	<i>Steatomys pratensis</i>	Common African Fat Mouse	Least Concern	3
27.	<i>Procavia capensis</i>	Rock Hyrax	Least Concern	1
28.	<i>Epomophorus wahlbergi</i>	Wahlberg's Epauletted Fruit-bat	Least Concern	2
29.	<i>Thryonomys swinderianus</i>	Greater Cane Rat	Least Concern	4
30.	<i>Neoromicia capensis</i>	Cape Serotine	Least Concern	2
31.	<i>Pipistrellus rusticus</i>	Rusty Pipistrelle	Least Concern	2
32.	<i>Civettictis civetta</i>	African Civet	Least Concern	1
33.	<i>Genetta genetta</i>	Common Genet	Least Concern	3
34.	<i>Genetta tigrina</i>	Cape Genet	Least Concern	2

\*The occurrence probability of the mammal species listed above is indicated as follows:

Not likely to occur - 1, Low occurrence probability - 2, Medium occurrence probability - 3, High occurrence probability - 4, **Confirmed occurrence - 5**  
 Red Data species ranked as defined in Friedmann and Daly's S.A. Red Data Book of the mammals of South Africa (2004).

### 6. 3.3 Threatened and Red Listed Mammal species

The listed shrews (**Table 1**) are not necessarily threatened; they are listed as a precautionary measure as a result of their unknown status. Musk shrews are widespread and commonly found in residential gardens throughout Gauteng, as such they are generally assumed to be abundant. The conservation status of musk shrews are however still to be determined and as such they are listed as Data Deficient. Vlei Rats are considered to be sensitive due to their intolerance to drought and their association with wetlands. Their reliance on wetlands serves as the main reason for their sensitive status.

Suitable habitat for otters were found on the study area at the southernmost boundary where the Jukskei River borders the property. Although the preferred habitat for otters are present within the study area, this specific stretch of the Jukskei River was found to be highly polluted with both solid and chemical waste. During the field survey no sign of otter activity was observed. As a result of the polluted state of the river, the otter's food source are thought to be scarce or possibly absent, thus its occurrence within this section of the river was deemed to be highly unlikely. Although the probable occurrence of otters are very low, the river still provides a



connectivity function and as such otters might move through this stretch of the river from time to time.

No suitable bat roosts were observed on the study site, thus it is not expected that any of the threatened bat species are resident, although the area might still be utilized by bats for foraging purposes.

No other threatened or sensitive mammal species are thought to be present within the study area due to various factors such as man-made disturbances, transformed habitats, suboptimal habitat and restricted distribution ranges.

### **6.4 Findings**

The majority of the terrestrial habitats present on the study area have been transformed and degraded to such an extent that it can no longer be regarded as Klipriver Highveld Grassland nor Soweto Highveld Grassland vegetation. The current terrestrial habitats do however provide good habitat for the small mammals deducted to be present. On account of the assemblage of mammals as well as the present terrestrial habitats, no evidence exists to consider the study area to be an area of high mammalian sensitivity.

The drainage line and riverine area have the potential to support sensitive species with conservation concerns (Vlei Rats and Otters). On the other hand, -none of these species are thought to occur at present on account of the fairly recent construction activities within with the drainage line as well as the polluted and degraded state of the riverine habitat. The drainage line is largely artificial resulting in low mammal diversity as a result of structures such as high gabion walls. Both the drainage line and riverine area provides important ecological functions in terms of connectivity, as such both are considered to be highly sensitive from a mammalian point of view regardless of their current state.

## **7. HERPETOFAUNA HABITAT ASESMENT**

### **7.1 Methods**

The study site was visited on 7/04/2016. Habitat types identified within the study site was recorded, and a combined species list was compiled of the possible presence of herpetofauna species, considering the knowledge of their preferred habitats. Field guides such as those of du

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Preez & Carruthers (2009), Marais (2004), and (Alexander & Marais 2007 were used for identification and habitat description of herpetofauna species.

A desktop study was done to identify suitable habitats for the Red List fauna species known to occur in the QDS 2628AA. The Animal Demography Unit: Virtual Museum (<http://vmus.adu.org.za/>) was consulted to verify the record of occurrence of herpetofauna species recorded within the QDS 2628AA. The Gauteng Conservation Plan (C-plan v3.3) was consulted to evaluate ecologically sensitive areas.

The majority of herpetofauna species are nocturnal, poikilothermic secretive and seasonal, which makes it difficult to observe them during field surveys. In this case the presence of herpetofauna species was examined on habitat preferred by selected species and respective documented ranges.

### 7.2 Specific Requirements

Adequate amount of random transect walks in the study site was attempted to identify herpetofauna and invertebrate species. Emphasis on specific Red List species that might occur on the study site:

- Striped Harlequin Snake (*Homoroselaps dorsalis*)
- Southern African Python (*Python natalensis*)

### 7.3 Results

#### 7.3.1 Herpetofauna habitats identified

The open grassland, with no conspicuous standing or flowing water bodies in the study site, forms part of the terrestrial systems with ecological niche for both amphibians and reptiles (Du preez & Carruthers). The Riverine systems provide a permanent flow of water in a natural channel, which forms a micro-habitat for various amphibians (**Table 2**).

The grassland is a suitable habitat for the Striped Harlequin Snake (*Homoroselaps dorsalis*). It can be found in old termite mounds and under rocks (Marais 2004), both of which occur in the grassland. Most records of this snake are subterranean (Marais 2004).

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### 7.3.2 Expected and observed Herpetofauna species

No amphibians or reptiles were observed during the survey. Eleven amphibian species and 26 reptile species are expected to occur in the QDS 2628AA (Tables 2 & 3).

**Table 2:** Amphibian species observed and/or deducted to occur in QDS 2628AA.

Family name	Species name	Common name	Conservation status	Occurrence
BUFONIDAE	<i>Schismaderma carens</i>	Red Toad	Least Concern	4
BUFONIDAE	<i>Sclerophrys capensis</i>	Raucous Toad	Least Concern	3
BUFONIDAE	<i>Sclerophrys gutturalis</i>	Guttural Toad	Least Concern	4
HYPEROLIIDAE	<i>Kassina senegalensis</i>	Bubbling Kassina	Least Concern	4
PIPIDAE	<i>Xenopus laevis</i>	Common Platanna	Least Concern	5
PYXICEPHALIDAE	<i>Amietia fuscigula</i>	Cape River Frog	Least Concern	3
PYXICEPHALIDAE	<i>Amietia queketti</i>	Quekett's River Frog	Least Concern	3
PYXICEPHALIDAE	<i>Cacosternum boettgeri</i>	Common Caco	Least Concern	4
PYXICEPHALIDAE	<i>Pyxicephalus adspersus</i>	Giant Bull Frog	Least Concern	3
PYXICEPHALIDAE	<i>Tomopterna cryptotis</i>	Tremelo Sand Frog	Least Concern	2
PYXICEPHALIDAE	<i>Tomopterna natalensis</i>	Natal Sand Frog	Least Concern	2

\*The occurrence probability of the amphibian species listed above is indicated as follows:  
 Not likely to occur - 1, Low occurrence probability - 2, Medium occurrence probability - 3, High occurrence probability - 4, **Confirmed occurrence - 5**. The IUCN (2015) Red List of threatened species was used for conservation status of each species.

**Table 3:** Reptile species observed and/or deducted to occur in QDS 2628AA.

Family name	Species name	Common name	Conservation status	Occurrence
AGAMIDAE	<i>Agama aculeata</i> subsp. <i>distanti</i>	Distant's Ground Agama	Least Concern	2
AGAMIDAE	<i>Agama atra</i>	Southern Rock Agama	Least Concern	3
CHAMAELEONIDAE	<i>Bradypodion ventrale</i>	Eastern Cape Dwarf Chameleon	Least Concern	1
COLUBRIDAE	<i>Crotaphopeltis hotamboeia</i>	Red-lipped Snake	Least Concern	4
COLUBRIDAE	<i>Dasypeltis scabra</i>	Rhombic Egg-eater	Least Concern	2
CORDYLIDAE	<i>Cordylus vittifer</i>	Common Girdled Lizard	Least Concern	3
ELAPIDAE	<i>Hemachatus haemachatus</i>	Rinkhals	Least Concern	3
GEKKONIDAE	<i>Hemidactylus mabouia</i>	Common Tropical House Gecko	Least Concern	3
GEKKONIDAE	<i>Lygodactylus capensis</i>	Common Dwarf Gecko	Least Concern	4
GEKKONIDAE	<i>Pachydactylus affinis</i>	Transvaal Gecko	Least Concern	3
GEKKONIDAE	<i>Pachydactylus capensis</i>	Cape Gecko	Least Concern	3

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GERRHOSOURIDAE	<i>Gerrhosaurus flavigularis</i>	Yellow-throated Plated Lizard	Least Concern	3
LAMPROPHIIDAE	<i>Aparallactus capensis</i>	Black-headed Centipede-eater	Least Concern	3
LAMPROPHIIDAE	<i>Atractaspis bibronii</i>	Bibron's Stiletto Snake	Least Concern	3
LAMPROPHIIDAE	<i>Boaedon capensis</i>	Brown House Snake	Least Concern	4
LAMPROPHIIDAE	<i>Lamprophis aurora</i>	Aurora House Snake	Least Concern	3
LAMPROPHIIDAE	<i>Lycodonomorphus inornatus</i>	Olive House Snake	Least Concern	3
LAMPROPHIIDAE	<i>Lycodonomorphus rufulus</i>	Brown Water Snake	Least Concern	3
LAMPROPHIIDAE	<i>Lycophidion capense</i>	Cape Wolf Snake	Least Concern	3
LAMPROPHIIDAE	<i>Psammophis subtaeniatus</i>	Western Yellow-bellied Sand Snake	Least Concern	3
PELOMEDUSIDAE	<i>Pelomedusa subrufa</i>	Central Marsh Terrapin	Least Concern	3
SCINCIDAE	<i>Trachylepis capensis</i>	Cape Skink	Least Concern	3
SCINCIDAE	<i>Trachylepis punctatissima</i>	Speckled Rock Skink	Least Concern	5
SCINCIDAE	<i>Trachylepis varia</i>	Variable Skink	Least Concern	3
TESTUDINIDAE	<i>Stigmochelys pardalis</i>	Leopard Tortoise	Least Concern	3
TYPHLOPIDAE	<i>Afrotyphlops bibronii</i>	Bibron's Blind Snake	Least Concern	2

\*The occurrence probability of the reptile species listed above is indicated as follows:

Not likely to occur - 1, Low occurrence probability - 2, Medium occurrence probability - 3, High occurrence probability - 4, Confirmed occurrence - 5. Bates et al. (2014) was used for the conservation status of each species.

### 7.3.3 Threatened and Red Listed Herpetofauna species

The Striped Harlequin Snake (*Homoroselaps dorsalis*) is the only IUCN Red Listed Species which may occur at this site although it was not observed during the site visit.

### 7.4 Findings

Suitable habitat for the Striped Harlequin Snake (*Homoroselaps dorsalis*) was identified. The occurrence probability of the Spotted Harlequin Snake was deemed highly unlikely on account of the small surface area of the habitat, along with the fact that the grassland is totally isolated from other similar grasslands. Five species of amphibians and three species of reptiles were given a high probability of being found in the riverine area present on the study site.

## 8. INVERTEBRATE HABITAT ASSESSMENT

### 8.1 Methods

Surveys were conducted on 7/4/2016, which consisted of two random walked transects (10h18-11h08; 11h08-11h43). The dominant invertebrate species and possible suitable habitats for Red List invertebrate species were noted and sampled if necessary. Habitat characteristics for species present were derived from a survey and descriptions given in the field guide by Picker *et al.* (2004). The IUCN Red Listed Species were consulted online for conservation status of Red List species (IUCN 2015). All insects were identified *sensu*. Picker *et al.* (2004). IUCN Red Listed Butterflies were identified *sensu*. Henning *et al.* (2009) and Mecenero *et al.* (2013).

A desktop study was done to identify suitable habitats for the Red List invertebrate species known to occur in the QDS 2628AA. The Animal Demography Unit: Virtual Museum (<http://vmus.adu.org.za/>) was consulted to verify the record of occurrence of invertebrate species recorded within the QDS 2628AA.

The majority of invertebrate species are nocturnal, poikilothermic secretive and seasonal, which makes it difficult to observe them during field surveys. In this case the presence of invertebrate species was examined on habitat preferred by selected species and respective documented ranges.

### 8.2 Specific Requirements

The survey took place during the end of the wet season, thus the probability of detecting identifiable life history stages was highest based on their biology.

### 8.3 Results

#### 8.3.1 Invertebrate habitats identified

The major habitats of concern in this area were grassland and wetland habitats. The reason for this is because biodiversity in grasslands is only second to the Fynbos (WWF 2016). Wetlands are protected under the RAMSAR convention (<http://www.ramsar.org/>) and provide the habitat for many hemimetabolous insects to complete their life-cycles as they are amphibious and rely on water for breeding.

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### 8.3.2 Expected Invertebrate species

**Table 4:** Invertebrate species deducted to occur within QDS 2628AA.

Family name	Species name	Common name	Conservation status	occurrence
AGANAIDAE	<i>Asota speciosa</i> subsp. <i>speciosa</i>	Specious Tiger Moth	Not Evaluated	3
ARCTIIDAE	<i>Utetheisa pulchella</i> subsp. <i>pulchella</i>	Crimson-speckled Footman	Not Evaluated	4
BUTHIDAE	<i>Parabuthus transvaalicus</i>		Not listed	4
BUTHIDAE	<i>Pseudolychas ochraceus</i>		Not listed	2
CHRYSOPIDAE	<i>Chrysemosa jeanneli</i>		Not listed	3
CHRYSOPIDAE	<i>Chrysoperla</i> sp.	Green Lacewings	Not listed	3
CHRYSOPIDAE	<i>Dysochrysa furcata</i>		Not listed	3
COENAGRIONIDAE	<i>Africallagma glaucum</i>	Swamp Bluet	Not listed	4
COENAGRIONIDAE	<i>Pseudagrion</i>		Not listed	3
COENAGRIONIDAE	<i>Pseudagrion salisburyense</i>	Slate Sprite	Not listed	3
COENAGRIONIDAE	<i>Pseudagrion spernatum</i>	Upland Sprite	Not listed	3
CRAMBIDAE	<i>Spoladea recurvalis recurvalis</i>		Not Evaluated	3
CULICIDAE	<i>Culex</i> sp.	Mosquito	Not listed	4
CYDNIDAE	<i>Geocnethus plagiata</i>	Burrowing Bug	Not listed	4
GEOMETRIDAE	<i>Acanthovalva inconspicuaria</i> subsp. <i>inconspicuaria</i>		Not Threatened	2
GEOMETRIDAE	<i>Pingasa abyssinaria</i> subsp. <i>abyssinaria</i>		Not Threatened	2
GEOMETRIDAE	<i>Rhodometra sacraria</i> subsp. <i>sacraria</i>	Vestal	Not Threatened	4
GERRIDAE	<i>Gerris</i> sp.	Waterskater	Not listed	4
HESPERIIDAE	<i>Coeliades forestan</i> subsp. <i>forestan</i>	Striped policeman	Least Concern	1
HESPERIIDAE	<i>Coeliades pisistratus</i>	Two-pip policeman	Least Concern	1
HESPERIIDAE	<i>Gegenes niso</i> subsp. <i>Niso</i>	Common hottentot	Least Concern	3
HESPERIIDAE	<i>Gegenes pumilio</i> subsp. <i>gambica</i>	Dark hottentot	Least Concern	3
HESPERIIDAE	<i>Kedestes lepenula</i>	Chequered ranger	Least Concern	3
HESPERIIDAE	<i>Kedestes nerva</i> subsp. <i>nerva</i>	Scarce ranger	Least Concern	3
HESPERIIDAE	<i>Kedestes wallengrenii</i> subsp. <i>wallengrenii</i>	Wallengren's ranger	Least Concern	3
HESPERIIDAE	<i>Metisella malgacha</i> subsp. <i>malgacha</i>	Grassveld sylph	Least Concern	4
HESPERIIDAE	<i>Metisella willemi</i>	Netted sylph	Least Concern	3
HESPERIIDAE	<i>Tsitana tsita</i>	Dismal sylph	Least Concern	3
HESPERIIDAE	<i>Spialia diomus</i>	Common Sandman	Least Concern	4
HODOTERMITIDAE	<i>Hodotermes mossambicus</i>	Harvester termite	Not listed	4

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LIBELLULIDAE	<i>Brachythemis leucosticta</i>	Southern Banded Groundling	Not listed	3
LIBELLULIDAE	<i>Crocothemis erythraea</i>	Broad Scarlet	Not listed	4
LIBELLULIDAE	<i>Crocothemis sanguinolenta</i>	Small Scarlet	Least Concern	4
LIBELLULIDAE	<i>Diplacodes lefebvreii</i>	Black Percher	Not listed	3
LIBELLULIDAE	<i>Orthetrum</i>		Not listed	3
LIBELLULIDAE	<i>Orthetrum caffrum</i>	Two-striped Skimmer	Not listed	3
LIBELLULIDAE	<i>Orthetrum chrysostigma</i>	Epaulet Skimmer	Not listed	3
LIBELLULIDAE	<i>Orthetrum julia</i>	Julia Skimmer	Not listed	3
LIBELLULIDAE	<i>Orthetrum trinacria</i>	Long Skimmer	Not listed	3
LIBELLULIDAE	<i>Pantala flavescens</i>	Wandering Glider	Not listed	3
LIBELLULIDAE	<i>Tramea basilaris</i>	Keyhole Glider	Not listed	3
LIBELLULIDAE	<i>Trithemis</i>		Not listed	3
LIBELLULIDAE	<i>Trithemis dorsalis</i>	Highland Dropwing	Not listed	3
LIBELLULIDAE	<i>Trithemis kirbyi</i>	Orange-winged Dropwing	Not listed	3
LIBELLULIDAE	<i>Trithemis stictica</i>	Jaunty Dropwing	Not listed	3
LYCAENIDAE	<i>Actizera lucida</i>	Rayed blue	Least Concern	3
LYCAENIDAE	<i>Aloeides henningi</i>	Henning's copper	Least Concern	2
LYCAENIDAE	<i>Aloeides molomo</i> subsp. <i>molomo</i>	Molomo copper	Least Concern	2
LYCAENIDAE	<i>Aloeides taikosama</i>	Dusky copper	Least Concern	2
LYCAENIDAE	<i>Anthene amarah</i> subsp. <i>amarah</i>	Black striped hairtail	Least Concern	3
LYCAENIDAE	<i>Anthene definita</i> subsp. <i>definita</i>	Common hairtail	Least Concern	4
LYCAENIDAE	<i>Axiocerses tjoane</i> subsp. <i>tjoane</i>	Eastern scarlet	Least Concern	2
LYCAENIDAE	<i>Cacyreus fracta</i> subsp. <i>fracta</i>	Water geranium bronze	Least Concern	3
LYCAENIDAE	<i>Cacyreus marshalli</i>	Common geranium bronze	Least Concern	4
LYCAENIDAE	<i>Cacyreus virilis</i>	Mocker bronze	Least Concern	3
LYCAENIDAE	<i>Capys disjunctus</i>	Russet protea	Least Concern	3
LYCAENIDAE	<i>Chilades trochylus</i>	Grass jewel	Least Concern	2
LYCAENIDAE	<i>Cigaritis ella</i>	Ella's bar	Least Concern	2
LYCAENIDAE	<i>Cigaritis mozambica</i>	Mozambique bar	Least Concern	2
LYCAENIDAE	<i>Cigaritis natalensis</i>	Natal bar	Least Concern	2
LYCAENIDAE	<i>Cupidopsis cissus</i> subsp. <i>cissus</i>	Common meadow blue	Least Concern	3
LYCAENIDAE	<i>Euchrysops dolorosa</i>	Sabie smoky blue	Least Concern	2
LYCAENIDAE	<i>Euchrysops subpallida</i>	Ashen smoky blue	Least Concern	3
LYCAENIDAE	<i>Iolaus trimeni</i>	Trimen's sapphire	Least Concern	1
LYCAENIDAE	<i>Lachnocnema durbani</i>	D'Urban's woolly legs	Least Concern	2
LYCAENIDAE	<i>Lampides boeticus</i>	Pea blue	Least Concern	2
LYCAENIDAE	<i>Leptomyrina henningi</i> subsp. <i>henningi</i>	Henning's black-eye	Least Concern	2
LYCAENIDAE	<i>Leptotes species</i>		Not listed	2
LYCAENIDAE	<i>Myrina silenus</i> subsp. <i>ficedula</i>	Common fig tree blue	Least Concern	2

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LYCAENIDAE	<i>Oraidium barberae</i>	Dwarf blue	Least Concern	2
LYCAENIDAE	<i>Tarucus sybaris</i> subsp. <i>sybaris</i>	Dotted blue	Least Concern	1
LYCAENIDAE	<i>Tuxentius melaena</i> subsp. <i>melaena</i>	Black pie	Least Concern	2
LYCAENIDAE	<i>Uranotaema nubifer</i> subsp. <i>nubifer</i>	Black heart	Least Concern	2
LYCAENIDAE	<i>Zizeeria knysna</i> subsp. <i>knysna</i>	African grass blue	Least Concern	2
LYCAENIDAE	<i>Zizina otis</i> subsp. <i>antanossa</i>	Dark grass blue	Least Concern	2
LYCAENIDAE	<i>Zizula hylax</i>	Tiny grass blue	Least Concern	2
LYCOSIDAE		Wolf Spider	Not listed	4
LYNIPHIDAE	<i>Lyniphia</i> sp.	Sheet Orb Web Spider	Not listed	4
MYRMELEONTIDAE	<i>Creoleon mortifer</i>	Large Grassland Antlion	Not listed	3
MYRMELEONTIDAE	<i>Hagenomyia tristis</i>	Gregarious Antlion	Not listed	3
MYRMELEONTIDAE	<i>Macroleon quinquemaculatus</i>		Not listed	3
MYRMELEONTIDAE	<i>Palpares caffer</i>	Dotted Veld Antlion	Not listed	3
NOCTUIDAE	<i>Callopietria yerburii</i> subsp. <i>yerburii</i>		Not Evaluated	2
NOCTUIDAE	<i>Sphingomorpha chlorea</i> subsp. <i>chlorea</i>		Not Evaluated	2
NYMPHALIDAE	<i>Acraea horta</i>	Garden acraea	Least Concern	4
NYMPHALIDAE	<i>Acraea neobule</i> subsp. <i>neobule</i>	Wandering donkey acraea	Least Concern	3
NYMPHALIDAE	<i>Byblia ilithyia</i>	Spotted joker	Least Concern	4
NYMPHALIDAE	<i>Charaxes jasius</i> subsp. <i>saturnus</i>	Foxy charaxes	Least Concern	3
NYMPHALIDAE	<i>Danaus chrysippus</i> subsp. <i>orientis</i>	African monarch, Plain tiger	Least Concern	4
NYMPHALIDAE	<i>Hypolimnas misippus</i>	Common diadem	Least Concern	4
NYMPHALIDAE	<i>Junonia hierta</i> subsp. <i>cebrene</i>	Yellow pansy	Least Concern	4
NYMPHALIDAE	<i>Junonia oenone</i> subsp. <i>oenone</i>	Blue pansy	Least Concern	4
NYMPHALIDAE	<i>Junonia orithya</i> subsp. <i>madagascariensis</i>	Eyed pansy	Least Concern	3
NYMPHALIDAE	<i>Melanitis leda</i>	Twilight Brown	Least Concern	2
NYMPHALIDAE	<i>Precis archesia</i> subsp. <i>archesia</i>	Garden commodore	Least Concern	3
NYMPHALIDAE	<i>Stygionympha wichgrafi</i> subsp. <i>wichgrafi</i>	Wichgraf's hillside brown	Least Concern	2
NYMPHALIDAE	<i>Telchinia rahira</i> subsp. <i>rahira</i>	Marsh acraea	Least Concern	2
NYMPHALIDAE	<i>Vanessa cardui</i>	Painted lady	Least Concern	4
PAPILIONIDAE	<i>Papilio demodocus</i> subsp. <i>demodocus</i>	Citrus swallowtail	Least Concern	4
PAPILIONIDAE	<i>Papilio nireus</i> subsp. <i>lyaeus</i>	Green-banded swallowtail	Least Concern	3
PIERIDAE	<i>Belenois aurota</i>	Brown-veined white	Least Concern	4
PIERIDAE	<i>Belenois creona</i> subsp. <i>severina</i>	African common	Least Concern	4



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		white		
PIERIDAE	<i>Belenois zochalia</i> subsp. <i>zochalia</i>	Forest white	Least Concern	2
PIERIDAE	<i>Catopsilia florella</i>	African migrant	Least Concern	4
PIERIDAE	<i>Colias electo</i> subsp. <i>electo</i>	African clouded yellow	Least Concern	3
PIERIDAE	<i>Colotis annae</i> subsp. <i>annae</i>	Scarlet tip	Least Concern	2
PIERIDAE	<i>Colotis evenina</i> subsp. <i>evenina</i>	Orange tip	Least Concern	
PIERIDAE	<i>Eurema brigitta</i> subsp. <i>brigitta</i>	Broad-bordered grass yellow	Least Concern	4
PIERIDAE	<i>Mylothris agathina</i> subsp. <i>agathina</i>	Common dotted border	Least Concern	1
PIERIDAE	<i>Pontia helice</i> subsp. <i>helice</i>	Common meadow white	Least Concern	4
PILLBUG	<i>Armadillidium vulgare</i>		Not listed	4
POTOMONAUTIDAE	<i>Potomonautes warreni</i>	Warren's	Not listed	4
PYRGOMORPHIDAE	<i>Phymateus viridipes</i>	Green Milkweed Locust	Not listed	4
SALTICIDAE		Jumping Spider	Not listed	4
SCARABAEIDAE	<i>Catharsius sesostris</i>	Three-horned Dung Beetle	Not listed	4
SCARABAEIDAE	<i>Liatongus militaris</i>		Not listed	3
SCARABAEIDAE	<i>Onitis caffer</i>	Bronze Dung Beetle	Not listed	4
SCARABAEIDAE	<i>Onthophagus ebeus</i>		Not listed	3
SCARABAEIDAE	<i>Onthophagus pugionatus</i>		Not listed	3
SPARASSIDAE	<i>Palystes superciliosus</i>	Rain spiders	Not listed	4
SPHINGIDAE	<i>Basiothia</i>		Not Evaluated	2
SPIROSTREPTIDAE	<i>Doratogonus</i> sp.	Spirostreptidan Millipede	Not listed	4
THERAPHOSIDAE	<i>Harpactira hamiltoni</i>		Not listed	4

\*The occurrence probability of the invertebrate species listed above is indicated as follows:

Not likely to occur - 1, Low occurrence probability - 2, Medium occurrence probability - 3, High occurrence probability - 4,

### 8.3.3 Threatened and Red Listed Invertebrate species

No Red Data invertebrate species were recorded or deducted to occur on or near the study area.

### 8.4 Findings

The presence of three wetland species alone provides immediate evidence for the existence of the wetland and its necessary preservation. These are all hemimetabolous species which are tied to the habitat for breeding and territorial reasons. Any developmental changes to this habitat would be detrimental to their existence. These are important as putative flagship or indicator species. The small scarlet (*Crocothemis sanguinolenta*) is easily confused with *Crocothemis erythraea* and until the possible breeding differences (alluded to by abdominal differences) between the two have been established, development of these systems should be carefully monitored. No sensitive invertebrate species were recorded or are expected to occur within the study area. Species such as *Crocothemis* which are dependent on wetland habitats are conservation priority.

## 9. OVERALL FINDINGS AND IMPLICATIONS

The majority of the terrestrial habitats present on the study area have been transformed and degraded. The current terrestrial habitats do however provide good habitat for a number of small mammals deducted to be present. Suitable habitat for the Striped Harlequin Snake (*Homoroselaps dorsalis*) was identified in the grassland habitat. The occurrence probability of the Striped Harlequin Snake was deemed highly unlikely on account of the small surface area of the habitat, along with the fact that the grassland is totally isolated from other similar grasslands. The aforementioned isolated nature of the grassland restricts the movement of fauna to and from similar habitats, as such the grassland habitat was deemed moderately sensitive from a faunal perspective. On account of the assemblage of fauna as well as the present terrestrial habitats, no evidence exists to consider the terrestrial habitats present within the study area to be of high ecological sensitivity.

The drainage line and riverine habitat have the potential to support sensitive species and/or species with conservation concerns (Vlei Rats and Otters). None of these species are believed

## Fauna Assessment Report: LP 10

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to occur at present on account of the fairly recent construction activities within with the drainage line as well as the polluted and degraded state of the riverine habitat. Five species of amphibians and three species of reptiles were given a high probability of occurring in the riverine area (**Tables 2 & 3**). The presence of three wetland invertebrate species provides immediate evidence for the existence of the wetland and its necessary preservation. Both the drainage line and the riverine habitat provide important ecological functions in terms of connectivity and as such both are considered to be highly sensitive from a faunal perspective regardless of their current state.

### 10. LIMITATIONS

The bulk of the data used to conclude the distribution of Red Data species were sourced by making use of the Animal Demography Unit: Virtual Museum data basis. Any limitations in the above mentioned data basis will in effect have implications on the findings and conclusion of this assessment. Furthermore this faunal assessment was conducted during April; hence the survey was done outside the main reproductive period of the local faunal species. Moreover, a lot of the hibernating fauna began with their hibernation period.

Limited time to conduct the survey could potentially result in not recording all species within the study area. Three and a half hours were spent on site while conducting this faunal assessment. As a result of the small size of the study area as well as the amount of disturbance on the study area, three hours was deemed sufficient time to record all the resident faunal habitats on and around the study area.

### 11. RECOMMENDATIONS

- An appropriate management authority that must be contractually bound to implement the EMP and ROD during the constructional and operational phase of the development should be identified and informed of their responsibilities in terms of the EMP and ROD.
- Prior to any activities commencing on site, all construction staff should be briefed in an environmental induction regarding the environmental status and requirements of the site. This should include providing general guidelines for minimizing environmental damage during construction, as well as education with regards to basic environmental ethics, such as the prevention of littering, lighting of fires, etc.

## Fauna Assessment Report: LP 10

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- Induction should be done for all civil contractors and for each building contractor prior to them commencing on site.
- Construction should be restricted to areas deemed to have a low to medium ecological sensitivity (Please refer to **Figure 10**).
- Areas where construction is to take place should be clearly demarcated and fenced off, all areas outside that of the defined works should be deemed no-go areas.
- All construction activities must be restricted to the demarcated areas to ensure that no further disturbance into the surrounding vegetation or habitat takes place.
- It is recommended that prior to the commencement of construction activities' initial clearing of all alien vegetation should take place.
- No vehicles should be allowed to move in or through the drainage line. This will cause destruction of faunal habitat and will leave notable scares on site.
- The contractor must ensure that no faunal species are trapped, killed or in any way disturbed during the constructional phase.
- It is recommended that all concrete and cement works be restricted to areas of low ecological sensitivity and defined on site and clearly demarcated. Cement powder has a high alkalinity pH rating, which can contaminate and affect both soil and water pH dramatically. A shift in the pH can have serious consequences on the functioning of soil, vegetation and fauna.
- To ensure minimal disturbance of faunal habitat it is recommended that construction should take place during winter, outside the reproductive season of the species present on site.
- Construction, vegetation clearing and top soil clearing should commence from a predetermined location and gradually commence to ensure that fauna present on the site have enough time to relocate.
- When construction is completed, disturbed areas should be rehabilitated using vegetation cleared prior to construction to ensure that the habitat stays intact and that faunal species present on the site before construction took place, return to the area.
- It is recommended that the section of the Jukskei River bordering the study area on the Southern boundary should be rehabilitated and pollution prevention methods should be put in place to prevent further habitat degradation.
- It is recommended that no construction takes place within 32 meters of the Jukskei River.
- As a result of the artificial nature of the drainage line it was concluded that no additional buffers with respect to the upper section of the drainage line are necessary.

## 12. CONCLUSION

Due to the sensitive nature of the drainage line and riverine areas induction with all the partaking contractors, workers, road engineers and landowners is necessary, in order to make them aware of the areas deemed to be sensitive according to this report and act accordingly. Development should be restricted to areas deemed to have a low to medium ecological sensitivity (**Figure 10**).

Given the acceptance of the recommendations, the proposed development will not result in the destruction and/or loss of important or ecologically sensitive habitat units from a faunal perspective.

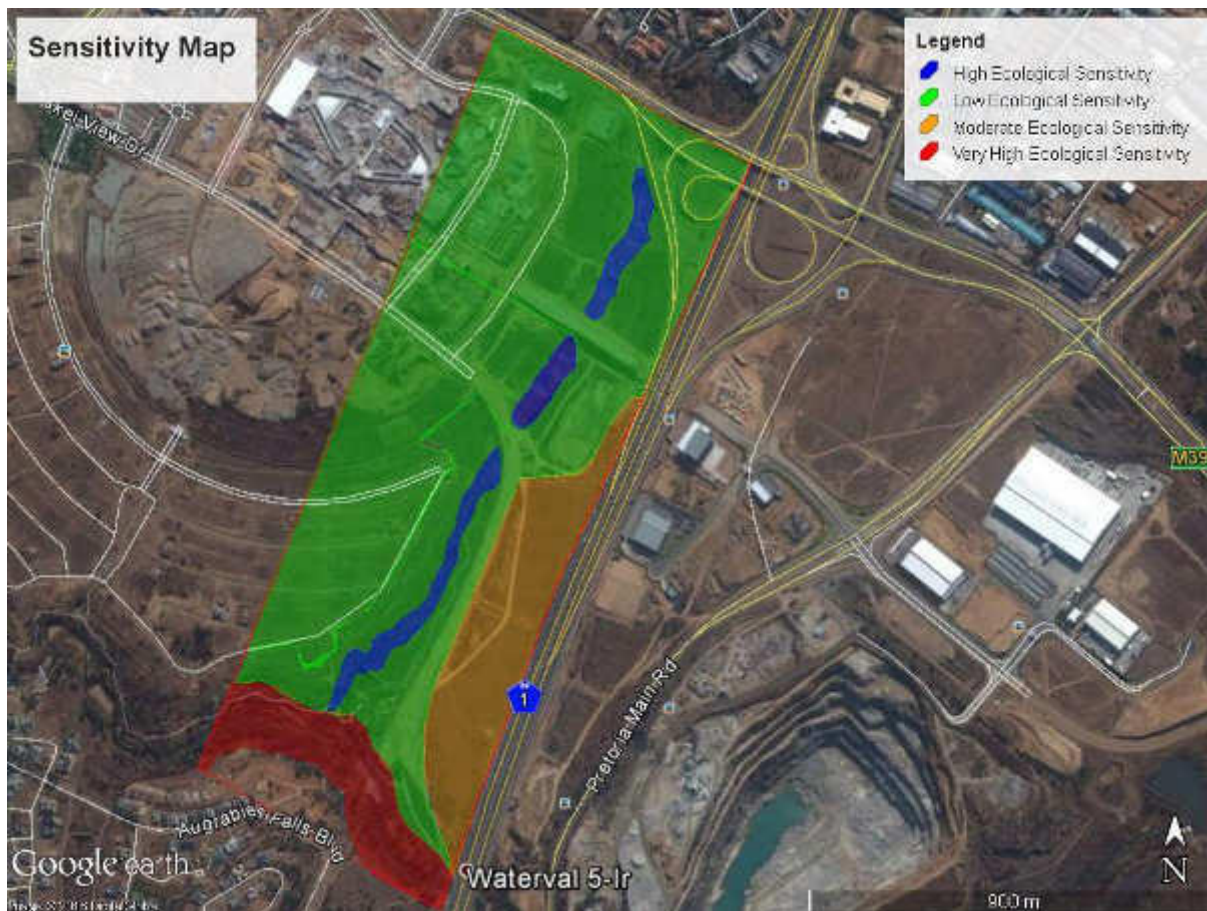


Figure 10: Faunal Sensitivity Map

### 13. LITERATURE SOURCES

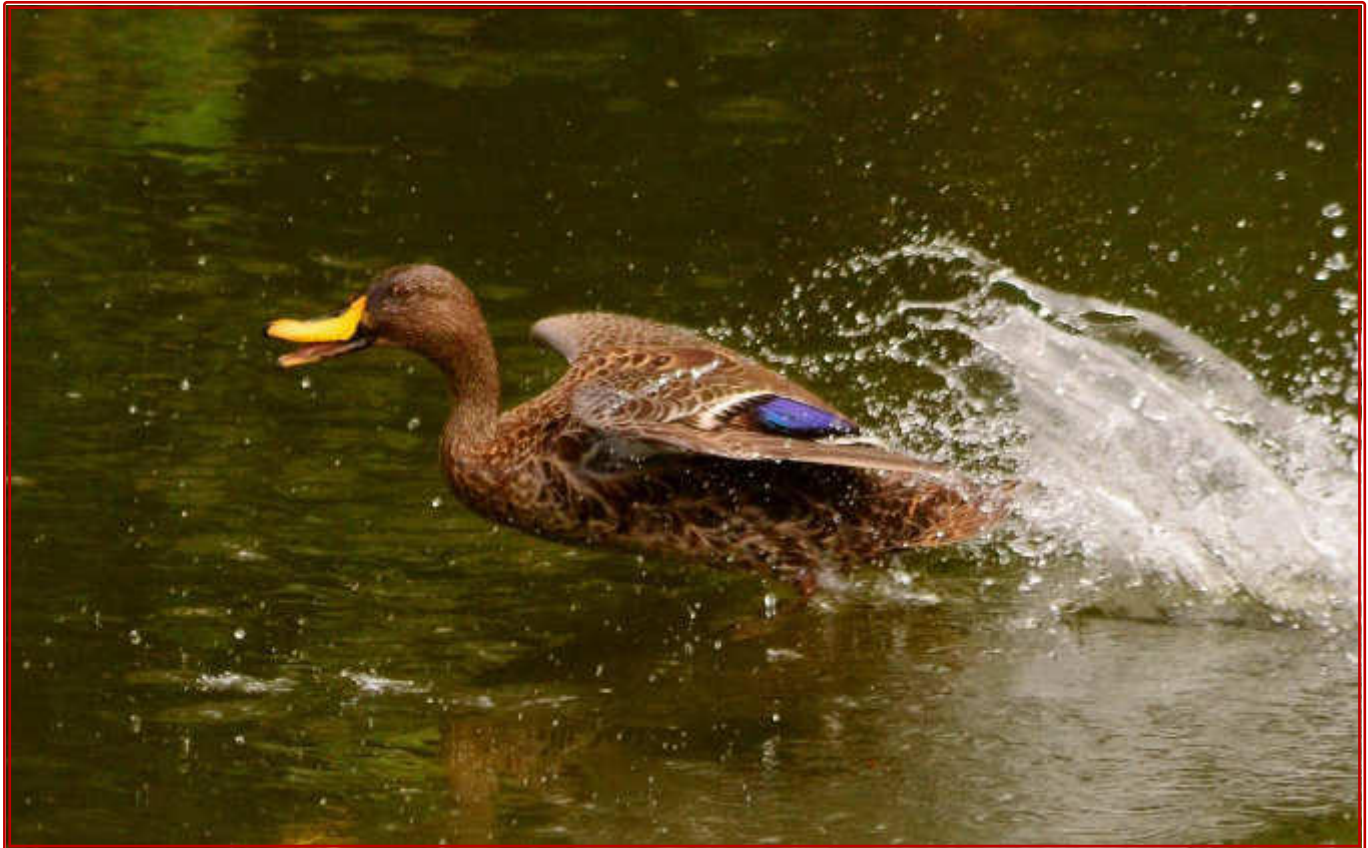
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AVIFAUNAL ASSESSMENT  
OF  
THE REMAINING EXTENT OF PORTION 1 OF THE FARM WATERFALL 5-IR ALSO  
KNOWN AS LAND PARCEL 10



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07 May 2016

To whom it may concern,

**REVIEW OF SPECIALIST AVIFAUNAL ASSESSMENT:**

**THE REMAINING EXTENT OF PORTION 1 OF THE FARM WATERFALL 5-IR ALSO  
KNOWN AS LAND PARCEL 10**

I, Lukas Jurie Niemand, member and principal consultant of Pachnoda Consulting and registered professional scientist in the fields of Zoological and Ecological sciences, evaluated the avifaunal (bird) component of the abovementioned specialist assessment compiled by Mr CW Vermeulen of Bokamoso. The report was evaluated in accordance with the Gauteng Directorate of Nature Conservation (GDARD) Requirements for Biodiversity Assessments Version 3 and in terms of general content and avifaunal conservation.

In general, criticism lodged against avifaunal/ecological studies include: poor use of relevant scientific literature, lack of, or poor field surveys and associated data collection, poor use of regional information datasets, general poor knowledge of subject, failure to describe limitations or constraints on survey methodology, insufficient or inadequate data, vague generalisations with no indication of the relative importance of a particular component. With regards to the above criticism, none of it is relevant to the avifaunal assessment of the aforementioned report.

It is concluded that the report comply with the provincial requirements, and the content as discussed in the report is relevant and concise.



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Regards

A handwritten signature in black ink, appearing to read 'Lukas Niemand', is written over a light grey, textured background that resembles a piece of paper or a signature strip.

Lukas Niemand  
MSc Zoology - UP; Pr. Sci. Nat. Reg. no. 400095/06)  
Pachnoda Consulting

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## 1. Introduction

Bokamoso Environmental Consultants CC; Specialist Division was appointed to conduct a Basic Faunal Assessment for the proposed mixed used development on the remaining extent of Portion 1 of the Farm Waterfall 5-IR, Gauteng Province, also known as Land Parcel 10 (hereafter referred to as the study area).

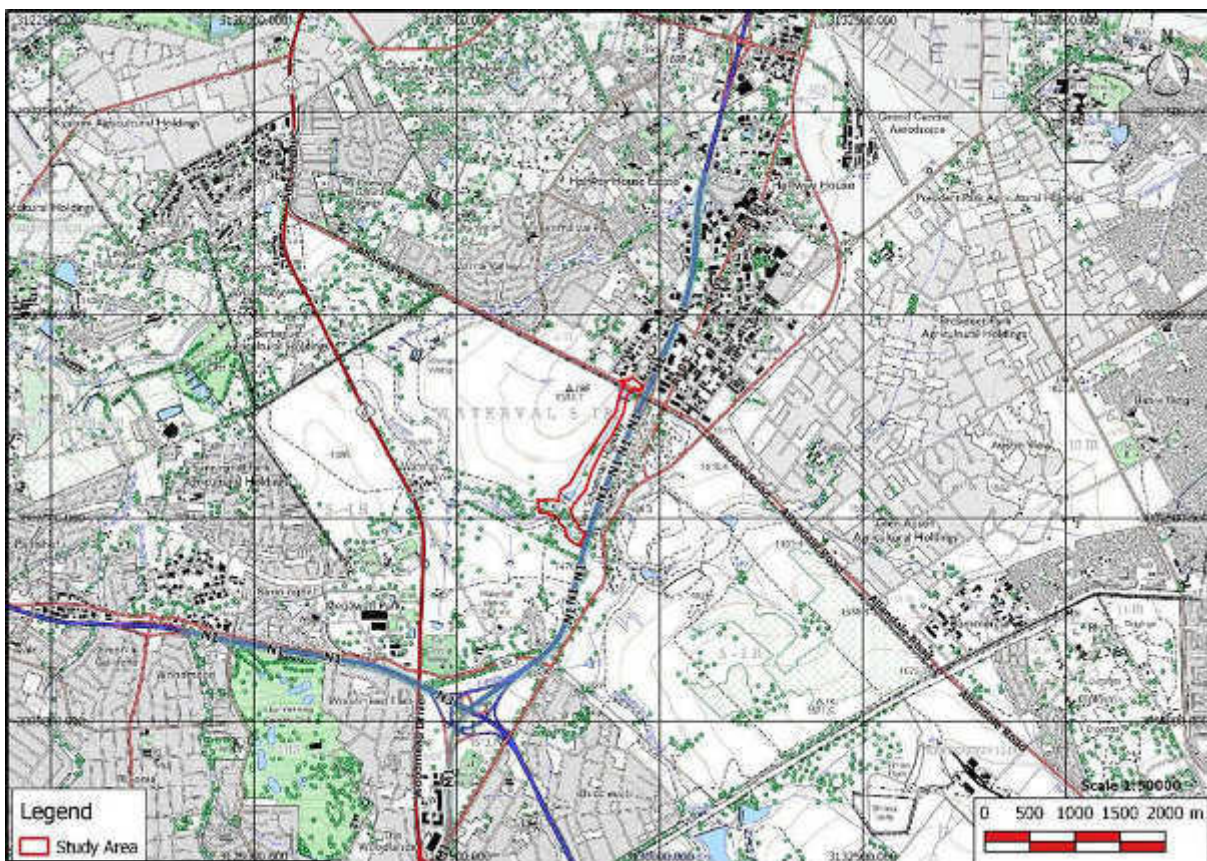
This report is based on the avifaunal species present on the study area as well as species that could potentially be present. The report primarily focuses on species with conservation concerns (**NT** = Near Threatened, **VU** = Vulnerable, **EN** = Endangered, **CR** = Critically Endangered) and other species with conservation importance occurring on or near the study area to ensure that, should any such species exists, the appropriate actions are taken to guarantee the well-being of these species.

## 2. Scope of the study

- To identify as many species as possible present on the study area.
- To identify all the distinct habitats on the study area.
- To compare the species occurring in and around the study area with all the species that has been recorded in that area in recent history.
- To identify ecologically sensitive areas in terms of species occurrence and/ or habitat.
- To provide lists of all the species occurring on the study area as well as species possibly occurring in the area as a result of habitat preferences and previous records.
- To provide a list of species with conservation importance.
- To provide recommendations in the form of mitigation of negative impacts, should the development be approved.

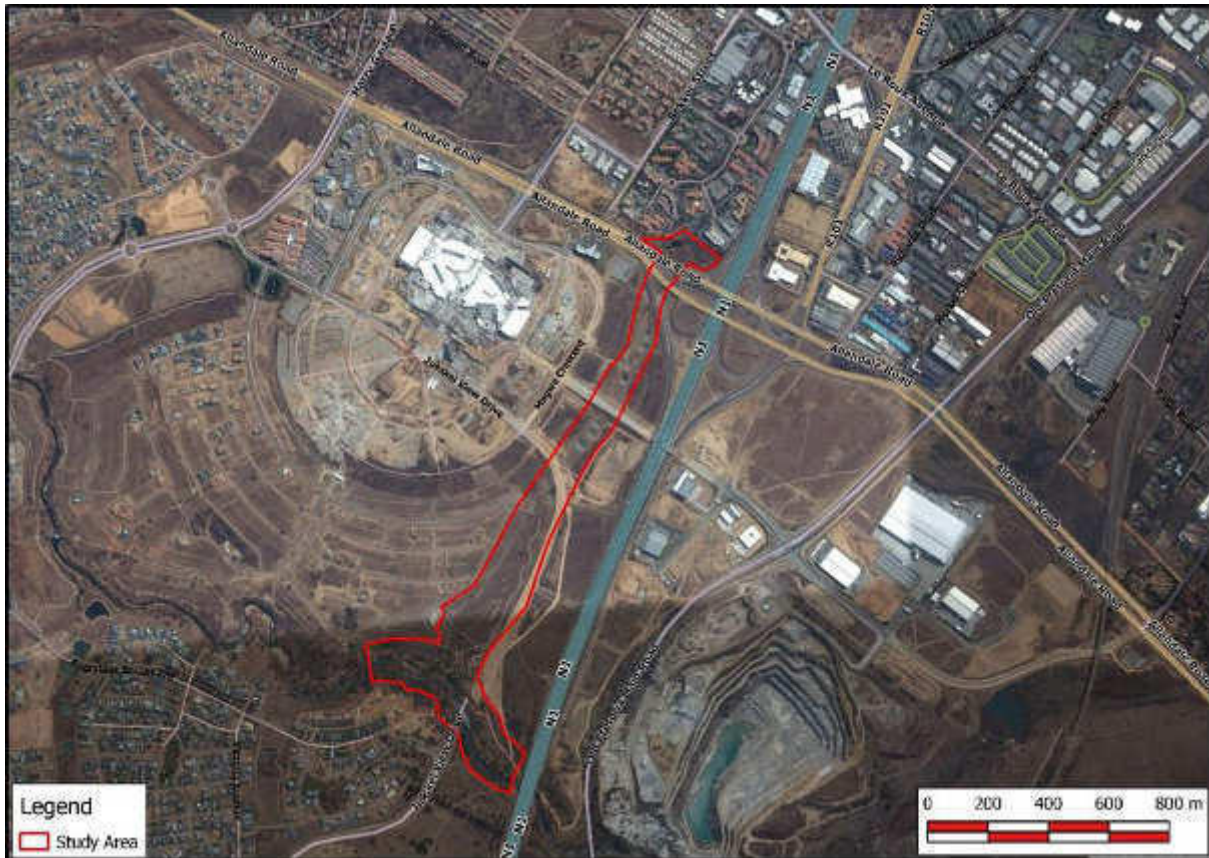
### 3. Study Area

The study area is situated on the remaining extent of Portion 1 of the farm Waterfall 5-IR, Gauteng Province and also known as Land Parcel 10. The size of the property is approximately 103 ha and is located within the 2628AA quarter degree square (QDS) ( $26^{\circ}01'24.74''S$ ;  $28^{\circ}06'35.73''E$ ) and within the 2600\_2805 pentad (A pentad is a 5 minute x 5 minute coordinate grid super-imposed over the continent for spatial reference, one QDGC comprises of 9 pentads) (SABP2). The study area is located within the Egoli Granite Grassland vegetation unit (Mucina and Rutherford, 2006). The study area is located north of the N1 highway and west of Allendale road. The property largely consists of open grassland with small scattered trees and a drainage line cutting through the center from the north to the south. Moreover, the drainage line is completely transformed as a result of the use of gabions as a form of stabilizing the steep banks and protection against erosion. A small rocky outcrop is situated on the South-eastern part of the study area. The Jukskei River directly borders the study area on the most Southerly boarder. The property is located approximately 1468 meters above sea level and slopes gently to the South-west (Figures 1 and 2).



**Figure 1: Locality Map**

An overhead map showing all the surrounding roads and open space as well as the location of the study area within the larger Midrand area.



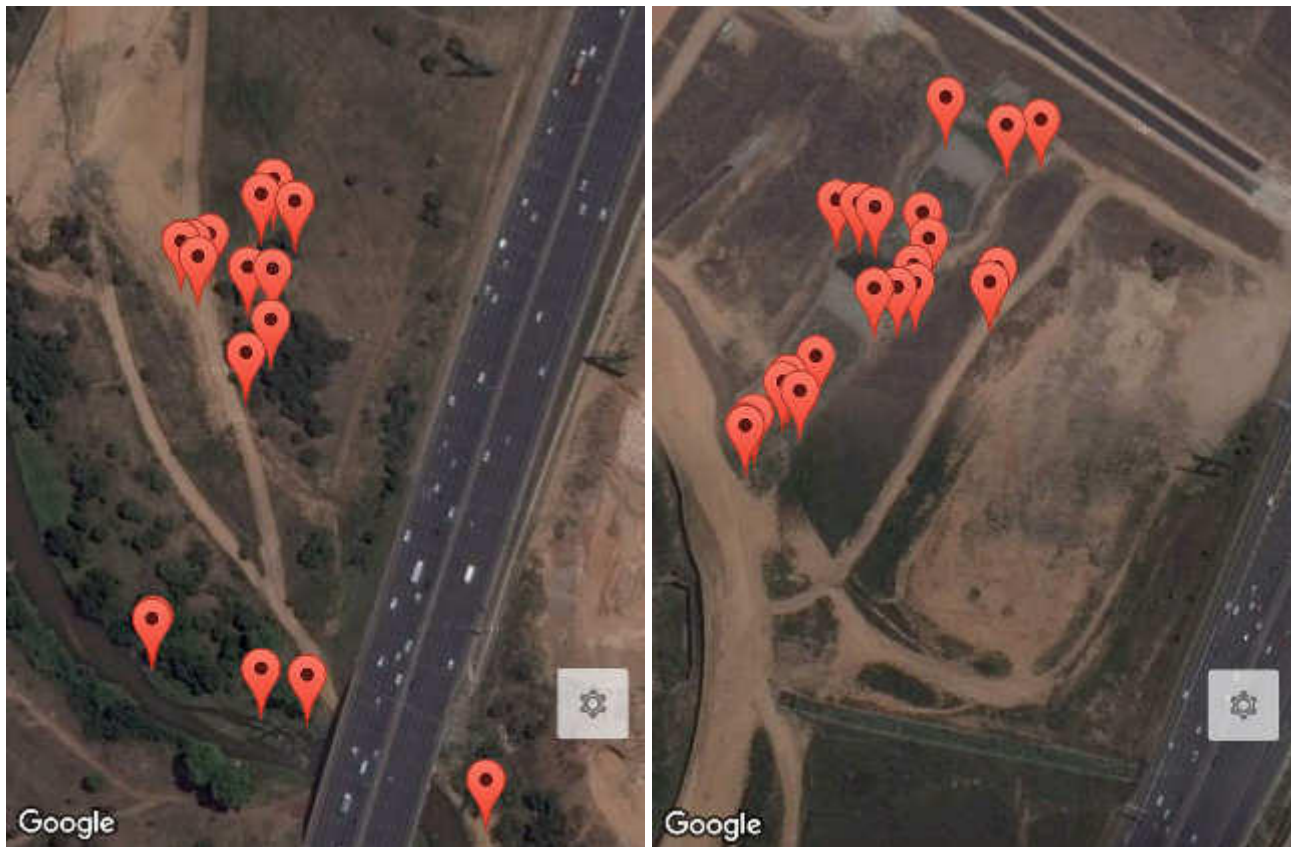
**Figure 2: Aerial photo**

An aerial photo showing the location of the study area. The Jukskei River, Mall of Africa as well as the Afrisam Aggregate Quarry are clearly visible.

## 4. Methods

### 4.1 Field Survey

A three and a half hour field survey was conducted on the 7<sup>th</sup> of April 2016, starting at 10:17 and ending at 12:50. Before conducting a field survey on the study area a desktop assessment was conducted to note the prevalent faunal species occurring on or near the site. A list of expected species was compiled and used as a reference during the field survey to ensure that species that should theoretically occur were not overlooked. All distinct avifaunal habitats were identified on site, after which each habitat was assessed to record the associated faunal species present in that specific habitat. Some species were identified by call as well as signs of presence in the form of eggshells, nests, droppings and feathers (Chris & Tilde Stuart., 2000). Where necessary, species were verified using Sasol Birds of Southern Africa (Sinclair *et al.*, 2011).



**Figure 3: GPS waypoints for each bird species recorded**

Each GPS waypoint accounts for a bird species recorded within the study area. These observed species are color coded and listed in Table 1 (**Recorded on site – 5**)

#### 4.2 Listing all the possible species occurring on site

By using Southern Africa Bird Atlas Project 1 and 2 (SABAP2) a comprehensive species list could be compiled for the 2628AA QDS / 2600\_2805 pentad. SABAP2 is the follow-up project to the Southern African Bird Atlas Project (for which the acronym was SABAP, and which is now referred to as SABAP1). This first bird atlas project took place from 1987-1991. The second bird atlas project started on 1 July 2007 and plans to run indefinitely. The project aims to map the distribution and relative abundance of birds in southern Africa. The field work for this project is done by more than one thousand nine hundred volunteers, known as citizen scientists. The unit of data collection is the pentad, five minutes of latitude by five minutes of longitude, squares with sides of roughly 9 km.

The initial list compiled for the species occurring in the QDS can however not be used as an accurate list in terms of the species occurring within the study area since it covers a larger area as well as a wider variety of habitats. In order to compile an accurate species list for the study area, all the species previously recorded in the 2628AA QDS were considered and added or eliminated on account of the

habitat present on the study area as well as the habitat preferences of each of the species previously recorded within the larger QDS.

#### 4.3 Red Data bird species

All the Red Data bird species occurring in or around the study area were reviewed (Roberts VII, Hockey *et al.* 2005; Taylor *et al.*, 2015) before conducting the field survey. During the field survey special attention was paid to identify any signs such as; actual sightings, suitable habitat, nest sites, suitable hunting/ foraging habitat or roosting spots pointing to the presence of these species.

A list was compiled to indicate the presence and/ or occurrence probability of Red Data bird species based on the above mentioned indicators.

#### 4.4 Specific Requirements in terms of Red Data Avifaunal species

According to the Gauteng Department of Agriculture and Rural Development's (GDARD) requirements for Biodiversity Assessments, Version 3.3 (March 2014), as well as for any other Red Data species: Eleven threatened bird species were prioritized for inclusion into the Gauteng C-Plan based on:

1. Threat status (2 Endangered (**EN**), 5 Vulnerable (**VU**) and 4 Near Threatened (**NT**)).
2. Whether the species was actually present, on a frequent basis, in the province. Vagrants, erratic visitors or erratic migrants to the province (Tarboton *et al.*, 1987) have been excluded from the conservation plan.
3. Whether the threat was due to issues related to land use planning. Species which are impacted on mostly by threats such as poisoning were excluded.

#### Threatened Bird species regional conservation status (Taylor *et al.*, 2015):

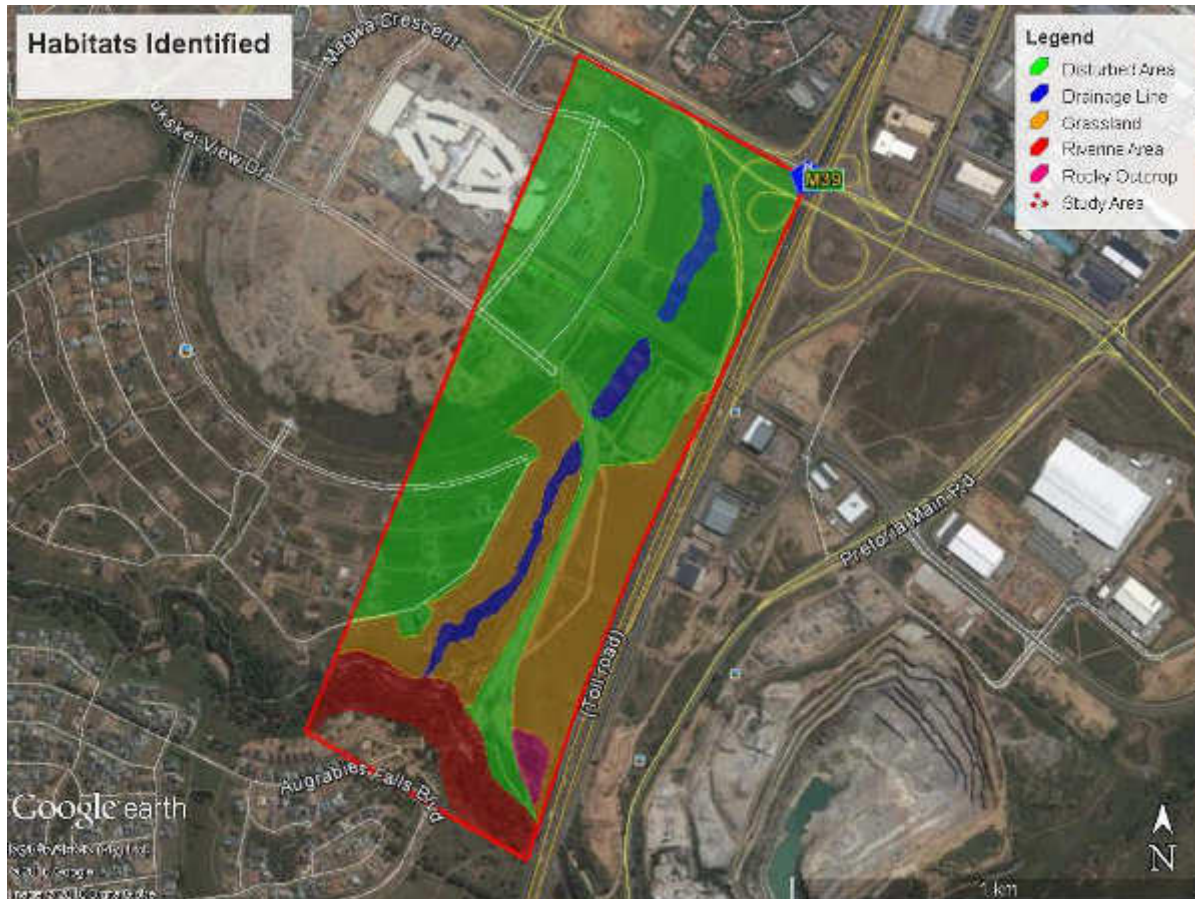
- Half-Collared Kingfisher (*Alcedo semitorquata*) **NT**
- Blue Crane (*Anthropoides paradiseus*) **NT**
- African Marsh-Harrier (*Circus ranivorus*) **EN**
- Blue Korhaan (*Eupodotis caerulescens*) **NT**
- White-bellied Korhaan (*Eupodotis senegalensis*) **VU**
- White-backed Night-Heron (*Gorsachius leuconotus*) **VU**
- Cape Vulture (*Gyps coprotheres*) **EN**
- Melodious Lark (*Mirafra cheniana*) **NT**
- African Finfoot (*Podica senegalensis*) **VU**
- Secretarybird (*Sagittarius serpentarius*) **VU**
- African Grass-Owl (*Tyto capensis*) **VU**



## 5. Results

### 5.1 Avifaunal Habitat Assessment:

During the habitat assessment five distinct bird habitats were identified within the study area. These habitats are: Disturbed Areas, Drainage Line, Grassland, Rocky Outcrop, and Riverine Area (**Figure 4**). All the habitats identified on the study area are individually discussed hereafter.



**Figure 4: Habitats Identified**

#### 5.1.1 Disturbed Area:

This area contains various disturbances in the form of roads, degraded grassland and general disturbances as a result of trampling and degradation as result of heavy vehicle activity. Large parts of this area have been transformed by means of trampling, to such an extent that only bare ground remains (**Figure 5**). Further disturbance in the form of alien vegetation encroachment is also evident. The area contains a limited amount of natural vegetation; instead a large number of invasive plants including herbaceous plants (*Verbena bonariensis*) and alien trees (*Acacia mearensii*). The reason for the inclusion of this area as a habitat in its own right, is due to the large number of bird species that have adapted to this unique environment. Species such as Sparrows,

Lapwings, Doves, Pigeons and Indian Mynas were present in large numbers in this habitat. Many of these species are non-specialised and transient.



**Figure 5: Disturbed Area**

### **5.1.2 Drainage Line:**

A drainage line cuts through the center of the study area from the North to the South. The Drainage Line area encompasses the ideal habitat for Ralids, Plovers, Lapwings, Warblers, Bishops and Widowbirds. The largest part of this area has been transformed as a result of bank stabilization and erosion protection through the use of gabions to control and channel the flow of water. It is evident that rehabilitation of the drainage line is still an ongoing process and that this habitat will gradually improve in the near future. Although the current state of this area as an important avifaunal habitat can be debated owing to its fairly recent completion, the evidence of a potentially ideal wetland/drainage line habitat is apparent when attention is paid to the wetland vegetation and bird species currently present. Over time this area should provide the preferred habitat for various bird species once the current vegetation proliferates and connectivity to the natural drainage network is restored. Thus it is expected that this area will provide a favorable wetland habitat in the near future and as such can be earmarked as an area with high ecological sensitivity, please refer to sensitivity map.



**Figure 6: Drainage Line**

### 5.1.3 Grassland

The Grassland habitat contains two distinct floristic compositions (**Figure 7**). The Eastern grassland contains a well established population of various grass species and grassland vegetation communities, whereas the Western grassland contains large numbers of alien vegetation and other disturbances such as trampling and evidence of heavy vehicle activity. The Eastern grassland supports a large number of widespread bird species and could potentially provide the preferred habitat for three Red Data bird species namely; Blue Crane, White-bellied Korhaan and Secretarybird. Although the Eastern grassland is the preferred habitat of the afore mentioned species, their occurrence is highly unlikely due to the small size of the grassland as well as the disturbances caused by the adjacent road. As a result of the current near natural state of the Eastern part of the grassland habitat, this section of the grassland was deemed moderately sensitive from an avifaunal perspective as it is likely to support a number of more common species, like Spotted Thick-knee, Lapwings, Quails, Francolins and Spurfowl. The rest of the grassland habitat is already degraded and was deemed to have a low ecological and avifaunal sensitivity.



**Figure 7: Grassland**

#### 5.1.4 Rocky Outcrop:

This habitat is situated on the South-eastern side of the study area and is directly adjacent to the Eastern grassland habitat (**Figure 8**). Although it makes out a fairly small part of the larger study area, the largest number of bird species for the study area was recorded here. The reason for the large amount of species present in this small area is a direct result of the occurrence of a number of large indigenous trees (mainly *Vachelia karoo* and *Celtis africanus*), along with a healthy community of shrubs and other vegetation, which provides the perfect nesting, foraging and roosting habitat for a variety of grassland and savanna bird species. As a result, this area was deemed moderately sensitive from an avifaunal perspective.



**Figure 8: Rocky Outcrop**

### 5.1.5 Riverine Area:

The southernmost part of the study area borders the Jukskei River (**Figure 9**). Due to large number of bird species preferring this habitat type, the riverine area was expected to produce the highest species richness in comparison with the other habitats within the study area,. The state of the river was however very poor on account of the high amount of alien vegetation encroachment as well as the highly polluted river water (both chemical and solid waste) (Sibali *et al.*, 2008) (**Figure 10**). The low species count for this habitat is a direct result of the polluted river. The riverine area provides the optimal habitat for the Half-collared Kingfisher, with all the habitat preferences for this bird species present along this stretch of the river. These habitat preferences include clear, fast flowing perennial streams and/or rivers with dense marginal vegetation often near rapids (Roberts VII, Hockey *et al.*, 2005). All of these habitat preferences are present on the study area. If this section of the river is to be properly rehabilitated it could potentially be a highly diverse habitat and would most probably support the Red-listed Half-collared Kingfisher and also potentially the African Finfoot, although the chances of the latter occurring would be highly unlikely as a result of the polluted water. Due to the afore mentioned reasons this habitat is deemed highly sensitive, not on account of species currently present within the habitat, but rather as a result of the potential that this area holds if proper rehabilitation thereof is implemented.



**Figure 9: Riverine Area**



Figure 10: Highly polluted section of the Jukskei River.

**Table 1: Bird species observed within the study area during the field survey, as well as bird species potentially occurring on the study area as a result of habitat preferences and previous records.**

The biodiversity index indicates the probability of a species breeding (BR) within the study area and/or occurring within the study area according to the habitat preferences (HP) of that specific species. Very Low – 1, Low – 2, Medium – 3, High – 4, Recorded on site – 5, Not likely to occur/breed – 0, Red Data Species

	Species name	Afrikaans	Taxonomic name	Rep Rate (%)	HP	BR
1.	Apalis, Bar-throated	Bandkeelkleinjantjie	<i>Apalis thoracica</i>	2.515	3	3
2.	Avocet, Pied	Bontelsie	<i>Recurvirostra avosetta</i>	8.515	2	1
3.	Babbler, Arrow-marked	Pylvlekkatlagter	<i>Turdoides jardineii</i>	0.22	3	3
4.	Barbet, Acacia Pied	Bonthoutkapper	<i>Tricholaema leucomelas</i>	2.07	3	3
5.	Barbet, Black-collared	Rooikophoutkapper	<i>Lybius torquatus</i>	56.435	4	4
6.	Barbet, Crested	Kuifkophoutkapper	<i>Trachyphonus vaillantii</i>	75.28	5	4
7.	Batis, Chinspot	Witliesbosbontrokkie	<i>Batis molitor</i>	0.24	2	2
8.	Bee-eater, European	Europese Byvreter	<i>Merops apiaster</i>	27.92	4	1
9.	Bee-eater, Little	Kleinbyvreter	<i>Merops pusillus</i>	0.045	2	1

10.	Bee-eater, White-fronted	Rooikeelbyvreter	<i>Merops bullockoides</i>	5.95	3	3
11.	Bishop, Southern Red	Rooivink	<i>Euplectes orix</i>	71.62	5	5
12.	Bishop, Yellow-crowned	Goudgeelvink	<i>Euplectes afer</i>	10.385	4	4
13.	Bittern, Little	Kleinrietreier (Woudapie)	<i>Ixobrychus minutus</i>	3.865	3	3
14.	Bokmakierie, Bokmakierie	Bokmakierie	<i>Telophorus zeylonus</i>	30.86	3	3
15.	Boubou, Southern	Suidelike Waterfiskaal	<i>Laniarius ferrugineus</i>	8.595	4	4
16.	Brubru, Brubru	Bontroklaasman	<i>Nilaus afer</i>	0.13	2	1
17.	Bulbul, African Red-eyed	Rooioogtiptol	<i>Pycnonotus nigricans</i>	0.675	2	2
18.	Bulbul, Dark-capped	Swartoogtiptol	<i>Pycnonotus tricolor</i>	90.83	5	4
19.	Bunting, Cinnamon-breasted	Klipstreepkoppie	<i>Emberiza tahapisi</i>	2.125	2	2
20.	Buttonquail, Kurrichane	Bosveldkwarteltjie	<i>Turnix sylvaticus</i>	0.37	2	2
21.	Buzzard, Jackal	Rooiborsjakkalsvoel	<i>Buteo rufofuscus</i>	0.27	2	2
22.	Buzzard, Lizard	Akkedisvalk	<i>Kaupifalco monogrammicus</i>	1.33	1	1
23.	Buzzard, Steppe	Bruinjakkalsvoel	<i>Buteo vulpinus</i>	16.015	4	0
24.	Canary, Black-throated	Bergkanarie	<i>Crithagra atrogularis</i>	48.705	5	4
25.	Canary, Yellow	Geelkanarie	<i>Crithagra flaviventris</i>	0.885	2	2
26.	Canary, Yellow-fronted	Geeloogkanarie	<i>Crithagra mozambicus</i>	25.83	3	3
27.	Chat, Familiar	Gewone Spekvreter	<i>Cercomela familiaris</i>	14.05	3	3
28.	Cisticola, Cloud	Gevlekte Klopkloppie	<i>Cisticola textrix</i>	4.16	2	2
29.	Cisticola, Desert	Woestynklopkloppie	<i>Cisticola aridulus</i>	2.605	2	2
30.	Cisticola, Lazy	Luitinktinkie	<i>Cisticola aberrans</i>	0.22	1	1
31.	Cisticola, Levillant's	Vleitinktinkie	<i>Cisticola tinniens</i>	38.985	5	4
32.	Cisticola, Wailing	Huiltinktinkie	<i>Cisticola lais</i>	2.09	2	2
33.	Cisticola, Zitting	Landeryklopkloppie	<i>Cisticola juncidis</i>	23.565	3	3
34.	Cliff-swallow, South African	Familieswael	<i>Hirundo spilodera</i>	3.505	4	3
35.	Coot, Red-knobbed	Bleshoender	<i>Fulica cristata</i>	63.255	3	3
36.	Cormorant, Reed	Rietduiker	<i>Phalacrocorax africanus</i>	69.015	4	2
37.	Cormorant, White-breasted	Witborsduiker	<i>Phalacrocorax carbo</i>	37.85	2	1
38.	Coucal, Burchell's	Gewone Vleiloerie	<i>Centropus burchellii</i>	21.39	4	3
39.	Crake, Black	Swartriethaan	<i>Amaurornis</i>	5.22	4	4

			<i>flavirostris</i>			
40.	Crane, Blue	Bloukraanvoel	<i>Anthropoides paradiseus</i>	0.5	0	0
41.	Crombec, Long-billed	Bosveldstompstert	<i>Sylvietta rufescens</i>	0.14	1	1
42.	Crow, Cape	Swartkraai	<i>Corvus capensis</i>	2.915	1	1
43.	Crow, Pied	Witborskraai	<i>Corvus albus</i>	78.735	4	4
44.	Cuckoo, Black	Swartkoekoek	<i>Cuculus clamosus</i>	0.13	3	3
45.	Cuckoo, Diderick	Diederikkie	<i>Chrysococcyx caprius</i>	28.15	4	4
46.	Cuckoo, Klaas's	Meitjie	<i>Chrysococcyx klaas</i>	0.11	2	2
47.	Cuckoo, Red-chested	Piet-my-vrou	<i>Cuculus solitarius</i>	13.455	4	4
48.	Cuckoo-shrike, Black	Swartkatakoeroe	<i>Campephaga flava</i>	0.185	2	2
49.	Darter, African	Slanghalsvoel	<i>Anhinga rufa</i>	41.665	4	1
50.	Dove, Laughing	Rooiborsduifie	<i>Streptopelia senegalensis</i>	94.175	5	4
51.	Dove, Namaqua	Namakwaduifie	<i>Oena capensis</i>	1.025	1	1
52.	Dove, Red-eyed	Grootringduif	<i>Streptopelia semitorquata</i>	59.505	5	4
53.	Dove, Rock	Tuinduif	<i>Columba livia</i>	60.46	4	4
54.	Drongo, Fork-tailed	Mikstertbyvanger	<i>Dicrurus adsimilis</i>	6.905	3	3
55.	Duck, African Black	Swarteend	<i>Anas sparsa</i>	53.715	5	4
56.	Duck, Fulvous	Fluiteend	<i>Dendrocygna bicolor</i>	1.11	1	1
57.	Duck, Maccoa	Bloubekeend	<i>Oxyura maccoa</i>	1.08	1	1
58.	Duck, White-backed	Witrugeend	<i>Thalassornis leuconotus</i>	0.96	1	1
59.	Duck, White-faced	Nonnetjie-eend	<i>Dendrocygna viduata</i>	22.515	4	4
60.	Duck, Yellow-billed	Geelbekeend	<i>Anas undulata</i>	57.665	5	5
61.	Eagle, Long-crested	Langkuifarend	<i>Lophaelus occipitalis</i>	16.445	3	3
62.	Eagle, Martial	Breekoparend	<i>Polemaetus bellicosus</i>	0.02	0	0
63.	Eagle, Verreaux's	Witkruisarend	<i>Aquila verreauxii</i>	0.02	0	0
64.	Eagle-owl, Spotted	Gevlekte Ooruil	<i>Bubo africanus</i>	13.46	3	3
65.	Egret, Cattle	Veereier	<i>Bubulcus ibis</i>	65.34	4	0
66.	Egret, Great	Grootwitreier	<i>Egretta alba</i>	1.36	1	0
67.	Egret, Little	Kleinwitreier	<i>Egretta garzetta</i>	29.4	4	0
68.	Egret, Yellow-billed	Geelbekwitreier	<i>Egretta intermedia</i>	4.955	2	0
69.	Falcon, Amur	Oostelike Rooipootvalk	<i>Falco amurensis</i>	2.66	3	0
70.	Falcon, Lanner	Edelvalk	<i>Falco biarmicus</i>	0.62	1	0
71.	Falcon, Peregrine	Swervvalk	<i>Falco peregrinus</i>	0.6	1	0
72.	Falcon, Red-footed	Westelike Rooipootvalk	<i>Falco vespertinus</i>	0.14	1	0
73.	Finch, Cuckoo	Koekoekvink	<i>Anomalospiza imberbis</i>	0.13	1	1



74.	Finch, Red-headed	Rooikopvink	<i>Amadina erythrocephala</i>	14.15	4	4
75.	Firefinch, Jameson's	Jamesonse Vuurvinkie	<i>Lagonosticta rhodopareia</i>	7.72	5	4
76.	Firefinch, Red-billed	Rooibekvuurvinkie	<i>Lagonosticta senegala</i>	0.185	3	3
77.	Fiscal, Common (Southern)	Fiskaallaksman	<i>Lanius collaris</i>	87.725	5	4
78.	Fish-eagle, African	Visarend	<i>Haliaeetus vocifer</i>	17.785	3	3
79.	Flamingo, Greater	Grootflamink	<i>Phoenicopterus ruber</i>	1.96	1	0
80.	Flamingo, Lesser	Kleinflamink	<i>Phoenicopterus minor</i>	0.065	0	0
81.	Flufftail, Red-chested	Rooiborsvleikuiken	<i>Sarothrura rufa</i>	0.49	3	3
82.	Flycatcher, Fairy	Feevlieievanger	<i>Stenostira scita</i>	1.99	2	1
83.	Flycatcher, Fiscal	Fiskaalvlieievanger	<i>Sigelus silens</i>	45.735	5	4
84.	Flycatcher, Southern Black	Swartvlieievanger	<i>Melaenornis pammelaina</i>	6.64	2	2
85.	Flycatcher, Spotted	Europese Vlieievanger	<i>Muscicapa striata</i>	13.905	4	0
86.	Francolin, Coqui	Swempie	<i>Peliperdix coqui</i>	0.37	1	1
87.	Francolin, Orange River	Kalaharipatrys	<i>Scleroptila levaillantoides</i>	15.15	3	3
88.	Go-away-bird, Grey	Kwêvoel	<i>Corythaixoides concolor</i>	58.455	4	4
89.	Goose, Egyptian	Kolgans	<i>Alopochen aegyptiacus</i>	79.175	5	4
90.	Goose, Spur-winged	Wildemakou	<i>Plectropterus gambensis</i>	13.375	3	3
91.	Goshawk, Gabar	Kleinsingvalk	<i>Melierax gabar</i>	0.14	1	1
92.	Grass-owl, African	Grasuil	<i>Tyto capensis</i>	0.38	0	0
93.	Grassbird, Cape	Grasvoel	<i>Sphenoeacus afer</i>	0.405	1	1
94.	Grebe, Great Crested	Kuifkopdobbertjie	<i>Podiceps cristatus</i>	10.925	1	1
95.	Grebe, Little	Kleindobbertjie	<i>Tachybaptus ruficollis</i>	45.92	4	4
96.	Green-pigeon, African	Papegaaiduif	<i>Treron calvus</i>	0.36	3	3
97.	Greenshank, Common	Groenpootruiter	<i>Tringa nebularia</i>	4.215	3	0
98.	Guinea fowl, Helmeted	Gewone Tarentaal	<i>Numida meleagris</i>	61.68	5	5
99.	Gull, Grey-headed	Gryskopmeeu	<i>Larus cirrocephalus</i>	42.99	5	0
100.	Hamerkop, Hamerkop	Hamerkop	<i>Scopus umbretta</i>	21.615	4	4
101.	Harrier-Hawk, African	Kaalwangvalk	<i>Polyboroides typus</i>	0.48	2	1
102.	Heron, Black	Swartreier	<i>Egretta ardesiaca</i>	3.195	2	2
103.	Heron, Black-headed	Swartkopreier	<i>Ardea</i>	65.065	4	1

			<i>melanocephala</i>			
104	Heron, Goliath	Reusereier	<i>Ardea goliath</i>	3.9	3	1
105	Heron, Green-backed	Groenrugreier	<i>Butorides striata</i>	8.435	4	3
106	Heron, Grey	Bloureier	<i>Ardea cinerea</i>	35.05	4	1
107	Heron, Purple	Rooiereier	<i>Ardea purpurea</i>	15.425	3	1
108	Heron, Squacco	Ralreier	<i>Ardeola ralloides</i>	6.905	3	1
109	Hobby, Eurasian	Europese Boomvalk	<i>Falco subbuteo</i>	3.685	1	0
110	Honey-buzzard, European	Wespedief	<i>Pernis apivorus</i>	1.2	1	0
111	Honeybird, Brown-backed	Skerpbekheuningvoel	<i>Prodotiscus regulus</i>	4.765	3	3
112	Honeyguide, Greater	Grootheuningwyser	<i>Indicator indicator</i>	7.485	3	3
113	Honeyguide, Lesser	Kleinheuningwyser	<i>Indicator minor</i>	15.25	4	4
114	Hoopoe, African	Hoephoep	<i>Upupa africana</i>	35.835	4	4
115	Hornbill, African Grey	Grysneushoringvoel	<i>Tockus nasutus</i>	7.685	3	3
116	House-martin, Common	Huisswael	<i>Delichon urbicum</i>	5.84	4	0
117	Ibis, African Sacred	Skoorsteenveer	<i>Threskiornis aethiopicus</i>	72.865	5	0
118	Ibis, Glossy	Glansibis	<i>Plegadis falcinellus</i>	28.055	4	1
119	Ibis, Hadeda	Hadeda	<i>Bostrychia hagedash</i>	91.07	5	4
120	Indigobird, Purple	Witpootblouvinkie	<i>Vidua purpurascens</i>	1.2	1	1
121	Indigobird, Village	Staalblouvinkie	<i>Vidua chalybeata</i>	0.045	1	1
122	Jacana, African	Grootlangtoon	<i>Actophilornis africanus</i>	1.535	1	1
123	Kestrel, Greater	Grootrooivalk	<i>Falco rupicoloides</i>	2.005	1	1
124	Kestrel, Lesser	Kleinrooivalk	<i>Falco naumanni</i>	0.195	1	0
125	Kingfisher, Brown-hooded	Bruinkopvisvanger	<i>Halcyon albiventris</i>	8.755	4	4
126	Kingfisher, Giant	Reusevisvanger	<i>Megaceryle maximus</i>	18.855	4	4
127	Kingfisher, Half-collared	Blouvisvanger	<i>Alcedo semitorquata</i>	0.405	2	2
128	Kingfisher, Malachite	Kuifkopvisvanger	<i>Alcedo cristata</i>	17.275	4	4
129	Kingfisher, Pied	Bontvisvanger	<i>Ceryle rudis</i>	23.27	4	4
130	Kingfisher, Woodland	Bosveldvisvanger	<i>Halcyon senegalensis</i>	6.505	3	3
131	Kite, Black	Swartwou	<i>Milvus migrans</i>	1.635	1	0
132	Kite, Black-shouldered	Blouvalk	<i>Elanus caeruleus</i>	56.655	5	4
133	Kite, Yellow-billed	Geelbekwou	<i>Milvus aegyptius</i>	9.93	2	0
134	Korhaan, Northern Black	Witvlerkkorhaan	<i>Afrotis afraoides</i>	17.37	2	2

135	Korhaan, White-bellied	Witpenskorhaan	<i>Eupodotis senegalensis</i>	1.195	0	0
136	Lapwing, African Wattled	Lelkiewiet	<i>Vanellus senegallus</i>	50.85	5	4
137	Lapwing, Blacksmith	Bontkiewiet	<i>Vanellus armatus</i>	72.99	5	4
138	Lapwing, Crowned	Kroonkiewiet	<i>Vanellus coronatus</i>	72.885	4	4
139	Lark, Eastern Clapper	Hoeveldklappertjie	<i>Mirafra fasciolata</i>	0.64	1	1
140	Lark, Melodious	Spotlewerik	<i>Mirafra cheniana</i>	0.15	1	1
141	Lark, Red-capped	Rooikoplewerik	<i>Calandrella cinerea</i>	1.915	1	1
142	Lark, Rufous-naped	Rooineklewerik	<i>Mirafra africana</i>	21.6	3	3
143	Lark, Spike-heeled	Vlaktelewerik	<i>Chersomanes albofasciata</i>	2.6	2	2
144	Longclaw, Cape	Oranjekeelkalkoentjie	<i>Macronyx capensis</i>	33.1	4	4
145	Mannikin, Bronze	Gewone Fret	<i>Spermestes cucullatus</i>	22.075	5	4
146	Marsh-harrier, African	Afrikaanse Vleivalk	<i>Circus ranivorus</i>	0.11	0	0
147	Martin, Banded	Gebande Oewerswael	<i>Riparia cincta</i>	1.1	1	1
148	Martin, Brown-throated	Afrikaanse Oewerswael	<i>Riparia paludicola</i>	33.825	5	4
149	Martin, Rock	Kransswael	<i>Hirundo fuligula</i>	19.415	3	3
150	Masked-weaver, Southern	Swartkeelgeelvink	<i>Ploceus velatus</i>	94.83	5	5
151	Moorhen, Common	Grootwaterhoender	<i>Gallinula chloropus</i>	55.98	5	4
152	Mousebird, Red-faced	Rooiwangmuisvoel	<i>Urocolius indicus</i>	44.42	4	4
153	Mousebird, Speckled	Gevlekte Muisvoel	<i>Colius striatus</i>	67.185	4	4
154	Mousebird, White-backed	Witkruisvoel	<i>Colius colius</i>	2.22	1	1
155	Myna, Common	Indiese Spreeu	<i>Acridotheres tristis</i>	92.975	5	4
156	Neddicky, Neddicky	Neddikkie	<i>Cisticola fulvicapilla</i>	34.185	4	4
157	Night-Heron, Black-crowned	Gewone Nagreier	<i>Nycticorax nycticorax</i>	6.06	3	1
158	Nightjar, European	Europese Naguil	<i>Caprimulgus europaeus</i>	0.415	1	0
159	Nightjar, Rufous-cheeked	Rooiwangnaguil	<i>Caprimulgus rufigena</i>	0.39	1	1
160	Olive-pigeon, African	Geelbekbosduif	<i>Columba arquatrix</i>	17.425	4	4
161	Oriole, Black-headed	Swartkopwielewaal	<i>Oriolus larvatus</i>	4.75	3	3
162	Owl, Barn	Nonnetjie-uil	<i>Tyto alba</i>	4.735	3	3
163	Owl, Marsh	Vlei-uil	<i>Asio capensis</i>	16.895	2	2
164	Painted-snipe, Greater	Goudsnip	<i>Rostratula benghalensis</i>	0.045	0	0
165	Palm-swift, African	Palmwindswael	<i>Cypsiurus parvus</i>	47.525	5	0
166	Paradise-flycatcher, African	Paradysvlievanger	<i>Terpsiphone viridis</i>	17.15	4	4

167	Parakeet, Rose-ringed	Ringnekparkiet	<i>Psittacula krameri</i>	2.41	4	4
168	Pigeon, Speckled	Kransduif	<i>Columba guinea</i>	50.815	5	4
169	Pipit, African	Gewone Koester	<i>Anthus cinnamomeus</i>	30.78	4	4
170	Pipit, Buffy	Vaalkoester	<i>Anthus vaalensis</i>	0.34	1	1
171	Pipit, Long-billed	Nicholsonse Koester	<i>Anthus similis</i>	0.47	1	1
172	Pipit, Plain-backed	Donkerkoester	<i>Anthus leucophrys</i>	0.87	1	1
173	Plover, Common Ringed	Ringnekstrandkiewiet	<i>Charadrius hiaticula</i>	0.11	2	0
174	Plover, Three-banded	Driebandstrandkiewiet	<i>Charadrius tricollaris</i>	35.41	5	4
175	Pochard, Southern	Bruineend	<i>Netta erythrophthalma</i>	20.62	2	2
176	Pratincole, Black-winged	Swartvlerksprinkaanvoel	<i>Glareola nordmanni</i>	0.02	0	0
177	Prinia, Black-chested	Swartbandlangstertjie	<i>Prinia flavicans</i>	36.425	5	4
178	Prinia, Tawny-flanked	Bruinsylangstertjie	<i>Prinia subflava</i>	57.425	5	4
179	Puffback, Black-backed	Sneeubal	<i>Dryoscopus cubla</i>	4.93	3	3
180	Pytilia, Green-winged	Gewone Melba	<i>Pytilia melba</i>	0.12	1	1
181	Quail, Common	Afrikaanse Kwartel	<i>Coturnix coturnix</i>	0.39	2	2
182	Quailfinch, African	Gewone Kwartelvinkie	<i>Ortygospiza atricollis</i>	3.715	3	3
183	Quelea, Red-billed	Rooibekkwelea	<i>Quelea quelea</i>	10.585	3	3
184	Rail, African	Grootriethaan	<i>Rallus caerulescens</i>	0.455	3	3
185	Reed-warbler, African	Kleinrietsanger	<i>Acrocephalus baeticatus</i>	11.815	4	4
186	Reed-warbler, Great	Grootrietsanger	<i>Acrocephalus arundinaceus</i>	4.355	2	0
187	Robin-chat, Cape	Gewone Janfrederik	<i>Cossypha caffra</i>	76.125	4	4
188	Roller, European	Europese Troupant	<i>Coracias garrulus</i>	0.15	0	0
189	Roller, Lilac-breasted	Gewone Troupant	<i>Coracias caudatus</i>	0.23	1	1
190	Ruff, Ruff	Kemphaan	<i>Philomachus pugnax</i>	2.975	3	0
191	Rush-warbler, Little	Kaapse Vleisanger	<i>Bradypterus baboecala</i>	9.405	4	3
192	Sandpiper, Common	Gewone Ruiters	<i>Actitis hypoleucos</i>	11.965	4	0
193	Sandpiper, Green	Witgatruiter	<i>Tringa ochropus</i>	1.2	1	0
194	Sandpiper, Marsh	Moerasruiter	<i>Tringa stagnatilis</i>	1.785	1	0
195	Sandpiper, Wood	Bosruiter	<i>Tringa glareola</i>	11.27	3	0
196	Scimitarbill, Common	Swartbekkakalear	<i>Rhinopomastus cyanomelas</i>	0.13	1	1
197	Secretarybird	Sekretarisvoel	<i>Sagittarius serpentarius</i>	0.37	0	0

198	Seedeater, Streaky-headed	Streepkopkanarie	<i>Crithagra gularis</i>	10.81	3	3
199	Shelduck, South African	Kopereend	<i>Tadorna cana</i>	0.195	3	3
200	Shoveler, Cape	Kaapse Slopeend	<i>Anas smithii</i>	5.25	3	3
201	Shrike, Lesser Grey	Gryslaksman	<i>Lanius minor</i>	1.43	1	0
202	Shrike, Red-backed	Rooiruglaksman	<i>Lanius collurio</i>	4.345	2	0
203	Snipe, African	Afrikaanse Snip	<i>Gallinago nigripennis</i>	7.78	4	3
204	Sparrow, Cape	Gewone Mossie	<i>Passer melanurus</i>	82.79	5	4
205	Sparrow, House	Huismossie	<i>Passer domesticus</i>	59.125	4	4
206	Sparrow, Southern Grey-headed	Gryskopmossie	<i>Passer diffusus</i>	34.565	4	4
207	Sparrowhawk, Black	Swartsperwer	<i>Accipiter melanoleucus</i>	2.26	3	3
208	Sparrowhawk, Little	Kleinsperwer	<i>Accipiter minullus</i>	1.59	3	3
209	Sparrowhawk, Ovambo	Ovambosperwer	<i>Accipiter ovampensis</i>	8.805	4	4
210	Spoonbill, African	Lepelaar	<i>Platalea alba</i>	11.07	3	0
211	Spurfowl, Swainson's	Bosveldfisant	<i>Pternistis swainsonii</i>	41.945	4	4
212	Starling, Cape Glossy	Kleinglansspreeu	<i>Lamprotonis nitens</i>	62.56	4	4
213	Starling, Pied	Witgatspreeu	<i>Spreo bicolor</i>	25.365	3	2
214	Starling, Red-winged	Rooivlerkspreeu	<i>Onychognathus morio</i>	15.315	4	1
215	Starling, Wattled	Lelspreeu	<i>Creatophora cinerea</i>	1.495	2	1
216	Stilt, Black-winged	Rooipootelsie	<i>Himantopus himantopus</i>	10.995	3	2
217	Stint, Little	Kleinstrandloper	<i>Calidris minuta</i>	2.77	3	0
218	Stonechat, African	Gewone Bontrokkie	<i>Saxicola torquatus</i>	50.925	4	4
219	Stork, Abdim's	Kleinswartooievaar	<i>Ciconia abdimii</i>	0.435	0	0
220	Stork, Black	Grootswartooievaar	<i>Ciconia nigra</i>	0.11	0	0
221	Stork, Marabou	Maraboe	<i>Leptoptilos crumeniferus</i>	0.14	0	0
222	Stork, Saddle-billed	Saalbekooievaar	<i>Ephippiorhynchus senegalensis</i>	0.02	0	0
223	Stork, White	Witooievaar	<i>Ciconia ciconia</i>	4.87	1	0
224	Stork, Yellow-billed	Nimmersat	<i>Mycteria ibis</i>	0.02	0	0
225	Sunbird, Amethyst	Swartsuikerbekkie	<i>Chalcomitra amethystina</i>	31.435	5	4
226	Sunbird, Malachite	Jangroentjie	<i>Nectarinia famosa</i>	0.98	1	1
227	Sunbird, White-bellied	Witpensuikerbekkie	<i>Cinnyris talatala</i>	14.68	4	4
228	Swallow, Barn	Europese Swael	<i>Hirundo rustica</i>	38.705	5	0
229	Swallow, Greater Striped	Grootstreepswael	<i>Hirundo cucullata</i>	42.695	5	4

230	Swallow, Lesser Striped	Kleinstreepswael	<i>Hirundo abyssinica</i>	24.11	4	4
231	Swallow, Red-breasted	Rooiborsswael	<i>Hirundo semirufa</i>	1.71	2	1
232	Swallow, White-throated	Witkeelswael	<i>Hirundo albigularis</i>	41.715	5	4
233	Swamp-warbler, Lesser	Kaapse Rietsanger	<i>Acrocephalus gracilirostris</i>	36.545	4	4
234	Swamphen, African Purple	Grootkoningriethaan	<i>Porphyrio madagascariensis</i>	10.385	2	2
235	Swift, African Black	Swartwindswael	<i>Apus barbatus</i>	1.97	2	0
236	Swift, Common	Europese Windswael	<i>Apus apus</i>	2.235	2	0
237	Swift, Horus	Horuswindswael	<i>Apus horus</i>	4.355	2	2
238	Swift, Little	Kleinwindswael	<i>Apus affinis</i>	38.185	4	4
239	Swift, White-rumped	Witkruiswindswael	<i>Apus caffer</i>	41.54	5	4
240	Tchagra, Black-crowned	Swartkroontjagra	<i>Tchagra senegalus</i>	2.265	2	2
241	Tchagra, Brown-crowned	Rooivlerktjagra	<i>Tchagra australis</i>	0.795	1	1
242	Teal, Cape	Teeleend	<i>Anas capensis</i>	1.405	1	1
243	Teal, Hottentot	Gevlekte Eend	<i>Anas hottentota</i>	1.25	1	1
244	Teal, Red-billed	Rooibekeend	<i>Anas erythrorhyncha</i>	5.87	3	3
245	Tern, Whiskered	Witbaardsterretjie	<i>Chlidonias hybrida</i>	4.01	2	0
246	Tern, White-winged	Witvlerksterretjie	<i>Chlidonias leucopterus</i>	1.94	1	0
247	Thick-knee, Spotted	Gewone Dikkop	<i>Burhinus capensis</i>	38.085	4	4
248	Thrush, Karoo	Geelbeklyster	<i>Turdus smithi</i>	72.53	4	4
249	Thrush, Kurrichane	Rooibeklyster	<i>Turdus libonyanus</i>	9.765	3	3
250	Tinkerbird, Yellow-fronted	Geelblestinker	<i>Pogoniulus chrysoconus</i>	0.045	3	3
251	Tit-babbler, Chestnut-vented	Bosveldtjeriktik	<i>Parisoma subcaeruleum</i>	13.99	2	2
252	Turtle-dove, Cape	Gewone Tortelduif	<i>Streptopelia capicola</i>	89.2	5	4
253	Vulture, Cape	Kransaasvoel	<i>Gyps coprotheres</i>	0.02	0	0
254	Wagtail, African Pied	Bontkwikkie	<i>Motacilla aguimp</i>	0.295	1	1
255	Wagtail, Cape	Gewone Kwikkie	<i>Motacilla capensis</i>	71.68	5	4
256	Warbler, Garden	Tuinsanger	<i>Sylvia borin</i>	2.485	1	0
257	Warbler, Marsh	Europese Rietsanger	<i>Acrocephalus palustris</i>	4.435	2	1
258	Warbler, River	Sprinkaansanger	<i>Locustella fluviatilis</i>	0.6	1	0
259	Warbler, Sedge	Europese Vleisanger	<i>Acrocephalus schoenobaenus</i>	0.905	1	0
260	Warbler, Willow	Hofsanger	<i>Phylloscopus trochilus</i>	19.83	4	0
261	Waxbill, Blue	Gewone Blousysie	<i>Uraeginthus</i>	0.22	2	2

			<i>angolensis</i>			
262	Waxbill, Common	Rooibeksysie	<i>Estrilda astrild</i>	25.825	5	4
263	Waxbill, Orange-breasted	Rooiassie	<i>Amandava subflava</i>	6.285	4	4
264	Weaver, Cape	Kaapse Wewer	<i>Ploceus capensis</i>	17.575	4	4
265	Weaver, Thick-billed	Dikbekwewer	<i>Amblyospiza albifrons</i>	26.125	4	4
266	Wheatear, Capped	Hoevelskaapwagter	<i>Oenanthe pileata</i>	4.4	2	2
267	Wheatear, Mountain	Bergwagter	<i>Oenanthe monticola</i>	16.625	2	2
268	White-eye, Cape	Kaapse Glasogie	<i>Zosterops virens</i>	78.16	5	4
269	White-eye, Orange River	Gariepglasogie	<i>Zosterops pallidus</i>	39.31	4	4
270	Whydah, Pin-tailed	Koningrooibekkie	<i>Vidua macroura</i>	28.25	5	4
271	Widowbird, Long-tailed	Langstertflap	<i>Euplectes progne</i>	26.705	4	4
272	Widowbird, Red-collared	Rooikeelflap	<i>Euplectes ardens</i>	12.365	4	4
273	Widowbird, White-winged	Witvlerkflap	<i>Euplectes albonotatus</i>	2.695	4	4
274	Wood-hoopoe, Green	Rooibekkekelaar	<i>Phoeniculus purpureus</i>	48.34	4	4
275	Woodpecker, Cardinal	Kardinaalspeg	<i>Dendropicos fuscescens</i>	9.875	4	4
276	Woodpecker, Golden-tailed	Goudstertspeg	<i>Campethera abingoni</i>	1.525	2	2
277	Wryneck, Red-throated	Draaihals	<i>Jynx ruficollis</i>	16.355	3	3
<b>Totals</b>				0	17 Species (6.2%)	60 Species (22.7%)
				1	52 Species (18.7%)	53 Species (19.2%)
				2	44 Species (15.9%)	29 Species (9.4%)
				3	53 Species (19.2%)	46 Species (16.6%)
				4	70 Species (25.2%)	85 Species (30.7%)
				5	41 Species (14.8%)	4 Species (1.4%)
<b>Total Red Data Species Recorded for 2628AA QDS</b>				23		

Habitat Preference – HP, Breeding –Br. Reporting Rate – Rep Rate %

The reporting rate is calculated as follows: Total number of cards on which a species was reported (SABAP1) x 100 ÷ total number of cards submitted for the particular grid cell + the total number of cards on which a species was reported (SABAP2) x 100 ÷ total number of cards submitted for the particular pentad ÷ 2.

**Red Data Bird Species**

Red Data bird species previously recorded within the 2628AA QDS according to Harrison et al (1997), Tarboton et al (1987) (Table 2).

**Table 2: Red Data bird species recorded for the 2628AA QDS to date.**

	Species name	Latest Date Record (Year)	Red Data: (Regional; Global)	Taxonomic name	Rep Rate (%)	HP	Br
1.	Crane, Blue	2016	NT, VU	<i>Anthropoides paradiseus</i>	0.5	0	0
2.	Duck, Maccoa	2015	NT, NT	<i>Oxyura maccoa</i>	1.08	1	1
3.	Eagle, Martial	Prior to 2007	EN, VU	<i>Polemaetus bellicosus</i>	0.02	0	0
4.	Eagle, Verreaux's	Prior to 2007	VU, LC	<i>Aquila verreauxii</i>	0.02	0	0
5.	Falcon, Lanner	2016	VU, LC	<i>Falco biarmicus</i>	0.62	1	0
6.	Falcon, Red-footed	2016	NT, NT	<i>Falco vespertinus</i>	0.14	1	0
7.	Flamingo, Greater	2015	NT, LC	<i>Phoenicopterus ruber</i>	1.96	1	0
8.	Flamingo, Lesser	Prior to 2007	NT, NT	<i>Phoenicopterus minor</i>	0.065	0	0
9.	Grass-owl, African	2012	VU, LC	<i>Tyto capensis</i>	0.38	0	0
10.	Kingfisher, Half-collared	2016	NT, LC	<i>Alcedo semitorquata</i>	0.405	2	2
11.	Korhaan, White-bellied	Prior to 2007	VU, LC	<i>Eupodotis senegalensis</i>	1.195	0	0
12.	Lark, Melodious	Prior to 2007	LC, NT	<i>Mirafrja cheniana</i>	0.15	1	1
13.	Marsh-harrier, African	Prior to 2007	EN, LC	<i>Circus ranivorus</i>	0.11	0	0
14.	Painted-snipe, Greater	Prior to 2007	NT, LC	<i>Rostratula benghalensis</i>	0.45	1	0
15.	Pratincole, Black-winged	Prior to 2007	NT, NT	<i>Glareola nordmanni</i>	0.02	0	0
16.	Roller, European	Prior to 2007	NT, LC	<i>Coracias garrulus</i>	0.15	0	0
17.	Secretarybird,	Prior to 2007	VU, VU	<i>Sagittarius serpentarius</i>	0.37	0	0
18.	Stork, Abdim's	Prior to 2007	VU, VU	<i>Ciconia abdimii</i>	0.435	0	0
19.	Stork, Black	Prior to 2007	VU, LC	<i>Ciconia nigra</i>	0.11	0	0
20.	Stork, Marabou	2015	NT, LC	<i>Leptoptilos crumeniferus</i>	0.14	0	0
21.	Stork, Saddle-billed	Prior to 2007	EN, LC	<i>Ephippiorhynchus senegalensis</i>	0.02	0	0
22.	Stork, Yellow-billed	Prior to 2007	EN, LC	<i>Mycteria ibis</i>	0.02	0	0
23.	Vulture, Cape	2013	EN, EN	<i>Gyps coprotheres</i>	0.02	0	0

**Red data species Categories for the Birds of Southern Africa (Birdlife South Africa 2015)**

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



A total of 23 Red Data species have previously been recorded within the 2628AA QDS (**Table 2**). Fourteen of which have not yet been recorded within the 2600\_2805 pentad since the commencement of the South African Bird Atlas Project 2 in 2007; therefore these species are highly unlikely to recur as they have not been recorded in the pentad within the past 9 years. This could be as a result of various factors such as, habitat loss, degradation or fragmentation. Nine of the 23 species have been recorded during the past five years, however, the reporting rates of these species are extremely low and they are unlikely to occur on the study area. Of the above named Red Data species, only the Half-collared Kingfisher could potentially be resident on the study area. The southern boundary of the study area borders the Jukskei River which could be considered the preferred habitat for the Half-collared Kingfisher. The stretch of the Jukskei River bordering the study area is however highly polluted, thus the probability of this species occurring is unlikely, however it's occurrence cannot be ruled out entirely. The water quality itself does not affect this species directly but rather its food source which in turn has a negative effect, forcing it move. The unlikely occurrence of this species can also be as a result of the variability of water levels and un-deterministic flooding of the river due to inappropriate storm water management. This will invariably affect the breeding habitat which could deter this species from utilising the area.

## 6. Findings

The distinct habitats identified on the study area contain a large variety of bird species, approximately 135, with habitats ranging from grassland, savanna, riverine, wetland associated species as well as species adapted to a disturbed and/ or transformed environments. Although some parts of the study area can be deemed as the preferred habitat for certain Red Data species previously recorded within the QDS, the surrounding land use and disturbance in the form of roads, urbanization, pollution and habitat transformation through alien vegetation infestation and man-made barriers, significantly reduces the probable occurrence of these mostly specialized and localized species. Only the Half-collared Kingfisher can be expected to occur on the study area provided that proper rehabilitation of the stretch of the Jukskei River bordering the Southern part of the study area is carried out.

## 7. Limitations

The bulk of the data used to conclude the distribution of Red Data species were sourced by making use of the SABAP 1 and 2 data basis. Any limitations in the above mentioned studies will in effect have implications on the findings and conclusion of this assessment. Furthermore this avifaunal assessment was conducted during April; hence the survey was done outside the main breeding period of the local bird species. Moreover, most of the Palearctic and intra-Africa migratory bird species have started their migration to the North by this time. With respect to this assessment the implications of not being able to record migratory bird species will be minimal, seeing as most are threatened in their Northern hemisphere distributions.

Limited time to conduct the survey could potentially result in not recording all species within the study area. Three and a half hours were spent on site while conducting this avifaunal assessment. As a result of the small size of the study area as well as the amount of disturbance on the study area, three hours was deemed sufficient time to record all the resident bird species on and around the study area.

## 8. Recommendations

- Prior to any activities commencing on site, all construction staff should be briefed in an environmental induction regarding the environmental status and requirements of the site. This should include providing general guidelines for minimizing environmental damage during construction, as well as education with regards to basic environmental ethics, such as the prevention of littering, lighting of fires, etc.
- Induction should be done for all civil contractors and for each building contractor prior to them commencing on site.
- Areas where construction is to take place should be clearly demarcated and fenced off, all areas outside that of the defined works should be deemed no-go areas.
- All construction activities must be restricted to the demarcated areas to ensure that no further disturbance into the surrounding vegetation or habitat takes place.
- It is recommended that prior to the commencement of construction activities' initial clearing of all alien vegetation should take place.
- No vehicles should be allowed to move in or through the drainage line. This will cause destruction of faunal habitat and will leave notable scares on site.
- The contractor must ensure that no faunal species are trapped, killed or in any way disturbed during construction. Collecting of eggs such as Guineafowl and duck eggs present on site should not be tolerated.
- It is recommended that all concrete and cement works be restricted to areas of low ecological sensitivity and defined on site and clearly demarcated. Cement powder has a high alkalinity pH rating, which can contaminate and affect both soil and water pH dramatically. A shift in the pH can have serious consequences on the functioning of soil, vegetation and fauna.
- To ensure minimal disturbance of avifaunal species it is recommended that construction should take place during winter, outside the breeding season of the species present on site.
- Construction, vegetation clearing and top soil clearing should commence from a predetermined location and gradually commence to ensure that birds and other fauna present on the site have enough time to relocate.
- When construction is completed, disturbed areas should be rehabilitated using vegetation cleared prior to construction to ensure that the habitat stays intact and that faunal species present on the site before construction took place, return to the area.
- The section of the Jukskei River bordering the study area on the South should be rehabilitated and pollution prevention method must be put in place to prevent further degradation of the habitat.
- It is recommended that no construction takes place within 32 meters of the Jukskei River as well as within 32 meters of the western edge of the drainage line, as this area contains signs of a seasonal wetland. The Eastern side of the drainage line does not require a buffer.

## 9. Conclusion

The largest part of the study area supports a number of widespread grassland bird species such as Widowbirds, Bishops, Lapwings and Weaver with other species like African Stonechat, Pipits and Cape Longclaw scattered throughout the study area at a lower frequency. Other species such as Dark-capped Bulbul, Karoo Thrush, Barbets, Southern Boubou, Flycatchers, Honeyguides, etcetera occurring on the study area are mostly confined to the Rocky outcrop and the Riverine area where large indigenous and alien trees are present. These species include; Cisticolas, Prinias, Bulbuls, Dove's, Ducks, Ibis etc. None of the bird species recorded or considered to have a high occurrence probability is of conservation concern.

The Riverine area and the Drainage Line do however provide the optimal habitat for a number of widespread species and the Riverine area could potentially support the Red-listed Half-collared Kingfisher. For these reasons the Riverine area and Drainage line are considered to be of high ecological sensitivity.

Due to the near natural state of the habitat, the Eastern Grassland and the Rocky outcrop was deemed to have moderate sensitivity in terms of avifauna richness, the rest of the study area was judged to have a low ecological and avifaunal sensitivity level (**Figure 9**). Should development take place, it is suggested that no disturbance occurs within the Riverine and Drainage line areas. None of the 23 Red Data avifaunal species recorded for the 2628AA QDS are likely to occur on the study area, with the exception of the Half-collared Kingfisher, provided that proper rehabilitation of the Riverine area is implemented. Most of the Red Data species recorded for the 2628AA QDS were recorded before 2007 of which many of these species were probably not recorded on the study area. Although the Riverine habitat is the preferred habitat for the Half-collared Kingfisher, this bird is unlikely to occur as a result of the highly polluted state of the river. In conclusion, apart from the Half-collared Kingfisher, no evidence in the form of suitable breeding, roosting and foraging habitat was found on the study area to support the presence or probable occurrence of any Red Data avifaunal species.

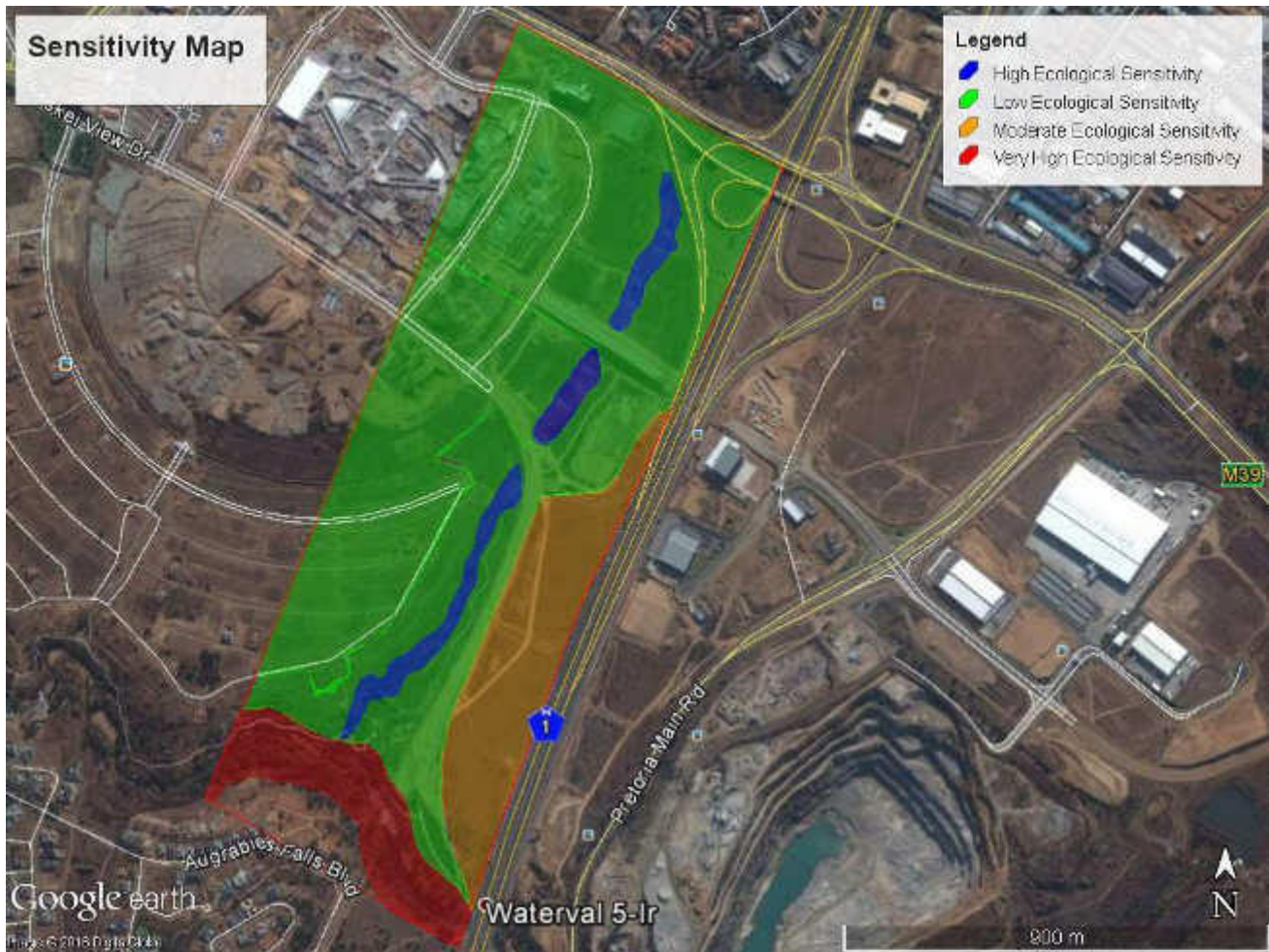


Figure 9: Avifaunal Sensitivity Map

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# **Annexure N**

## Environmental Management Plan



# Final Environmental Management Programme (EMPr) For Portions of the Remainder of Portion 1 of the Farm Waterval 5IR



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## 1. Project Outline

### 1.1 Background

*Bokamoso Landscape Architects and Environmental Consultants CC* were appointed by Atterbury Waterfall Investment Company (PTY) LTD to conduct an Amendment **Environmental Authorisation** for the Proposed Mixed-use Development for which Environmental Authorisation was granted under Reference Number GAUT 002/05-06/1476.

This is a Draft Environmental Management Programme (EMPr), as part of the Amendment Application, and it will be finalised when the Impact Assessment has been completed and more detail on associated impacts are available.

### 1.2 Project description

The Proposed Mixed-use Development is situated on portions of the Remainder of Portion 1 of the Farm Waterval 5IR in Midrand, Gauteng, just south of Allandale Road and west of the N1 freeway. The study site falls in the jurisdiction of the City of Johannesburg Metropolitan Municipality. *(Refer to Figure 1 for the Locality Map and Figure 2 for the Aerial Map).*

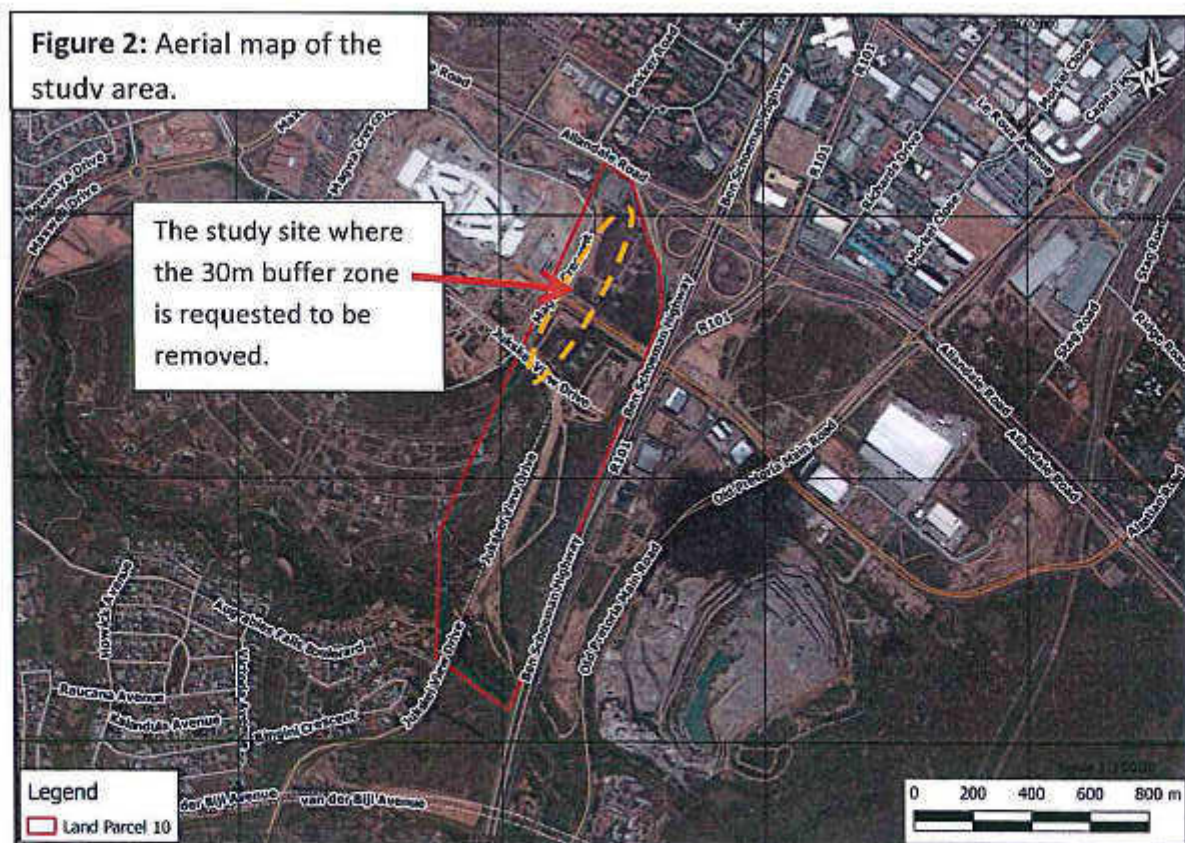
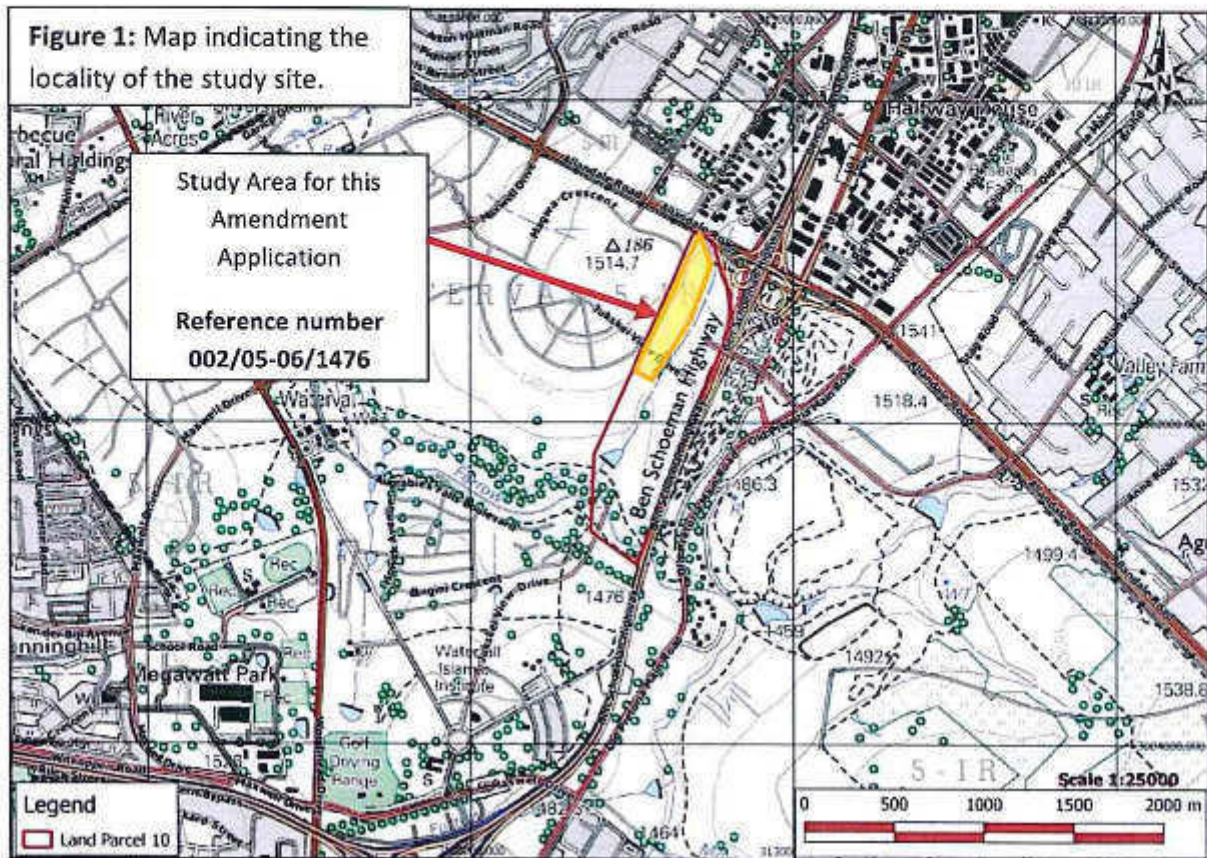
#### **Timeframe for construction:**

The construction timeframe for the development that will encroach onto the 30m wetland buffer will be determined by the potential tenants/ new occupants of the structures to be erected. The applicant already negotiated with several big tenants that are interested to occupy the proposed new structures, but the construction and occupation timeframes of the various tenants/ occupants can only be finalized once delegated authority agreed to the relaxation of the 30m buffer,

At this stage the applicant is planning to develop the area within the next 5-10 years and the storm water management and rehabilitation measures will be implemented per phase to be developed. It is also important to note that the some of the maintenance and rehabilitation measures will be applied from the outset and will be implemented in an on-going basis. The measures to be implemented in an on-going basis are highlighted in green in the EMPr to follow. This EMPr will be a binding document for purposes of compliance.

**Take note:** There is already an approved Rehabilitation Plan and EMPr for the study area and no amendments to these plans will be required. However, a new Rehabilitation Plan and EMPr which will specifically be applicable to the relaxation of the 30m buffer area, potential impacts associated with the proposed development activities within the 30m buffer and to additional rehabilitation works and proposed mitigation measures required within the watercourse to accommodate the hydrological changes. This will be submitted as part of the amendment environmental authorisation, Bokamoso therefore request that

GDARD regard this as supplementary documentation to the existing Rehabilitation Plan and EMPr which have already been approved and implemented in the former authorisations.



### 1.3 Receiving Environment

#### Hydrology:

- A perennial river and man-made/ artificial wetland occurs within the study area.
- The perennial river is situated downstream (south of the study area) of the wetland. Dr. Johan van der Waals wrote a 2-pager as requested by the GDARD for the impacts of the proposed development on the downstream watercourse and suggested mitigation measures.

#### Wetland:

- The *Hydropedology based Wetland Buffer Assessment and Management Report* done by *TerraSoil Science* indicate that the wetland area has been transformed significantly through historical anthropological activities in the form of urban infrastructure development and storm water modifications
- The water course/wetland area towards the north of the study area has been rehabilitated to accommodate more water and attenuate water energy and flow.
- The site requires very significant and focussed storm water planning and intervention for the stabilisation of the watercourse as well as prevention of sediment generation.
- Further downstream rehabilitation will be needed to compensate for the additional storm water runoff created by the removal of the wetland buffer. The Civil engineer included a bio-swale downstream for the additional storm water run-off as well as gabion structures to prevent erosion and ensure stability of the system downstream.

#### Geology and Soils:

- The Halfway House Granite Dome Catena is a well-studied example of a quartz dominated Bb catena.
- The soils in the drainage feature are predominantly high clay content swelling soils with vertic properties.
- Vertic soils are highly erodible once disturbed which could cause rapid degradation of the watercourse once storm water volumes increase following surface sealing in the wetland buffer zone and its surrounding areas.

#### Flora:

The Proposed Development falls in the Egoli Granite Grassland vegetation unit which is regarded as Endangered (Mucina and Rutherford, 2006). According to *Bokamoso Environmental Specialist Division* the rehabilitated wetland area is dominated by *Cyperus sp.*, *Fuirena sp.*, *Imperata cylindrical*, *Schoenoplectus sp.*, and *Typha capensis*. Some alien species such as *Ipomoea purpurea*, *Tagetes minuta*, *Verbena spp.* and

*Xanthium spinosum* also occur. Indigenous trees such as *Celtis africana*, *Combretum erythrophyllum*, *Olea europaea* subsp. *africana*, *Searsia lancea* and *Vachellia karroo* were planted on the embankments of the wetland to stabilise the soil.

#### **Fauna:**

All the fauna studies were conducted by **Bokamoso Environmental: Specialist Division**. Both the drainage line and the riverine habitat provide important ecological functions in terms of connectivity and as such both are considered to be highly sensitive from a faunal perspective regardless of their current state.

#### **Birds**

Birds species that can possibly occur in and around the study area include Widowbirds, Bishops, Lapwings, Weaver, African Stonechat, Pipits Dark-capped Bulbul, Karoo Thrush, Barbets, Southern Boubou, Flycatchers, Honeyguides and Cape Longclaw. None of the bird species recorded or considered to have a high occurrence probability is of conservation concern; however the Jukskeiriver could potentially support the Red-listed Half-collared Kingfisher. None of the 23 Red Data avifaunal species recorded for the 2628AA QDS are likely to occur on the study area, with the exception of the Half-collared Kingfisher, provided that proper rehabilitation of the riverine area is implemented. In addition, the wetland area provides the optimal habitat for a number of widespread species. Both the riverine and wetland area is considered to be of high importance for the protection of avifauna species.

#### **Mammals**

The drainage line and riverine habitat have the potential to support sensitive species and/or species with conservation concerns (Vlei Rats and Otters). None of these species are believed to occur at present on account of the fairly recent construction activities within with the drainage line as well as the polluted and degraded state of the riverine habitat. No Red-listed mammal species was recorded for this site, however both the riverine and wetland area is considered to be of high importance for the protection of mammal species.

#### **Amphibians and Reptiles**

Five species of amphibians and three species of reptiles were given a high probability of occurring in the riverine area. No threatened species is known to occur in the area.

#### **Invertebrates:**

The presence of aquatic invertebrate species provides immediate evidence for the existence of a watercourse. Species such as *Crocothemis* which are dependent on wetland habitats makes it necessary to preserve the wetland. No sensitive invertebrate species were recorded or are expected to occur within the study area.

**Visual:**

The Proposed Development will consist of numerous prominent building structures which will be highly visible to the surrounding area, including the Ben Schoeman N1 highway. However, the proposed development is situated on probably one of the busiest areas in the country (between Pretoria and Johannesburg in the highest economic province in the country) will improve the aesthetic value of the area and may even contribute to the 'sense of place' if adequate measures as described later in this document are taken into consideration.

## 2. EMPr Objectives and context

### Objectives

The objectives of this plan are to:

- Identify the possible environmental impacts of the proposed activity;
- Develop measures to minimise, mitigate and manage these impacts;
- Meet the requirements of the Environmental Authorisation of GDARD and requirements of other Authorities; and
- Monitor the project.

### EMPr context

This EMPr fits into the overall planning process of the project by carrying out the conditions of consent set out by the Gauteng Department of Agriculture and Rural Development. In addition, all mitigation measures recommended in the Amended Environmental Authorisation report should also be adhered to.

This EMPr addresses the following two phases of the development:

- Construction phase; and
- Operational phase.

## 3. Monitoring

In order for the EMPr to be successfully implemented all the role players involved must have a clear understanding of their roles and responsibilities in the project.

These role players may include the Authorities (A), other Authorities (OA), Developer/ Proponent (D), Environmental Control Officer (ECO), Project Manager (PM), Contractors (C),

Environmental Assessment Practitioner (EAP) and Environmental Site Officer (ESO). Landowners, Interested and Affected Parties (I&APs) and the relevant environmental and project specialists are also important role players.

### **3.1 Roles and responsibilities**

#### **Developer (D)**

The developer is ultimately accountable for ensuring compliance with the EMP and conditions contained in the Environmental Authorisation. The developer must appoint an independent Environmental Control Officer (ECO), for the duration of the pre-construction and construction phases, to ensure compliance with the requirements of this EMPr. The developer must ensure that the ECO is integrated as part of the project team.

#### **Project Manager (PM)**

The Project Manager is responsible for the coordination of various activities and ensures compliance with this EMPr through delegation of the EMPr to the contractors and monitoring of performance as per the Environmental Control Officer's monthly reports.

#### **Environmental Control Officer (ECO)**

An independent Environmental Control Officer (ECO) shall be appointed, for the duration of the pre-construction and construction phases of the development, by the developer to ensure compliance with the requirements of this EMPr.

- The Environmental Control Officer shall ensure that the contractor is aware of all the specifications pertaining to the project.
- Any damage to the environment must be repaired as soon as possible after consultation between the Environmental Control Officer, Consulting Engineer and Contractor.
- The Environmental Control Officer shall ensure that the developer staff and/or contractor are adhering to all stipulations of the EMPr.
- The Environmental Control Officer shall be responsible for monitoring the EMP throughout the project by means of site visits and meetings. This should be documented as part of the site meeting minutes.
- The Environmental Control Officer shall be responsible for the environmental training program.

- The Environmental Control Officer shall ensure that all clean up and rehabilitation or any remedial action required, are completed prior to transfer of properties.
- A post construction environmental audit is to be conducted to ensure that all conditions in the EMPr have been adhered to.

#### **Contractor (C):**

The contractors shall be responsible for ensuring that all activities on site are undertaken in accordance with the environmental provisions detailed in this document and that the sub-contractors and laborers are duly informed of their roles and responsibilities in this regard.

The contractor will be required, where specified to provide Method Statements setting out in detail how the management actions contained in the EMPr will be implemented.

The contractors will be responsible for the cost of rehabilitation of any environmental damage that may result from non-compliance with the environmental regulations.

#### **Environmental Site Officer (ESO):**

The ESO is appointed by the developer and then finally the home owner as his/her environmental representative to monitor, review and verify compliance with the EMPr by the contractor. The ESO is not an independent appointment but must be a member of the contractor's management team. The ESO must ensure that he/she is involved at all phases of the construction (from site clearance to rehabilitation).

#### **Authority (A):**

The authorities are the relevant environmental department that has issued the Environmental Authorization. The authorities are responsible for ensuring that the monitoring of the EMPr and other authorization documentation is carried out by means of reviewing audit reports submitted by the ECO and conducting regular site visits.

#### **Other Authorities (OA):**

Other authorities are those that may be involved in the approval process of the EMPr.

#### **Environmental Assessment Practitioner (EAP):**

According to Section 1 of NEMA the definition of an Environmental Assessment Practitioner is "the individual responsible for the planning, management and coordination of Environmental Impact Assessments, Strategic Environmental Assessments, Environmental Management Programmes or any other appropriate environmental instruments through regulations".



### **3.2 Lines of Communication**

The Environmental Control Officer in writing should immediately report any breach of the EMPr to the Project Manager. The Project Manager should then be responsible for rectifying the problem on-site after discussion with the contractor. Should this require additional cost, then the developer should be notified immediately before any additional steps are taken.

### **3.3 Reporting Procedures to the Developer**

Any pollution incidents must be reported to the Environmental Control Officer immediately (within 12 hours). The Environmental Control Officer shall report to the Developer on a regular basis (site meetings).

### **3.4 Site Instruction Entries**

The site instruction book entries will be used for the recording of general site instructions as they relate to the works on site. There should be issuing of stop work order for the purposes of immediately halting any activities of the contractor that may pose environmental risk.

### **3.5 ESA/ESO (Environmental Site Officer) Diary Entries**

Each of these books must be available in duplicate, with copies for the Engineer and Environmental Site Officer. These books should be available to the authorities for inspection or on request. All spills are to be recorded in the ESA/Environmental Site Officer's diary.

### **3.6 Methods Statements**

Methods statements from the contractor will be required for specific sensitive actions on request of the authorities or ESA/ESO (Environmental Site Officer). All method statements will form part of the EMPr documentation and are subject to all terms and conditions contained within the EMPr document. For each instance wherein it is requested that the contractor submit a method statement to the satisfaction of ESA/ESO, the format should clearly indicate the following:

- What – a brief description of the work to be undertaken
- How – a detailed description of the process of work, methods and materials
- Where – a description / sketch map of the locality of work; and
- When – the sequencing of actions with due commencement dates and completion date estimate.

The contractor must submit the method statement before any particular construction activity is due to start. Work may not commence until the method statement has been approved by the ESA/ESO.

### 3.7 Record Keeping

All records related to the implementation of this Management Programme (e.g. site instruction book, ESA/ESO diary, methods statements etc.) must be kept together in an office where it is safe and can be retrieved easily. These records should be kept for two years at any time be available for scrutiny by any relevant authorities.

### 3.8 Acts

#### 3.8.1 The National Water Act, 1998 (Act No: 36 of 1998)

The purpose of this Act is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways that take into account, amongst other factors, the following:

- Meeting the basic human needs of present and future generations;
- Promoting equitable access to water;
- Promoting the efficient, sustainable and beneficial use of water in the public interest;
- Reducing and preventing pollution and degradation of water resources;
- Facilitating social and economic development; and
- Providing for the growing demand for water use.

#### Impact on proposed Development:

This impact is not considered significant. The site borders a perennial river system and a rehabilitated wetland occurs on site. It will be necessary to apply for an amendment of the existing Section 21 (c) and (i) water-use licenses issued for the study area.

#### 3.8.2 Atmospheric Pollution Prevention Act (Act 45 of 1965)

The NEM: AQA serves to repeal the Atmospheric Pollution Prevention Act (45 of 1965) and various other laws dealing with air pollution and it provides a more comprehensive framework within which the critical question of air quality can be addressed.

The purpose of the Act is to set norms and standards that relate to:

- Institutional frameworks, roles and responsibilities
- Air quality management planning
- Air quality monitoring and information management
- Air quality management measures
- General compliance and enforcement

Amongst other things, it is intended that the setting of norms and standards will achieve the following:

- The protection, restoration and enhancement of air quality in South Africa
- Increased public participation in the protection of air quality and improved public access to relevant and meaningful information about air quality
- The reduction of risks to human health and the prevention of the degradation of air quality.

The Act describes various regulatory tools that should be developed to ensure the implementation and enforcement of air quality management plans. These include:

- Priority Areas, which are air pollution 'hot spots'
- Listed Activities, which are 'problem' processes that require an Atmospheric Emission License
- Controlled Emitters, which includes the setting of emission standards for 'classes' of emitters, such as motor vehicles, incinerators, etc.
- Control of Noise
- Control of Odours.

#### **Impact on proposed Development:**

Not significant - The Act has relevance to the proposed development during the construction phase. Dust pollution could be a concern primarily during the construction phase of the proposed project. Dust control would be adequately minimised during this phase by way of water spraying and possible dust-nets, when working close to existing residential dwellings or roads/highways. It is not foreseen that the proposed development would contribute significantly to pollution in terms of emissions and noise during its operational phase.

#### **3.8.3 National Environmental Management Act (Act 107 of 1998)**

The NEMA is primarily an enabling Act in that it provides for the development of environmental implementation plans and environmental management plans. The principles listed in the act serve as a general framework within which environmental management and implementation plans must be formulated.

The principles in essence state that environmental management must place people and their needs at the forefront of its concern and that development must be socially, environmentally and economically sustainable.

**Impact on proposed Development:**

Significant - Section 28 (1) of NEMA stated that every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.

The EMP is compiled in terms of Section 28 of NEMA.

**3.8.4 The National Environmental Management: Waste Act (Act 59 of 2008)**

This Act came into effect on 11 June 2009. It aims to consolidate waste management in South Africa, and contains a number of commendable provisions, including:

- The establishment of a national waste management strategy, and national and provincial norms and standards for, amongst others, the classification of waste, waste service delivery, and tariffs for such waste services;
- Addressing reduction, reuse, recycling and recovery of waste;
- The requirement for industry and local government to prepare integrated waste management plans;
- The establishment of control over contaminated land;
- Identifying waste management activities that requires a licence, which currently include facilities for the storage, transfer, recycling, recovery, treatment and disposal of waste on land;
- Co-operative governance in issuing licenses for waste management facilities, by means of which a licensing authority can issue an integrated or consolidated license jointly with other organs of state that has legislative control over the activity; and
- The establishment of a national waste information system.

On 3 July 2009 the Minister of Environmental Affairs and Tourism promulgated a list of waste management activities that might have a detrimental effect on the environment. These listed activities provide the activities that require a Waste Management License. Two

Categories is specified: Category A and Category B. As part of Category A Waste Management License application a Basic Assessment in terms of Section 24(5) of the National Environmental Management Act (Act 107 of 1998) must be submitted to the relevant Authority. As part of a Category B Waste Management License a Scoping and EIA process in terms of Section 24(5) of the National Environmental Management Act (Act 107 of 1998) must be followed and submitted to the relevant Authority. On 29 November 2013 the Minister of Environmental Affairs and Tourism amended the list of waste activities that might be detrimental to the environment.

**Impact on proposed Development:**

This impact is not considered significant. No Waste Management License is expected to be required during the construction or operational phase of the proposed development.

**3.8.5 The Municipal Systems Act (Act 32 of 2000)**

This Act was introduced to provide for the core principles, mechanisms and processes that are necessary to enable municipalities to move progressively towards the social and economic upliftment of local communities, and ensure universal access to essential services that are affordable to all.

The proposed development will support the local authority in complying with the principles of the Municipal Systems Act, by assisting in providing the community with essential services, such as water and sewage infrastructure.

**Impact on proposed Development:**

Significant - The proposed development will contribute to the municipal services in the area.

**3.8.6 National Veld and Forest Fire Act, 1998 (Act No. 101, 1998)**

The purpose of this Act is to prevent and combat veld, forest and mountain fires throughout the Republic. Furthermore, the Act provides for a variety of institutions, methods and practices for achieving the prevention of fires.

**Impact on proposed Development:**

Significant - Fires of construction workers may only be lit in the designated site camp as indicated in assistance with the ECO. It is important that a site development camp be located on a part of the application site that is already disturbed.

### **3.8.7 Conservation of Agricultural Resources Act (Act No. 43 of 1983)**

This Act provides for control over the utilization of the natural agricultural resources of the Republic in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected therewith.

#### **Impact on proposed Development:**

This impact is not considered significant. According to the Gauteng Agriculture Potential Atlas (GAPA 3) the study area has a very low agricultural potential.

### **3.8.8 National Environmental Management Act: Biodiversity Act (Act No. 10 of 2004)**

The purpose of the Biodiversity Act is to provide for the management of South Africa's biodiversity within the Framework of the NEMA and the protection of species and ecosystems that warrant National protection. As part of the implementation strategy, the National Spatial Biodiversity Assessment was developed.

#### **Impact on proposed Development:**

This impact is not considered significant. Majority of the study area is regarded as degraded with some illegal dumping taking place in the Jukskeiriver. Some areas along the N4 highway is regarded as sensitive such as rocky outcrops and in addition to this area, the drainage line/watercourse should be regarded as sensitive.

### **3.8.9 National Spatial Biodiversity assessment**

The National Spatial Biodiversity Assessment (NSBA) classifies areas as worthy of protection based on its biophysical characteristics, which are ranked according to priority levels.

#### **Impact on proposed Development:**

Not Significant – Even though the proposed development is situated within the Endangered Egoli Granite Grassland vegetation type according to Mucina and Rutherford (2006) the natural vegetation of the study area is almost completely transformed.

### **3.8.10 Protected Species – Provincial Ordinances**

Provincial ordinances were developed to protect particular plant species within specific provinces. The protection of these species is enforced through permitting requirements associated with provincial lists of protected species. Permits are administered by the Provincial Departments of Environmental Affairs.

#### **Impact on proposed Development:**

Not significant – No Red List species were recorded on the study site. However, the wetland/watercourse and the perennial river towards the south of the study area should be regarded as sensitive.

### **3.8.11 National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003)**

The purpose of this Act is to provide for the protection, conservation and management of ecologically viable areas representative of South Africa's biological biodiversity and its natural landscapes.

#### **Impact on proposed Development:**

Not significant - The Application site is not located within any conservancy or protected area.

### **3.8.12 Heritage Act**

The National Heritage Resources Act legislates the necessity and heritage impact assessment in areas earmarked for development, which exceed 0.5ha. The Act makes provision for the potential destruction to existing sites, pending the archaeologist's recommendations through permitting procedures. Permits are administered by the South African Heritage Resources Agency (SAHRA).

**Impact on proposed Development:**

Not significant- No cultural/historical significant areas were identified with in the application site and thus no areas of historical or cultural value will be affected.

**3.8.13 Gauteng Province Environmental Management Framework (GPEMF)**

The newly enacted GPEMF replaces all other Environmental Management Frameworks in the Gauteng Province, in terms of Regulation 5(4) of the Environmental Management Framework Regulations, 2010, published under Government Notice R547 in *Gazette* 33306 on 18 June 2010.

**Impact on proposed Development:**

From an institutional point of view, this site is also regarded as strategically located for urban development. The newly enacted Gauteng Provincial Environmental Management Framework (GPEMF) placed the study area in Zone 1, which is an area in which development infill, densification and the concentration of urban development within the urban development zones will be supported and promoted. In this zone applicants are exempted from certain EIA Related listed activities, but the listed activities associated with a watercourse/ wetland will however still remain applicable.

**3.8.14 Gauteng Conservation Plan (C-Plan)**

A systematic conservation plan for the Gauteng Province was undertaken by Gauteng Nature Conservation, a division within the Gauteng department of Agriculture and Rural Development (GDARD). The Gauteng Conservation Plan version 3.3 (Gauteng C-Plan v3.3) was released in February 2012, and a technical report was made available in March 2014.

**Impact on proposed Development:**

Not significant – In the C-Plan, the study site is located in an important area. This is based on suitable habitat for Red and Orange List plant species and is considered as primary vegetation. However, only one Orange List species (*Hypoxis hemerocallidea*) was recorded during the plant species survey.



#### 4. Project activities

##### 4.1 Construction Phase

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
Contractors Camp	Vegetation and topsoil	To minimize damage to and loss of vegetation and retain quality of topsoil	<p>1) Site to be established under supervision of ECO.</p> <p>2) Clearing and relocation of plants to be undertaken in accordance with site specific requirements.</p>	Minimal vegetation removed/damaged during site activities.	Contractor	As and when required
	Surface and ground water pollution	To minimize pollution of surface and Groundwater resources.	<p>1) Sufficient and temporary facilities including ablution facilities must be provided for construction workers operating on the site.</p> <p>2) A minimum of one chemical toilet shall be provided per 10 persons.</p> <p>The contractor shall keep the toilets in a clean, neat and hygienic condition.</p> <p>Toilets provided by the contractor must be easily accessible and a maximum of 50m from the works area to ensure they are</p>	<ul style="list-style-type: none"> <li>• Effluents managed effectively.</li> <li>• No pollution of water resources from site.</li> <li>• Workforce use toilets provided.</li> </ul>	Contractor; ESO	As and when required

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			<p>utilized. The contractor (who must use reputable toilet-servicing company) shall be responsible for the cleaning, maintenance and servicing of the toilets. The contractor (using reputable toilet-servicing company) shall ensure that all toilets are cleaned and emptied before the builders' or other public holidays.</p> <p>3) No person is allowed to use any other area than chemical toilets.</p> <p>4) No French drain systems may be installed.</p> <p>5) No chemical or waste water must be allowed to contaminate the run-off on site.</p> <p>6) Avoid the clearing of the site camp (of specific phase) or paved surfaces with soap.</p>			
		To minimize pollution of surface and Groundwater resources due to spilling of	<p>1) Drip trays and/ or lined earth bunds must be provided under vehicles and equipment, to contain spills of hazardous materials such as fuel, oil and cement.</p> <p>2) Repair and storage of vehicles only within</p>	No pollution of the environment	Contractor; ESO	Daily

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		materials.	<p>the demarcated site area.</p> <p>3) Spill kits must be available on site.</p> <p>4) Oils and chemicals must be confined to specific secured areas within the site camp. These areas must be banded with adequate containment (at least 1.5 times the volume of the fuel) for potential spills or leaks.</p> <p>5) All spilled hazardous substances must be contained in impermeable containers for removal to a licensed hazardous waste site.</p> <p>6) No leaking vehicle shall be allowed on site. The mechanic/ the mechanic of the appointed contractor must supply the environmental officer with a letter of confirmation that the vehicles and equipment are leak proof.</p> <p>7) No bins containing organic solvents such as paints and thinners shall be cleaned on site, unless containers for liquid waste disposal are placed for this purpose on site.</p>			
		To minimize	The mixing of concrete shall only be done at	No evidence of	Contractor;	Daily

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		pollution of surface and groundwater resources by cement	specifically selected sites, as close as possible to the entrance, on mortar boards or similar structures to prevent run-off into drainage lines, streams and natural vegetation.	contaminated soil on the construction site.	ESO	
		To minimize pollution of surface and Groundwater resources due to effluent.	No effluent (including effluent from any storage areas) may be discharged into any water surface or ground water resource.	No evidence of contaminated water resources.	Contractor; ESO	Daily
	Pollution of the environment	To prevent unhygienic usage on the site and pollution of the natural assets.	<p>1) Weather proof waste bins must be provided and emptied regularly.</p> <p>2) The contractor shall appoint labourers to clean up the contractor's camp and construction site on a daily basis.</p> <p>3) Temporary waste storage points on the site should be determined. THESE AREAS SHALL BE PREDETERMINED AND LOCATED IN AREAS THAT IS ALREADY DISTURBED. These storage points should be accessible by waste removal trucks and these points should be located in already disturbed areas</p>	<p>No waste bins overflowing</p> <p>No litter or building waste lying in or around the site</p>	Contractor; ESO	Daily Weekly

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			<p>/areas not highly visible from the properties of the surrounding land-owners/ in areas where the wind direction will not carry bad odours across the properties of adjacent landowners. This site should comply with the following:</p> <ul style="list-style-type: none"> <li>• Skips for the containment and disposal of waste that could cause soil and water pollution, i.e. paint, lubricants, etc.;</li> <li>• Small lightweight waste items should be contained in skips with lids to prevent wind littering;</li> <li>• Bunded areas for containment and holding of dry building waste.</li> </ul> <p>4) No solid waste may be disposed of on the site.</p> <p>5) No waste materials shall at any stage be disposed of in the open veld of adjacent properties.</p> <p>6) The storage of solid waste on the site, until such time as it may be disposed of, must be in a manner acceptable to the local authority and DWS.</p>			

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			7) Cover any wastes that are likely to wash away or contaminate storm water.			
		Recycle material where possible and correctly dispose of unusable wastes	<p>1) Waste shall be separated into recyclable and non-recyclable waste, and shall be separated as follows:</p> <ul style="list-style-type: none"> <li>• General waste: including (but not limited to) construction rubble,</li> <li>• Reusable construction material.</li> </ul> <p>2) Recyclable waste shall preferably be deposited in separate bins.</p> <p>3) All solid waste including excess spoil (soil, rock, rubble etc.) must be removed to a permitted waste disposal site on a weekly basis.</p> <p>4) No bins containing organic solvents such as paints and thinners shall be cleaned on site, unless containers for liquid waste disposal are placed for this purpose on site.</p> <p>5) Keep records of waste reuse, recycling and disposal for future reference. Provide information to ECO.</p>	<p>Sufficient containers available on site</p> <p>No visible signs of pollution</p>	Contractor; ESO	Daily Weekly

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
	Waste	To keep the site clean and tidy. To ensure waste enters the appropriate waste stream in order to optimize recycling opportunities.	<ol style="list-style-type: none"> <li>1) Rubble must be removed from the construction site frequently and be disposed of at an approved dumping site.</li> <li>2) Sufficient and covered containers must be available on the construction site.</li> <li>3) Such containers are to be emptied frequently.</li> <li>4) All liquid effluent is to be disposed of in a manner approved of by the Local Authority.</li> <li>5) Material to be used as backfill during a later stage of the building construction must be covered with a layer of soil to prevent litter from being blown over the site and to prevent unhygienic conditions.</li> <li>6) Chemical containers and packaging brought onto the site must be removed for disposal at a suitable site.</li> <li>7) The burning of waste is prohibited.</li> <li>8) Where possible, waste must be separated into clearly marked containers and subsequent recycling thereof must be a</li> </ol>		Contractor	Monitor daily

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			priority.			
	Increased fire risk to site and surrounding areas	To decrease fire risk.	<ol style="list-style-type: none"> <li>1) Fires shall only be permitted in specifically designated areas and under controlled circumstances.</li> <li>2) Food vendors shall be allowed within specified areas.</li> <li>3) No wood may be collected from the site for fires.</li> <li>4) Fire extinguishers to be provided in all vehicles and fire beaters must be available on site.</li> <li>5) Emergency numbers/ contact details must be available on site, where applicable.</li> </ol>	No open fires on site that have been left unattended	Contractor	Monitor daily
Construction site	Geology and soils	To protect underground services from alkaline or corrosive attack.	Underground services should be treated appropriately prior to installation.	Underground services are not being corroded	Contractor	Monitor regularly/ as required
		To prevent the damage of the existing soils and	1) The top layer of all areas to be excavated for the purposes of construction shall be stripped and stockpiled in areas where this	Excavated materials correctly	Contractor	Monitor daily



TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		geology.	<p>material will not be damaged, removed or compacted.</p> <p>2) All surfaces that are susceptible to erosion, shall be protected either by cladding with biodegradable material or with the top layer of soil being seeded with grass seed/planted with a suitable groundcover.</p>	<p>stockpiled</p> <p>No signs of erosion</p>		
		<p>To prevent the loss of topsoil</p> <p>To prevent siltation &amp; water pollution.</p>	<p>1) Stockpiling will only be done in designated places where it will not interfere with the natural drainage paths of the environment.</p> <p>2) In order to minimize erosion and siltation and disturbance to existing vegetation, it is recommended that stockpiling be done/equipment is stored in already disturbed/exposed areas.</p> <p>3) Cover stockpiles and surround downhill sides with a sediment fence to stop materials washing away.</p> <p>4) Remove vegetation only in areas</p>	<p>Excavated materials correctly stockpiled</p> <p>No visible signs of erosion and sedimentation</p> <p>Minimal invasive weed growth</p> <p>Vegetation only</p>	<p>Contractor of the Individual Developer</p>	<p>Monitor daily</p>

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			<p>designated during the planning stage.</p> <p>5) Rehabilitation/ landscaping are to be done immediately after the involved works are completed. (<i>Refer to rehabilitation plan for more details</i>).</p> <p>6) All compacted areas should be ripped prior to them being rehabilitated/ landscaped by the contractor as appointed by the developer/ individual erf owner.</p> <p>7) The top layer of all areas to be excavated must be stripped and stockpiled in areas where this material will not be damaged, removed or compacted. This stockpiled material should be used for the rehabilitation of the site and for landscaping purposes.</p> <p>8) Strip topsoil at start of works and store in stockpiles no more than 1,5 m high in designated materials storage area.</p> <p>9) During the laying of any cables, pipelines or infrastructure (on or adjacent to the site) topsoil shall be kept aside to cover the</p>	<p>removed in designated areas</p>		

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
	Erosion and siltation	To prevent erosion and siltation <i>(Refer to rehabilitation plan for more details)</i>	<p>disturbed areas immediately after such activities are completed.</p> <p>1) It is recommended that the construction of the development be done in phases.                      2) Each phase should be rehabilitated immediately after the construction for that phase has been completed. The rehabilitated areas should be maintained by the appointed rehabilitation contractor until a vegetative coverage of at least 80% has been achieved as appointed by the developer/ individual erf owner.                      3) Mark out the areas to be excavated.                      4) Large exposed areas during the construction phases should be limited. Where possible areas earmarked for construction during later phases should remain covered with vegetation coverage until the actual construction phase. This will prevent unnecessary erosion and siltation in these areas.                      5) Unnecessary clearing of vegetation resulting in exposed soil prone to erosive conditions should be avoided.                      6) All embankments must be adequately</p>	<p>No erosion scars</p> <p>No loss of topsoil</p> <p>All natural damaged areas successfully rehabilitated</p>	Contractor ESO	Monitor daily

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			<p>compacted and planted with indigenous grass and trees to stop any excessive soils erosion and scouring of the landscape if required.</p> <p>7) The eradication of alien vegetation should be followed up as soon as possible by replacement with indigenous vegetation to ensure quick and sufficient coverage of exposed areas by the individual erf owner.</p> <p>8) Storm water outlets shall be correctly designed to prevent any possible soil erosion. This includes implementation of stilling basins and planting indigenous vegetation for silt trapping.</p> <p>9) All surface run-offs shall be managed in such a way so as to ensure erosion of soil does not occur.</p> <p>10) Implementation of temporary storm water management measures that will help to reduce the speed of surface water by the individual erf owner / developer.</p> <p>11) All surfaces that are susceptible to erosion shall be covered with a suitable vegetative cover as soon as construction is completed by the individual erf owner /</p>			

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
	Stability of structures due to geology	To ensure stability of structures	Preventative foundation designs shall be done, such as erecting gabion structures, using sand bags or hay bales etc. ( <i>Refer to rehabilitation plan for more details</i> ). Detailed foundation inspections should be carried out at the time of construction to identify any variances and adjust foundation designs accordingly if need be. The foundation recommendations from the geotechnical engineers must be adhered to.		Engineers; Contractor; Individual Developer	When required
	Seepage of groundwater into excavations	To ensure that excavations do not become flooded	Provision should be made for the removal of groundwater from excavations.		Contractor	Monitor daily
	Cracking of structures	To ensure that built structures do not crack due to collapsible soils and settlement	1)The floors of foundation excavations should be compacted by a hand-operated vibratory roller or else by a machine equivalent to a Wacker Rammer (a mechanised tamping device); a test section should firstly be compacted under supervision of the Engineer in order to determine the number of roller passes. The structures may then be constructed by	Built structures show no sign of cracks	Engineer; Contractor	As required

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			<p>conventional means.</p> <p>Additional precautionary measures that can be employed are:</p> <ol style="list-style-type: none"> <li>2) The provision of expansion joints in the walls of structures;</li> <li>3) A concrete walkway of 1,0m in width around the perimeter of each structure; and</li> <li>4) The shaping of the walkway and the ground surface in the vicinity of the structures so as to drain water away from each structure so that no ponding of surface water can take place in the vicinity of the structures.</li> </ol>			
	Hydrology	To minimise pollution of soil, surface and groundwater.	<ol style="list-style-type: none"> <li>1) Increased run-off during construction must be managed using berms and other suitable structures as required to ensure flow velocities are reduced. (<i>Refer to rehabilitation plan for more details</i>).</li> <li>2) The contractor shall ensure that excessive quantities of sand, silt and silted water do not enter the storm water system.</li> </ol>	<p>No visible signs of erosion.</p> <p>No visible signs of pollution</p>	Contractor	Monitor daily
	Wetland	Preserving River	<ol style="list-style-type: none"> <li>1) The rehabilitated wetland area should be</li> </ol>	No visible signs of	Contractor	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		and Wetland areas.	<p>clearly marked prior to construction. This area is strictly excluded from development and should remain open space during the proposed development activities.</p> <p>2) Construction of water control structures to prevent and control any erosion on the site.</p> <p>3) Prevent contamination of wetland areas from polluted runoff/ seepage/ drainage water by utilizing relevant control measures.</p> <p>4) During the construction phase, no dumping and no stockpiling of materials within the wetland areas and associated buffers should take place.</p> <p>5) No construction or dumping of activities should take place within the 1:50 year or 1:100 year floodline or a horizontal distance of 100m from a water resource unless authorized by DWA.</p> <p>6) No vehicles should be allowed to indiscriminately drive through the wetland areas. Fence-off sensitive areas prior to construction and apply temporary storm water management measures outside the</p>	pollution		

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			<p>watercourse and watercourse buffer zones to prevent entry into the wetland areas and drainage line by construction vehicles and prevent storing or dumping of topsoil, construction material and other waste in the wetland/drainage line.</p> <p>7) The area should be prepared with sandbags or other applicable measures to avoid siltation into the wetland area.</p>			
	Fauna and flora	Removing and controlling alien species ( <i>Refer to rehabilitation plan for more details</i> ).	<p>1) All alien invaders and weeds must be eradicated on a continuous basis.</p> <p>2) Alien invaders must be included in an alien management program for the site. Eradication must occur every 3 months.</p> <p>3) Alien plants, especially lawn grasses and other ground-covering plants, should not be introduced in the communal landscaping of the proposed site, as they will drastically interfere with the nature of the area.</p> <p>4) Where possible, trees naturally growing on the site should be retained as part of the landscaping.</p>	No alien plants used for landscaping	Contractor ESO / Home Owners Association / Design Review Committee	As and when required  Every 6 months
		To protect the existing fauna and flora.	<p>1) Trees that are intended to be retained shall be clearly marked on site.</p> <p>2) Snaring and hunting of fauna by construction workers on or adjacent to the</p>	No measurable signs of habitat destruction	Contractor ESO	As and when required



TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			<p>study area are strictly prohibited and the Council shall prosecute offenders.</p> <p>3) All mitigation measures for impacts on the indigenous flora of the area should be implemented in order to limit habitat loss as far as possible and maintain and improve available habitat, in order to maintain and possibly increase numbers and species of indigenous fauna.</p> <p>4) Wood harvesting of any trees or shrubs on the study area or adjacent areas shall be prohibited.</p> <p>5) Where possible, work should be restricted to one area at a time.</p> <p>6) Noise should be kept to a minimum and the development should be done in phases to allow faunal species to temporarily migrate into the conservation areas in the vicinity.</p> <p>7) The integrity of remaining wildlife should be upheld, and no trapping or hunting by construction personnel should be allowed. Caught animals should be relocated to the conservation areas in the vicinity.</p> <p>8) Entrance by vehicles, especially off-road</p>			

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			cars and bakkies, off-road bicycles and quad bikes and construction staff into the application site should be prohibited, both during the construction phase and during the lifespan of the project.			
		To protect the existing fauna and flora.	<p>1) Retain natural habitat elements such as tree stumps, termite mounds, etc. where possible.</p> <p>2) Preserve, maintain and construct biological corridors where possible, as well as retaining green belts interconnected with these corridors.</p>	No measurable signs of habitat destruction	Contractor ESO	As and when required
Social	Noise impact	To maintain noise levels below "disturbing" as defined in the national Noise Regulations.	<p>1) Site workers must comply with the Provincial noise requirements as outlined in Provincial Notice No. 5479 of 1999: Gauteng Noise Control Regulations.</p> <p>2) Noise activities shall only take place during working hours.</p>	No complaints from surrounding residents and I & APs	Contractor	Monitored daily
	Dust impact	Minimise dust from the site	1) Dust pollution could occur during the construction works, especially during the dry months. Regular and effective damping down of working areas (especially during the dry and windy periods) must be carried	No visible signs of dust pollution	Contractor	Monitored daily

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			<p>out to avoid dust pollution that will have a negative impact on the surrounding environment.</p> <p>2) When necessary, these working areas should be damped down in the mornings and afternoons.</p>	No complaints from surrounding residents and I & APs		
	Safety and security	To ensure the safety and security of the public.	<p>1) Although regarded as a normal practice, it is important to erect proper signs indicating the operations of heavy vehicles in the vicinity of dangerous crossings and access roads or even in the development site if necessary.</p> <p>2) With the exception of the appointed security personnel, no other workers, friend or relatives will be allowed to sleep on the construction site (weekends included)</p> <p>3) Construction vehicles and activities to avoid peak hour traffic times</p> <p>4) Presence of law enforcement officials at strategic places must be ensured</p> <p>5) Following actions would assist in management of safety along the road</p> <ul style="list-style-type: none"> <li>▪ Adequate road marking</li> <li>▪ Adequate roadside recovery areas</li> </ul>	No incidences reported	Contractor ESO	Monitored daily

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			<ul style="list-style-type: none"> <li>▪ Allowance for pedestrians and cyclists where necessary</li> <li>▪ Although regarded as a normal practice, it is important to erect proper signs indicating the danger of the excavation in and around the development site. Putting temporary fencing around excavations where possible.</li> </ul>			
	Infrastructure and services	Installation of services	<p>Determine areas where services will be upgraded and relocated well in advance.</p> <p>Discuss possible disruptions with affected parties to determine most convenient times for service disruptions and warn affected parties well in advance of dates that service disruptions will take place</p>	No complaints from I & AP	Contractor ESO	When required
	Visual impact	In order to minimise the visual impact.	<p>1) The disturbed areas shall be rehabilitated immediately after the involved construction works are completed.</p> <p>2) Shade cloth must be used to conceal and minimise the visual impact of the site camps and storage areas</p>	Visual impacts minimized	Contractor; ESO	Monitor daily
	Vegetation	Landscaping	1) When planting trees, care should be taken to avoid the incorrect positioning of	Landscaping done according to	Landscape	When

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
			<p>trees and other plants, to prevent the roots of trees planted in close proximity to the line of water-bearing services from causing leaking in, or malfunctioning of the services.</p> <p>2) The proposed planting materials for the areas to be landscaped should preferably be endemic and indigenous.</p> <p>3) All new trees and shrubs to be planted on the study area shall be inspected for pests and diseases prior to them being planted.</p> <p>4) The inspection shall be carried out by the maintenance contractor at the property of the supplier and not on the study area.</p>	landscape development plan	architect Contractor / Individual Developer	required
	Loss of plants		<p>1) Aerate compacted soil and check and correct pH for soils affected by construction activities.</p> <p>2) Make sure plant material will be matured enough and hardened off ready for planting. Water in plants immediately as planting proceeds.</p> <p>3) Apply mulch to conserve moisture.</p> <p>Plant according to the layout and planting techniques specified by the Landscape Architect in the Landscape Development plans for the site.</p>	Landscaping done according to landscape development plan	Landscape architect Contractor / Individual Developer	When required

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		Spread of weeds	<p>Ensure that materials used for mulching and topsoil/ fertilisers are certified weed free. Collect certifications where available.</p> <p>Control weeds growth that appears during construction.</p>	Weed growth controlled	<p>Landscape architect</p> <p>Contractor</p>	When required
		To ensure rehabilitation of the site	<ol style="list-style-type: none"> <li>1) Compacted soils shall be ripped at least 200mm.</li> <li>2) All clumps and rocks larger than 30mm diameter shall be removed from the soil to be rehabilitated.</li> <li>3) The soil shall be leveled before seeding</li> <li>4) Hydroseed the soil with Potch mixture</li> <li>5) Watering shall take place at least once per day for the first 14 days until germination of seeds have taken place</li> <li>6) Thereafter watering should take place at least for 20 minutes every 4 days until grass have hardened off.</li> </ol>	<p>Grass have hardened off</p>	<p>Landscape architect</p> <p>Contractor</p>	<p>Once a day</p> <p>Then every 4 days</p>
		Rehabilitation of area directly	<ol style="list-style-type: none"> <li>1) Vehicles and workers associated with construction should not have free access to</li> </ol>	No erosion surrounding new	Landscape	Immediately after

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action
		surrounding stream	<p>the stream and unnecessary disturbance to the stream should be avoided.</p> <p>2) No vegetation may be removed from the stream area or buffer zone unless stipulated in a Water Use License granted to the owner of the site.</p> <p>3) Erosion control measures should be implemented on all open soils and steep slopes.</p> <p>4) Upon completion of the construction in the area, the area should be rehabilitated to a level that will ensure that wetland vegetation can become re-established. In this regard special mention of the following is made:</p> <ul style="list-style-type: none"> <li>• All areas of disturbed and compacted soils need to be compacted and reprofiled.</li> <li>• Ongoing removal of alien vegetation from the area must take place after the completion of the structure to prevent the uncontrollable recruitment of these species.</li> </ul>	river area	architect Contractor	construction

#### 4.2 Operational Phase

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Responsibility	Frequency of Action
Site clean-up and preparation for use	Storm water pollution	Do not allow any materials to wash into the storm water system.	Remove erosion and sediment controls only if all bare soil is sealed, covered or re-vegetate. Sweep roadways clean and remove all debris from kerb and gutter areas. Do not wash into drains.	Contractor	-
		Minimise waste	Decontaminate and collect waste in storage area ready for off-site recycling or disposal Arrange for final collection and removal of excess and waste materials.	Contractor	-
Establishing plants	Revegetation to stabilise soil, loss or degradation of habitat	To ensure re-vegetation to stabilize soil	Agreed schedule for regular follow-up watering, weed control, mulch supplements and amenity pruning, if needed. Replace all plant failures within three month period after planting.	Contractor	To be agreed
Geology	Erosion of topsoil	Prevent topsoil erosion	Due to loose topsoil, the soil must be covered by means of re-seeding and vegetation with suitable ground covering.	Engineer; Contractor	Once off



TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Responsibility	Frequency of Action
		To ensure effective stormwater management	<p>1) Stormwater throughout the site should be managed to accommodate the higher quantities of run off;</p> <p>2) Sheet flow should be encouraged as far as possible, and channels should be designed to sufficiently address the problem of erosion; and</p> <p>3) Bio-swale system could be implemented to filter water from paved areas and especially from roads and parking areas to sufficiently clean water of heavy metals and other hazardous materials in stormwater in a natural manner. This will further provide an opportunity for water to infiltrate the soil, break the energy of stormwater and keep the water on site for longer.</p>	Section 21 Company; HOA	
Materials failure	Structural damage. Loss of site materials.		Inspect all structures monthly to detect any cracking or structural problems. Confirm with designer if there are design problems. Rectify with materials to match, or other agreed solution.	Contractor	-
Water management and Wetland	Work being done in Wetland Areas &		1) Continued implementation of an approved Stormwater Management Plan must take place. Siltation, prevention of obstruction at culverts and prevention of erosion must take place on	Developer	Storm water management as agreed upon

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Responsibility	Frequency of Action
features	Storm Water Management		<p>an ongoing basis. Continuous monitoring of storm water system should take place.</p> <p>2) Success of rehabilitation works is to be monitored on a continuous basis.</p> <p>3) Ecological integrity and functioning should be maintained and monitored to ensure stability of system. The success of the rehabilitated wetland habitats will only be evident after a couple of years.</p>		Rehabilitated watercourse monitored annually (adjusted if needed)
Drainage failure	On-site and downstream drainage pollution or flooding	Storm water management plan	Inspect all site drainage works and repair any failures. Confer with design engineer and to correct site problems.	Contractor	-
Site audit	Eventual project failure	Successful project establishment	Routinely audit the works and adjust maintenance schedule accordingly.	Contractor	-
General	Mismanagement	Maintenance team in place	A maintenance team as well as a landscaping team is needed to ensure that the development is well maintained.	Developer	-

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Responsibility	Frequency of Action
			Open fires and smoking during maintenance works are strictly prohibited.	Contractor	-

## **5. Procedures for environmental incidents**

### **5.1 Leakages and spills**

- Identify source of problem.
- Stop goods leaking, if safe to do so.
- Contain spilt material, using spills kit or sand.
- Notify Environmental Control Officer
- Remove spilt material and place in sealed container for disposal (if possible).
- Environmental Control Officer to follow Incident Management Plan.

### **5.2 Failure of erosion/sediment control devices**

- Prevent further escape of sediment.
- Contain escaped material using silt fence, hay bales, pipes, etc.
- Notify ECO.
- Repair or replace failed device as appropriate.
- Dig/scrape up escaped material; take care not to damage vegetation.
- Remove escaped material from site.
- ECO to follow Incident Management plan.
- Monitor for effectiveness until re-establishment.

### **5.3 Bank/slope failure**

- Stabilize toe of slope to prevent sediment escape using aggregate bags, silt fence, logs, hay bales, pipes, etc.
- Notify ECO.
- ECO to follow Incident Management plan.
- Divert water upslope from failed fence.
- Protect area from further collapse as appropriate.
- Restore as advised by ECO.
- Monitor for effectiveness until stabilized.

### **5.4 Discovery of rare or threatened species during construction phase**

- Stop work.
- Notify ECO.
- If a plant is found, mark location of plants with GPS and demarcate the area. A botany specialist should be consulted immediately.
- If an animal is found, mark location where sighted. Do not capture the animal or disturb it. Contact an appropriate fauna specialist immediately.
- ECO to identify or arrange for identification of species and or the relocation of the species if possible.

- If confirmed significant, ECO to liaise with Endangered Wildlife Trust.
- Recommence work when cleared by ECO.

## **6. EMPr review**

1. The Site Supervisor is responsible for ensuring the work crew is complying with procedures, and for informing the work crew of any changes. The site supervisor is responsible for ensuring the work crew is aware of changes that may have been implemented by GDARD before starting any works.
2. If the contractor cannot comply with any of the activities as described above, they should inform the ECO with reasons within 7 working days.

# **Annexure O**

## Rehabilitation and Wetland Management Plan



# Final Amended Rehabilitation and Wetland Management Plan For Portions of the Remainder of Portion 1 of the Farm Waterval 5IR



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## List of Abbreviations

**DWA:** Department of Water Affairs

**EMPr:** Environmental Management Programme

**GDARD:** Gauteng Department of Agriculture and Rural Development

**NEMA:** National Environmental Management Act

**SWMP:** Storm Water Management Plan

## Glossary of Terms

**Alien species:** A plant or animal species introduced from elsewhere: neither endemic nor indigenous.

**Biodiversity:** The variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are apart.

**Contractor:** The contractors shall be responsible for ensuring that all activities on site are undertaken in accordance with the environmental provisions detailed in the Environmental Management Programme and that the sub-contractors and laborers are duly informed of their roles and responsibilities in this regard. The contractors will be responsible for the cost of rehabilitation of any environmental damage that may result from non-compliance with the environmental regulations.

**Developer:** ATTACQ WATERFALL INVESTMENT COMPANY (Pty) Ltd (AWIC)

**Ecology:** The study of the inter relationships between organisms and their environments.

**Environment:** All physical, chemical and biological factors and conditions that influence an object and/or organism. Also defined as the surroundings within which humans exist and are made up of the land, water, atmosphere, plant and animal life (micro and macro), interrelationship between the factors and the physical or chemical conditions that influence human health and well-being.

**Environmental Management Plan:** A legally binding working document, which stipulates environmental and socio-economic mitigation measures that must be implemented by several responsible parties throughout the duration of the proposed project.

**Home Owners Association:**

**Study Area:** Refers to the entire study area compassing the total area of the land parcels as indicated on the study area map.

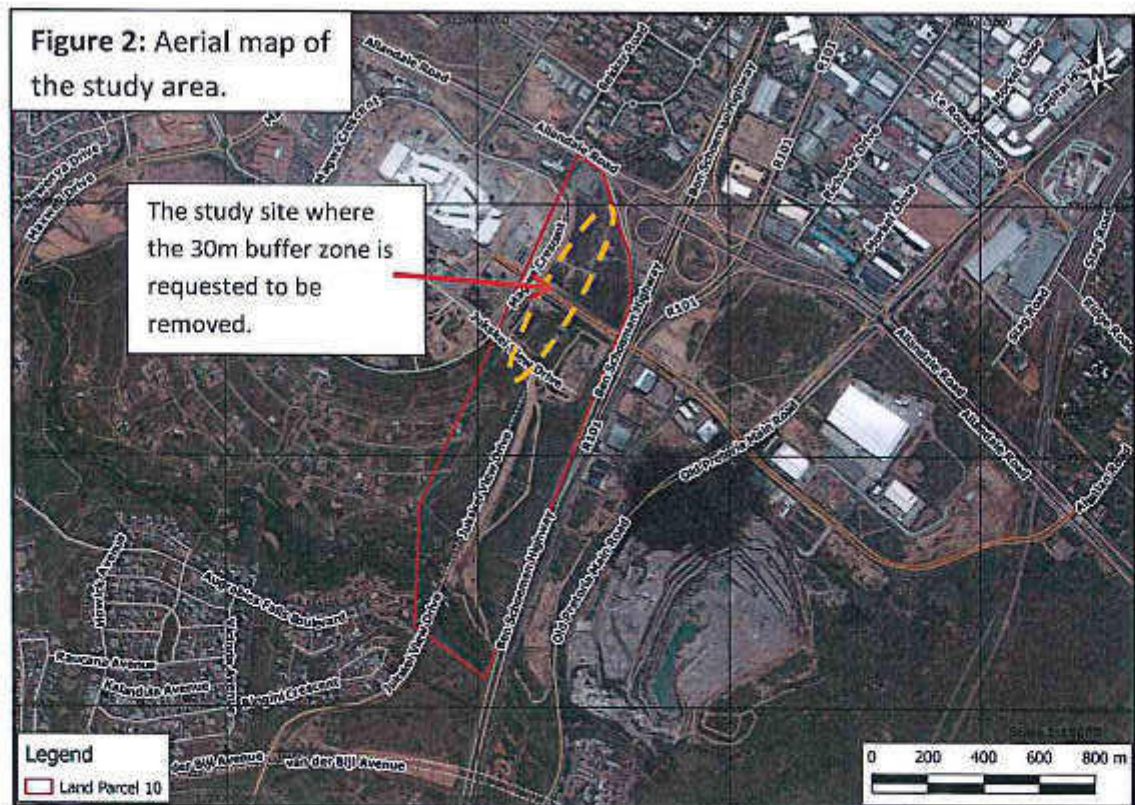
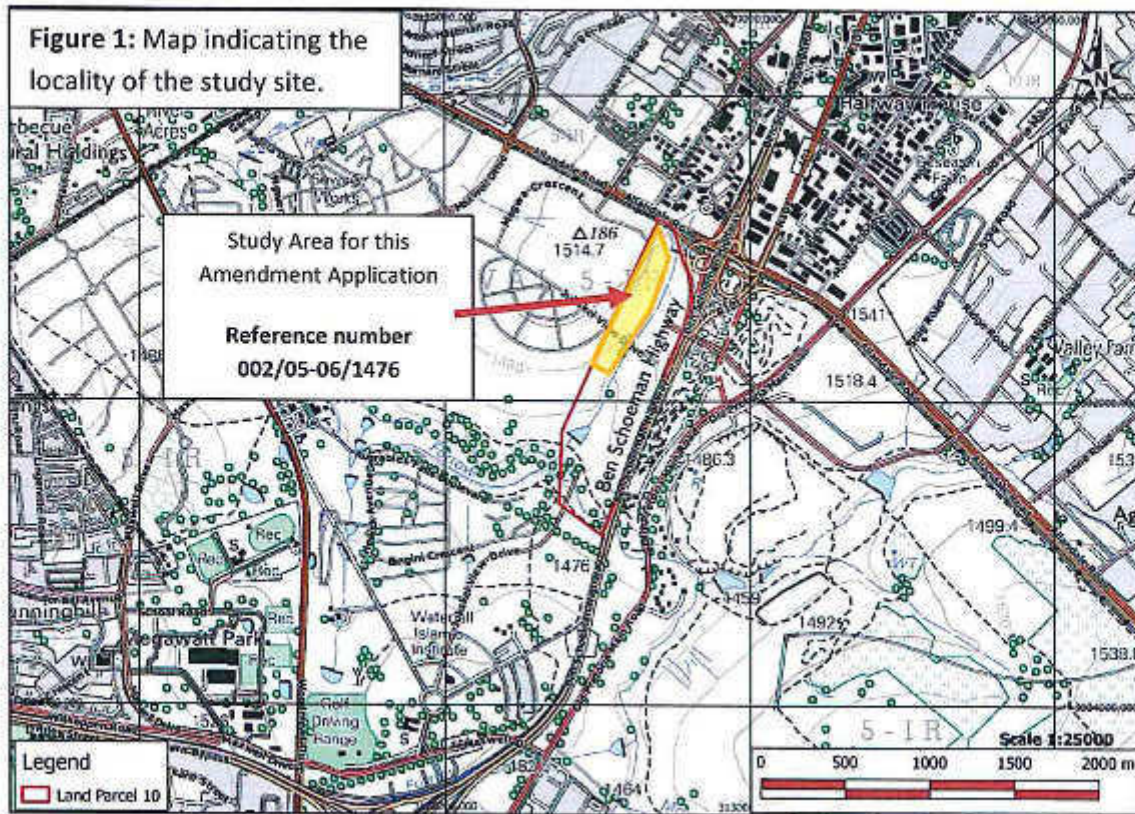
## 1. Introduction

**Bokamoso Landscape Architects & Environmental Consultants** has been appointed by **Atterbury Waterfall Investment Company (PTY) LTD** as independent Environmental Consultants/ Environmental Assessment Practitioner (EAP) to compile a Wetland Rehabilitation Plan for the Proposed Mixed-use Development, known as Northern Residential Estate. A RoD (Environmental Authorisation) was granted under Reference Number GAUT 002/05-06/1476. The application site is situated on portions of the Remainder of Portion 1 of the Farm Waterval 5IR in Midrand, Gauteng, just south of Allendale Road and west of the N1 freeway (**Figure 1 and 2**). The study site falls in the jurisdiction of the City of Johannesburg Metropolitan Municipality. An updated Rehabilitation Plan is required as the additional stormwater from the Proposed Development will be directed towards the wetland area which will have additional impacts on the system.

An updated "**Open Space and Wetland Management Plan**" was prepared by Dr. Gwen Theron in August 2012 in response to the ROD from the GDARD.

The purpose of the Amended Rehabilitation and Wetland Management Plan is to guide the additional rehabilitation work downstream of the existing rehabilitated wetland upstream to compensate for the additional stormwater run-off from the proposed development. This plan is flexible to be adapted where necessary and to address issues that may arise during the construction phase.

**Take note:** There is already an approved Rehabilitation Plan and EMPr for the study area and no amendments to these plans will be required. However, a new Rehabilitation Plan and EMPr which will specifically be applicable to the relaxation of the 30m buffer area and proposed mitigation measures will be submitted as part of this application and must be regarded as supplementary documentation to the existing Rehabilitation Plan and EMPr which have already been approved and implemented in the former authorisations.



## 2. Rationale and Objectives

The purpose of this document is to:

- Provide suitable rehabilitation measures in order to facilitate the ongoing ecological functioning of the wetland and associated areas;
- Incorporate the storm water management plan obtained from the engineer to reduce erosion and siltation;
- Provide recommendations and mitigation measures for adverse impacts caused during the construction phase;
- Guide the management of the ecological attributes of the wetland;
- Provide guidance as to the strategic decision making by the DWA and GDARD; and
- Inform the relevant stakeholders/role players, such as the Contractor, Developer and Home Owners Association of their responsibilities during and after the construction process.

The intention to rehabilitate the wetland area and riparian zone include:

- The stabilisation and rehabilitation of the wetland habitat area;
- The stabilisation and rehabilitation of the riverine zone;
- Rehabilitation of construction activities adjacent to the wetland area;
- Biodiversity conservation to maintain habitat for flora and fauna species associated with wetland areas;
- Reduction and management of soil erosion and siltation from storm water run-off;
- Maximise the service provision from the wetland and surrounding affected areas;
- Maximise the ecological functioning of the wetland and surrounding affected areas;
- Minimise impacts on the receiving environment; and
- Monitor the impact of the proposed development on the receiving environment.

## 3. Documentation consulted

The following reference material was consulted during the Amended Rehabilitation and Wetland Management Plan:

- Hydropedology Based Wetland Buffer Assessment and Management Report dated 3 September 2015 compiled by Dr. Johan H. van der Waals from TerraSoil Science (*Refer to Annexure H*).
- STORM WATER IMPACTS, MITIGATION AND WETLAND REHABILITATION: LAND PARCEL 10 dated 7 July 2016 compiled by Dr. Johan H. van der Waals from TerraSoil Science (*Refer to Annexure H(i)*).

- Waterfall Open Space and Wetland Management Plan dated August 2012 compiled by Dr. Gwen Theron (*Refer to Annexure G of EA*).
- ROD for Northern Residential Estate – GAUT 002/05-06/1476
- A Preliminary Wetland Delineation and Functional Assessment dated March 2006 compiled by Strategic Environmental Focus (PTY) LTD
- Wetland Buffer Zone Reduction Report dated September 2010 compiled by Antoinette Bootsma (Wetland Ecologist Specialist)
- The ecological assessments undertaken by Bokamoso Environmental: Specialist Division as part of the Amended Environmental Authorization Report dated May 2016.
- National Environmental Management Act (1998), including amendments to the Act;
- National Water Act (Act 36 of 1998);
- National Environmental Management: Biodiversity Act (2004);
- Conservation of Agricultural Resources Act (CARA; Act 43 of 1983)

### **3.1. The National Water Act, 1998 (Act No: 36 of 1998)**

#### **CHAPTER 6 Section 65**

##### ***Expropriation for rehabilitation and other remedial work***

*(1) If a person who is required under this Act to undertake rehabilitation or other remedial work on the land of another, reasonably requires access to that land in order to effect the rehabilitation or remedial work, but is unable to acquire access on reasonable terms, the Minister may -*

*(a) expropriate the necessary rights in respect of that land for the benefit of the person undertaking the rehabilitation or remedial work, who will then be vested with the expropriated rights; and*

*(b) recover all costs incurred in connection with the expropriation, including any compensation payable, from the person for whose benefit the expropriation was effected.*

*(2) Where a servitude of abutment, aqueduct or submersion is expropriated under this section, the Minister or water management institution responsible for the expropriation has the same rights as those vesting in the holder of a servitude under section 128.*

#### **CHAPTER 14 Section 137**

*(1) The Minister must establish national monitoring systems on water resources as soon as reasonably practicable.*

(2) The systems must provide for the collection of appropriate data and information necessary to assess, among other matters -

- (a) the quantity of water in the various water resources;
- (b) the quality of water resources;
- (c) the use of water resources;
- (d) the rehabilitation of water resources;
- (e) compliance with resource quality objectives;
- (f) the health of aquatic ecosystems; and
- (g) atmospheric conditions which may influence water resources.

#### 4. Limitations and Potential Problems

The success of the rehabilitation measures will only be evident after a certain time period has elapsed; therefore monitoring and record keeping is critical to ensure hydrological and ecological functioning. Vegetation used for the rehabilitation and stabilisation of the wetland habitat should be done according to this report based on the documentation consulted and the EMPr. If such measures are not implemented correctly the risk of storm water erosion and siltation in the wetland could cause water and soil pollution and further degradation of the entire system.

#### 5. Potential Impacts and Threats

The significance of Adverse Environmental Impacts on the water resources and other water users were assessed according to the criteria of Table 1. The adverse impacts and mitigation measures are discussed in Table 2.

**Table 1: Measures for determining the extent of the impacts on the Water Resources and Water Users**

<b>Improbable</b>	- Low possibility of impact to occur either because of design or historic experience.
<b>Probable</b>	- Distinct possibility that impact will occur.
<b>Highly probable</b>	- Most likely that impact will occur.
<b>Definite</b>	- Impact will occur, in the case of adverse impacts regardless of any prevention measures.

Table 2: Adverse Impacts and Mitigation Measures

POTENTIAL IMPACTS	DESCRIPTION	SIGNIFICANT RATING OF THE IMPACT	PROPOSED MITIGATION	SIGNIFICANT RATING OF THE IMPACT AFTER MITIGATION
Altered Storm Water Flow due to Altered Surfaces and Gradients	The proposed development will create relatively large impervious areas that will substantially increase the storm water runoff from the site. These areas should be mitigated, in order to ensure that the storm water be released into the shallow valley along the southern boundary of the site.	Highly Probable	<ul style="list-style-type: none"> <li>• Storm water run-off from the developed areas must be routed via the route channels and proposed storm water pipe-and-culvert network;</li> <li>• Spillways must be designed and implemented to assist with the flow of storm water;</li> <li>• The drainage system must be gravity operated to ensure that the capacity of the system is not affected;</li> <li>• The storm water management plan (SWMP) should be designed as to ensure the post-development run-off does not exceed pre-development values in: <ul style="list-style-type: none"> <li>○ Peak discharge for any given storm</li> <li>○ Total volume of runoff for any given storm</li> </ul> </li> </ul>	Probable



			<ul style="list-style-type: none"><li>○ Frequency of run-off</li><li>○ Pollutant and debris concentrations reaching water courses;</li><li>● The storm water management plan must ensure that all culverts and storm water discharge outlets promote diffuse flow and should be fitted with energy dissipaters;</li><li>● The concentration and size of the storm water outlets must be considered;</li><li>● Run-off from paved surfaces should be slowed down by the strategic placement of berms;</li><li>● Flows should be dispersed before reaching the culverted road crossing below and energy dissipating structures must be constructed above the culvert inlet. Measures to prevent erosion should be implemented and an energy dissipating structure should be constructed below the culvert outlet;</li><li>● A piped culvert is recommended at all road crossings or any place where infrastructure will</li></ul>	
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			<p>cross or infringe on the main storm water channel. All point source discharges and culverts should be fitted with energy dissipating structures at the outlets/outfall, which is where the storm water is received into the rehabilitated environment. Energy dissipaters are structures designed to reduce runoff velocity below an outfall;</p> <ul style="list-style-type: none"> <li>The use of permeable paving is advised for the parking lot to delay the speed of the water into the storm water drains. This will serve a localised flood attenuation function over a larger area.</li> </ul>	
<p>Erosion and siltation</p>	<p>If not planned and managed correctly, construction and other activities could cause soil erosion. Mitigation measures must be taken into account to prevent erosion and the possible</p>	<p>Highly Probable</p>	<ul style="list-style-type: none"> <li>The manner and volume of discharge of storm- and treated water must be addressed in the SWMP and accordingly be managed correctly and effectively to prevent erosion and siltation from occurring to ensure the sustainability of the drainage system especially lower down in the catchment;</li> <li>Mitigation measures to prevent erosion, siltation</li> </ul>	<p>Improbable</p>

	<p>impact on the wetlands and water quality.</p> <p>Erosion may occur due to surface runoff and the water discharged at the discharge points eroding the soil through occasional or permanent discharge and runoff. This is also dependant on the volumes of discharge.</p>	<p>and water pollution at the storm water discharge points should be provided by the involved storm water engineer;</p> <ul style="list-style-type: none"> <li>• The SWMP should be designed inherent to the following principles;             <ul style="list-style-type: none"> <li>○ Alter the natural flow regime of water course on site as little as possible</li> <li>○ Retain inherent drainage systems in natural areas</li> <li>○ Simulate natural runoff and convergence of storm water</li> <li>○ Minimise unnatural drainage diversions</li> <li>○ Promote sheet flow of storm water runoff on open areas</li> <li>○ Conserve the in situ soil mantle as far as possible by ensuring that accelerated erosion caused by human activities are addressed and attended to</li> <li>○ Make use of energy dissipation solutions to storm water systems where necessary</li> </ul> </li> </ul>	
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			<ul style="list-style-type: none"> <li>○ Minimise and avoid structures across drainage channels</li> <li>○ Protect and line open storm water drainage channels as an aid and secondary assistance to storm water management</li> <li>○ Maintain quality or even improve quality of water bodies</li> <li>● The SWMP plan should be signed and implemented in a way that aims to ensure that post development runoff does not exceed predevelopment values in:             <ul style="list-style-type: none"> <li>○ Peak discharge for any given storm</li> <li>○ Total volume of runoff for any given storm</li> <li>○ Frequency of runoff</li> <li>○ Pollutant and debris concentrations reaching water courses</li> </ul> </li> <li>● Exposed areas at runoff and discharge should be covered with vegetation to prevent unnecessary erosion and siltation in these areas.</li> <li>● Sufficient and temporary facilities including</li> </ul>	Probable
Contamination	Seepage of waste water or	Highly		Probable

<p>of surface and groundwater resources</p>	<p>storm water combined with process water can seep through to groundwater resources and contaminate it.</p>	<p>probable</p>	<p>ablation facilities must be provided for construction workers operating on the site;</p> <ul style="list-style-type: none"> <li>• A minimum of one chemical toilet shall be provided per 10 persons. The contractor shall keep the toilets in a clean, neat and hygienic condition. Toilets provided by the contractor must be easily accessible and a maximum of 50m from the works area to ensure they are utilized. The contractor (who must use reputable toilet-servicing company) shall be responsible for the cleaning, maintenance and servicing of the toilets. The contractor (using reputable toilet-servicing company) shall ensure that all toilets are cleaned and emptied before the builders or other public holidays;</li> <li>• The toilets must be placed outside the 1:100 year flood line and as far away as feasible from any water courses;</li> <li>• No person is allowed to use any other area than chemical toilets;</li> </ul>
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		<ul style="list-style-type: none"> <li>• No French drain systems may be installed;</li> <li>• No chemical or waste water must be allowed to contaminate the run-off on site;</li> <li>• Avoid the clearing of the site camp or paved surfaces with soap;</li> <li>• Drip trays and/ or lined earth bunds must be provided under vehicles and equipment, to contain spills of hazardous materials such as fuel, oil and cement;</li> <li>• The repair and storage of vehicles only within the demarcated site area;</li> <li>• Spill kits must be available on site. In case of accidental spills of oil, petroleum products, etc., good oil absorbent materials must be on hand to allow for the quick remediation of the spill. The kit should also be well marked and all personnel should be educated to deal with the spill. Vehicles must be kept in good working order and leaks must be fixed immediately on an oil absorbent mat. The use of a product such as Sunsoorb is</li> </ul>	
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			<p>advised;</p> <ul style="list-style-type: none"><li>• Oils and chemicals must be confined to specific secured areas within the site camp. These areas must be banded with adequate containment (at least 1.5 times the volume of the fuel) for potential spills or leaks;</li><li>• All spilled hazardous substances must be contained in impermeable containers for removal to a licensed hazardous waste site;</li><li>• No leaking vehicle shall be allowed on site. The appointed contractor must supply the environmental officer with a letter of confirmation that the vehicles and equipment are leak proof;</li><li>• No bins containing organic solvents such as paints and thinners shall be cleaned on site, unless containers for liquid waste disposal are placed for this purpose on site;</li><li>• No effluent (including effluent from any storage areas) may be discharged into any water surface</li></ul>
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			<p>or ground water resource;</p> <ul style="list-style-type: none"> <li>• The contractor shall ensure that excessive quantities of sand, silt and silted water do not enter the storm water system;</li> <li>• Ensure safe storage conditions so that there are no losses or leaks;</li> <li>• An area must be allocated for stockpiling of topsoil;</li> <li>• The area must be allocated before the construction takes place on the application site and must be situated away from any water source or drainage channel;</li> <li>• A sediment fence or temporary barrier must be constructed around the stockpile to prevent the soil from washing away by rain or any water; and</li> <li>• Water quality must be monitored from the commencement of construction.</li> </ul>	
<p>Protection of the Existing and Planned</p>	<p>To ensure that the existing and planned rehabilitated wetland areas on the</p>	<p>Probable</p>	<ul style="list-style-type: none"> <li>• The existing rehabilitated wetland area should be clearly marked prior to construction. This area is strictly excluded from development, and should</li> </ul>	<p>Improbable</p>



<p>Rehabilitated Wetland Areas</p>	<p>study area is adequately protected prior and during the construction phase as well as being monitored and managed throughout its lifespan</p>	<p>remain open space during the proposed development activities.</p> <ul style="list-style-type: none"> <li>• Changing the amount of water in the wetlands and riparian area             <ul style="list-style-type: none"> <li>➤ The groundwater reserves must be protected;</li> <li>➤ Monitor quality of water;</li> <li>➤ Control the activities directly impacting on the water resource;</li> <li>➤ Rehabilitation/restoration of indigenous vegetative cover;</li> <li>➤ Management of onsite water use;</li> <li>➤ Management of point discharges;</li> <li>➤ Alien plant control activities;</li> <li>➤ Storm water detention and treatment;</li> <li>➤ Establishment of a swale downstream to counter the additional runoff</li> <li>➤ Implementation of additional gabion structures and other erosion measures to ensure stability of the system downstream</li> </ul> </li> </ul>
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			<ul style="list-style-type: none"> <li>• Reducing the amount of sediment entering the wetland which will result in altered hydrology and associated change in turbidity (increasing or decreasing the amount);</li> <li>• Implementation of best management practices (Roads and associated drainage and also earthwork activities)             <ul style="list-style-type: none"> <li>➢ Source directed controls</li> <li>➢ Buffer zones to trap sediments</li> <li>➢ Active rehabilitation;</li> </ul> </li> <li>• Alteration of water quality - increasing the amount of nutrients (phosphates, nitrite, nitrate)             <ul style="list-style-type: none"> <li>➢ Provision of adequate sanitation facilities located outside of the wetland/riparian area or its associated buffer zone</li> <li>➢ Implementation of appropriate storm water management</li> </ul> </li> <li>• Utilize slow-release organic fertilizers.</li> </ul>	
Fauna and Flora	Alien plant species (not indigenous to the area)	Definite	<ul style="list-style-type: none"> <li>• A list of invader plant species is made available (<i>Addendum A</i>) which occurs on site which should</li> </ul>	Improbable

	<p>should be discouraged and restricted as far as possible. Alien species depletes surface and ground water resources. They have a significant impact on ecological integrity of natural systems, flooding, erosion, and also water quality and quantity.</p>	<p>be eradicated and not be used for rehabilitation purposes;</p> <ul style="list-style-type: none"> <li>• Only indigenous plant species, preferably those that are endemic to the natural vegetation of the area are to be used for rehabilitation purposes;</li> <li>• As far as possible plants and trees growing naturally on the study area must be retained as part of the landscaping;</li> <li>• Measures must be developed to protect and conserve the water resources by removing existing alien plants and to discourage recruitment and recolonisation of the alien plants on the study area according to the measures indicated by a qualified wetland/botany specialist;</li> <li>• <i>Hyopsis hemerocallidea</i> was identified during the flora assessment. <i>H. hemerocallidea</i> species should be clearly marked on site prior to construction, and should be relocated to areas with high sensitivity such as wetland boundaries,</li> </ul>
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			<p>before any site clearance takes place.</p> <ul style="list-style-type: none"><li>• If during the construction phase any species of fauna is found, it is advised that the species be removed to a safe place to ensure the species is not damaged by the construction activities according to the measures indicated by a qualified fauna specialist;</li><li>• There must be ensured that no fauna species are unnecessarily disturbed, trapped, hunted or killed during the construction phase</li></ul>	
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## 6. Wetland Rehabilitation Measures

### 6.1. Storm Water Management Plan (SWMP)

#### Construction Phase

- Energy dissipation structures and stilling basins must be installed at each storm water outlet structure. Stilling basins will help to reduce the amount of suspended solids in the storm water run-off and to act as sand traps.
- The internal storm water system must consist of an underground gravity pipe and culvert network, roadside channels and inlet structures that will drain the roads and other impermeable and semi-impermeable surface areas. It must be designed to have sufficient capacity to convey a 1:5 and 1:25 year rainfall event. It must thus be aimed to concentrate storm water runoff in certain areas, for example at low points in the parking areas and in the roadside channels.
- Storm water runoff from the developed areas will be routed via the road side channels and storm water pipe and culvert network. It must eventually be released into the shallow valley along the southern boundary of the site.
- Should the 30m buffer zone be relaxed as proposed, an additional swale should be implemented downstream of the existing rehabilitated wetland to counter the additional storm water run-off. The swale is not fixed in its position and can move up or down the stream with  $\pm 35\text{m}$  to suit existing site conditions. The catchment area affected is 4.2 ha, thus the catchment area requires an attenuation pond of  $1470\text{m}^3$  downstream.
- Frequent inspection of the wetland site must be done to ensure that no harmful practices/detrimental impacts (erosion, siltation etc.) occur on site. In the event that such practices/impacts are noted, it must be rectified and remediated immediately.
- Another aim is that the roads, walkways, parking areas and channels can act as overland flow routes which will channel, attenuate and ultimately discharge the surface runoff via predetermined escape routes into the shallow valley along the southern boundary of the site. The design will have to allow for adequate management of the 1:50 year rainfall event.
- Culvert outlet structures and overland chutes must be installed to convey storm water runoff from the development into the valley. Each outlet structure must have an energy dissipation structure and stilling basin to protect the river banks and riparian vegetation from erosion while also reducing the amount of suspended solids in the runoff released back into the river.
- The floor of each catch pit must have a sump 150mm lower than the invert of the outgoing pipe/culvert to act as sand traps all over the development.
- It is advised that for purposes of improved storm water quality, shallow overland storm water channels must be shaped from two major storm water outlets and stilling basins. The open channels must be planted with wetland vegetation such as reed beds to ensure that the levels of phosphorous in the storm water runoff are reduced.
- Other measures that are advised are:

- Identification and protection of potential routes for major floods;
- Minimising the concentration of storm water runoff;
- Promotion of onsite filtration; and
- Adequate drainage of all temporary/artificial low points;
- Spillways must be implemented to assist with the flow of storm water.
- The drainage system must be gravity operated to ensure that the capacity of the system is not affected.
- The storm water management must ensure that all culverts and storm water discharge outlets promote diffuse flow and should be fitted with energy dissipaters.
- Flows should be dispersed before reaching the wetland and energy dissipating structures such as gabions or Armorflex lining should be installed to aerate the water.
- The use of permeable paving is advised for the parking lots to delay the speed of the water into the storm water outlets.
- Shaping of the parking areas to allow water to drain into separate field drains and not collect into a single high flow system.

### Operational Phase

- Storm water runoff from the developed areas will be routed via the road side channels and storm water pipe and culvert network. It must eventually be released into the exiting rehabilitated wetland area.
- Frequent inspection of the wetland site must be done to ensure that no harmful practices/detrimental impacts (erosion, siltation etc.) occur on site. In the event that such practices/impacts are noted, it must be rectified and remediated immediately.
- Regular inspection of dissipation and erosion devices is needed.
- Removal of debris and other obstructing materials from the site and erosion prevention structures must be done regularly to prevent damming of water and increasing flooding danger.
- It is of utmost importance that storm water must be managed in an effective manner to ensure the following, especially in terms of the water resources:
  - Preserve and protect aquatic resources – Existing, relatively intact ecosystems are the keystone for conserving biodiversity and provide the biota and other natural materials needed for the recovery of impaired systems.
  - Maintain and/or improve ecological integrity – The ecologic integrity of the natural systems must be maintained to ensure that the aquatic ecosystems don't degrade.
  - Maintain and/or improve natural structure – Stream channelization, ditching in wetlands, disconnection from adjacent ecosystems and other modifications are examples of structural arrangements which need to be avoided as far as possible.
  - Maintain and/or improve natural function – Structure and function are closely linked in river corridors, lakes, wetlands, estuaries and other aquatic resources.

- Maintain and/or improve the natural potential of the watershed – A watershed has the capacity to become only what its physical and biological setting – its Ecoregion, climate, geology, hydrology and biological characteristics will support.
- Prevent degradation – When degradation is noted, restoration/rehabilitation must be implemented according to this rehabilitation plan.
- Develop clear, achievable and measurable goals for the resources – Environmental degradation may occur without clear goals which direct implementation measures such as storm water management and provide the standards for measuring success.
- Focus on feasibility – It is critical to focus on whether the activities related to the resources are feasible (taking into account scientific, financial, social and other considerations).
- To serve as a reference site – Reference sites are areas that are comparable in structure and function of water resources
- Manage/anticipate the current/future changes – The environment and our communities are both dynamic. Although it is impossible to plan for the future precisely or always effectively manage planned changes, many foreseeable ecological and societal changes can and should be factored into the changes/designs. It is important to take into account changes in runoff resulting from projected increases in upstream impervious surface areas due to development. In addition to impacts from changes in watershed land use, natural changes such as plant community succession can also play an important role.
- Involve skills and insights of a multi-disciplinary team - Management of water resources and/or rehabilitation can be a complex under taking that integrates a wide range of disciplines including ecology, aquatic biology, hydrology and hydraulics, geomorphology, engineering, planning, communications and social science.

## 6.2. Erosion, Siltation and Sedimentation

### Construction Phase

- Gabion structures and other erosion measures should be implemented downstream of the study area to protect the system from further erosion and provide stability.
- Large exposed areas during the construction phase should be limited.
- Where possible, areas earmarked for construction during later phases should remain covered with vegetation coverage until the actual construction phase. This will prevent unnecessary erosion and siltation in these areas.
- Unnecessary clearing of vegetation resulting in exposed soil prone to erosive conditions should be avoided.
- All embankments must be adequately compacted and planted with indigenous grass (such as *Eragrostis* spp., *Imperata cylindrica*, *Leersia hexandra* and *Sporobolus* spp.) and tree species (such as *Celtis africana*, *Combretum erythrophyllum*, *Olea europaea* subsp. *africana*, *Searsia lancea* and *Vachellia karroo*) to stop any excessive soil erosion.

- The removal of any alien plant species (*Addendum A*) should be followed up as soon as possible by replacement with indigenous vegetation to ensure quick and sufficient coverage of exposed areas.
- Storm water outlets must be correctly designed to prevent any possible soil erosion.
- All surface runoff must be managed in such a way as to ensure erosion of soil does not occur.
- Temporary storm water management measures that will help to reduce the speed of surface water must be implemented.
- An area (away from the wetland and drainage line) must be allocated for stockpiling of topsoil. The area must be allocated before the construction takes place on the application site and must be situated away from any water source.

### Operational Phase

- The groundwater reserves must be protected.
- Monitoring of water quality must take place regularly.
- Replanting and rehabilitation of indigenous vegetative cover such as indigenous grasses (such as *Eragrostis* spp., *Imperata cylindrica*, *Leersia hexandra* and *Sporobolus* spp.) and tree species (such as *Celtis africana*, *Combretum erythrophyllum*, *Olea europaea* subsp. *africana*, *Searsia lancea* and *Vachellia karroo*).
- Management of onsite water use.
- Management of point discharges.
- Alien plant control activities (*Addendum A*).

## 6.3. Surface and groundwater pollution

### Construction Phase

- Sufficient temporary facilities including ablution must be provided for construction workers.
- A minimum of one chemical toilet must be provided per 10 persons. The contractor must keep the toilets clean, neat and in a hygienic condition. Toilets provided by the contractor must be easily accessible and a maximum of 50m from the works area to ensure they are utilised. The contractor (who must use a reputable toilet servicing company) shall be responsible for the cleaning, maintenance and servicing of the toilets. The contractor is responsible for the cleaning, maintenance and servicing of the toilets. The contractor must insure that all toilets are cleaned and emptied before the builder's or other public holidays.
- No person is allowed to use any other area than the chemical toilets.
- No chemical or waste water must be allowed to contaminate the runoff on site.
- Avoid the clearing of the site camp or paved surfaces with soap.
- Repair and storage vehicles only allowed within the demarcated site area.
- No bins containing organic solvents such as paints and thinners shall be cleaned on site, unless containers for liquid waste disposal are placed for this purpose on site.
- No effluent may be discharged into any water surface or ground water resource.



- The contractor shall ensure that excessive quantities of sand, silt and silted water do not enter the storm water system.
- Ensure safe storage conditions so that there are no losses or leaks
- An area must be allocated for stockpiling of topsoil
- The area must be allocated before the construction takes place on the application site and must be situated away from any water resource

#### Operational Phase

- No chemical or waste water must be allowed to contaminate the storm water runoff on site.
- No effluent may be discharged into any surface water or ground water resource.
- No pollution of any sort may occur in or around the wetland area.

### 6.4. Fauna and flora

#### Construction Phase

- Propagation of plants should be encouraged. The growth of endangered and important indigenous plants must be encouraged
- If during the construction phase any species of fauna is found, it is advised that the species be removed to a safe place to ensure the species is not damaged by the construction activities
- It must be ensured that no fauna species are unnecessarily disturbed, trapped, hunted or killed during the construction phase.

#### Operational Phase

- Replanting and rehabilitation of indigenous vegetative cover in wetland areas such as:
  - Sedges (*Cyperus spp.*, *Fuirena spp.* and *Schoenoplectus spp.*)
  - Rushes (*Juncus spp.*)
  - Bull rushes (*Typha capensis*)
  - Reeds (*Phragmites australis*)
  - Grasses (*Imperata cylindrica*)
  - Bulbs (such as *Crinum spp.*, *Trachyandra spp.*, *Kniphofia ensifolia*) could also be used in non-permanent wetland zones.

Installation of the plants should reflect their natural position in a wetland area.

### 6.5. Wetland Management Plan

(Refer to Table 3 below).

Table 3: Wetland Rehabilitation Measures

Rehabilitation action	Method	Responsible person
1. Removing alien invasive species	Section 7 describes a recommended alien invasive monitoring program. Next to the existing wetland areas, any alien invasive species that are present should be removed. Locations where large individuals/groups are removed it will later in the rehabilitation program be replaced by indigenous species. (Refer to Addendum A for list of known alien plant species on site).	Landscape contractor
2. Additional swale downstream of existing rehabilitated wetland	<ul style="list-style-type: none"> <li>• An additional swale is recommended by the civil engineer to counter the additional storm water runoff from the extended infrastructure development. The swale will include two attenuation ponds of approx. 750 m<sup>3</sup>.</li> <li>• Soil erosion structures such as berms/water offshoots should be constructed at drainage outlets.</li> <li>• Indigenous hydrophyte vegetation should be used, such as:               <ul style="list-style-type: none"> <li>○ Sedges (<i>Cyperus</i> spp., <i>Fuirena</i> spp. and <i>Schoenoplectus</i> spp.)</li> <li>○ Rushes (<i>Juncus</i> spp.)</li> <li>○ Bull rushes (<i>Typha capensis</i>)</li> <li>○ Reeds (<i>Phragmites australis</i>)</li> <li>○ Grasses (<i>Imperata cylindrica</i>)</li> <li>○ Bulbs (such as <i>Crinum</i> spp., <i>Trachyantra</i> spp., <i>Kniphofia ensifolia</i>) could also be used in non-permanent wetland zones.</li> </ul> </li> <li>• Siltation prevention measures such as hay bales and indigenous vegetation should be installed at the outflows from all storm water outlets to catch any sediment still in suspension.</li> <li>• Energy dissipation measures such as gabions, straw bales and other dissipation devices must be installed at storm water inlets and outlets to decrease the speed and energy of water and to minimise the potential for downstream erosion.</li> </ul>	Engineer; Contractor; Landscape contractor; Hydro-seeding contractor

3. Stabilization of watercourse where erosion occur	<p>Levelling of the existing watercourses will be done where it has eroded to form gullies or deep (steep) river banks. This will make the stream shallower by increasing the width of the stream, resulting in a decreased velocity of the stream and reducing the erosion ability. Hyson cells or Eco mats can be considered if the stability of the sloped area is in question. Levelling of the watercourse will be done in conjunction with action no. 5 (construction of small structures).</p> <p>Downstream of the study area, gabion structures should be established and other measures to ensure stability of the downstream system and prevent further erosion.</p>	Contractor Engineer
4. Sloping	<p>If the embankments of the wetland is too steep (this is unlikely), it will be sloped to an acceptable gradient (decided upon by engineers) and be vegetated to ensure stability.</p>	Contractor Engineer
5. Regulate flow through the construction of small structures	<p>Construct boulder weirs at allocated points (indicated on the rehabilitation plan), where storm water enter the wetland stream, in order to decrease the water flow. The weir will allow the water table to rise a little and break the energy flow which will decrease the risk of erosion. The weir will include a Reno mattress which will assist with silt trapping and thus releasing cleaner water. Effective levelling should be conducted before the implementation of any rehabilitation structure. A geotextile lining may be incorporated between the boulders to act as a silt trap and ensure that the soil do not move downwards through the boulders.</p> <p>Below are illustrations of the recommended structures to be used for the rehabilitation of the wetland where storm water outlets will be directed towards the stream.</p> <p>The size and position of all weir structures need to be assigned by engineers after the necessary calculations and analysis have been conducted. The contractor on site will be responsible to</p>	Engineer Contractor