ANNEXURE D4aii:
FLORA ASSESSMENT

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Flora Assessment

of

PART OF THE REMAINDER OF PORTION 1 OF THE FARM WATERVAL 5-IR

November 2009

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Report verified/reviewed by: Dr. L.A. Coetzer (D.Sc., Prof. Nat. Sci.)

VERIFICATION STATEMENT

Petro Lemmer is a Certified Natural Scientist with the S.A. Council for Natural Scientific Professions. This statement serves to verify that the flora report compiled by Petro Lemmer has been prepared under my supervision, and I have verified the contents thereof.

Declaration of Independence: I, Dr. L.A. Coetzer (421009 5029 089) declare that I:

- am committed to biodiversity conservation but concomitantly recognize 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 for Natural Scientific Professions
- act as an independent specialist consultant in the field of botany
- am subcontracted as specialist consultant by Galago Environmental CC for the proposed Waterval Valley development project 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 the Galago Environmental CC 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, 2006.

Dr. L.A. Coetzer

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1. INTRODUCTION

Galago Environmental was appointed to conduct a vegetation survey on Part of the Remainder of Portion 1 of the farm Waterval 5-IR scheduled for residential/commercial development. The objective was to determine which species might still occur on the site. Special attention had to be given to the habitat requirements of all the Red List species that may occur in the area. This survey focuses on the current status of threatened plant species occurring, or which are likely to occur on the study site, and a description of the available and sensitive habitats on the site and within 200 meters of the boundary of the site.

2. OBJECTIVES OF THE STUDY

- To assess the current status of the habitat component and current general conservation status of the area;
- To list the perceptible flora of the site and to recommend steps to be taken should endangered, vulnerable or rare species be found;
- To highlight potential impacts of the development on the flora of the proposed site; and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.

3. SCOPE OF STUDY

This report:

- Lists the more noticeable trees, shrubs, herbs, geophytes and grasses observed during the study and offers recommendations about the preservation of the sensitive areas on the site;
- Indicates medicinal plants recorded and lists alien species;
- Comments on connectivity with natural vegetation on adjacent sites;
- Comments on ecological sensitive areas;
- Evaluates the conservation importance and significance of the site with special emphasis on the current status of resident threatened species; and
- Offers recommendations to reduce or minimise impacts, should the proposed development be approved

4. STUDY AREA

The study site lies in the quarter degree grid cell 2628AA (Johannesburg). Mucina and Rutherford (2006) classified the area as Egoli Granite Grassland, with archaean granite and gneiss of the Halfway House Granite at the core of the Johannesburg Dome supporting leached, shallow, coarsely grained, sandy soil poor in nutrients. This grassland falls within a strongly seasonal summer-rainfall region and very dry winters with frequent frosts.

This vegetation unit is considered endangered. Its conservation target is 24%. Only about 3% of this vegetation unit is conserved in statutory reserves and a few private conservation areas. More than two-thirds of the unit has already undergone transformation, mostly by urbanization, cultivation and by building of roads. Current rates of transformation threaten most of the remaining unconserved areas.

The site abuts road R101 along its western boundary and lies northeast of the township of Buccleuch. Its eastern boundary line runs along the Gautrain railway reserve.

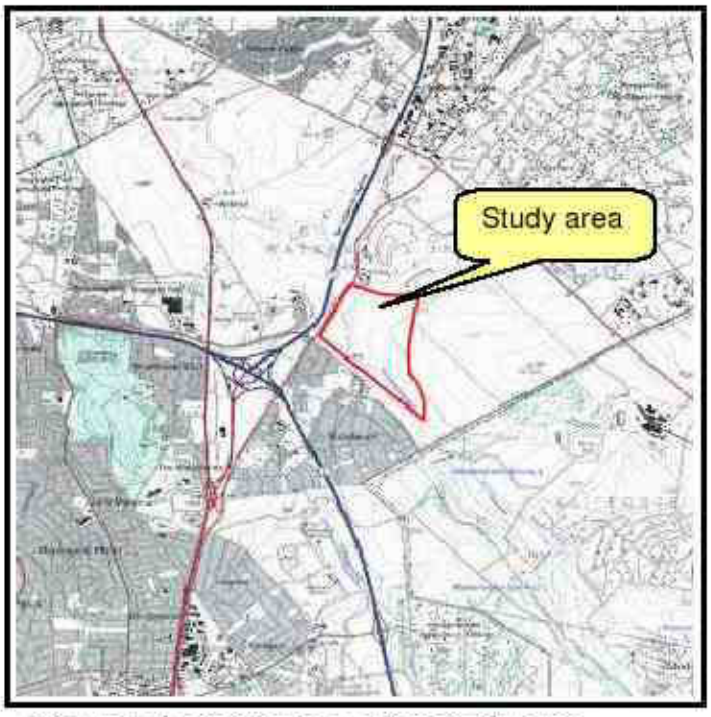

Figure 1: Locality map of the study area

5. METHOD

Information about the Red List and Orange List plant species that occur in the area was obtained from GDARD. The Guidelines issued by GDARD to plant specialists were consulted to ascertain the habitat of the Red- and Orange List species concerned.

The PRECIS list of plants recorded in the 2628AA quarter degree grid square was obtained from SANBI. This list was consulted to verify the record of occurrence of the plant species seen on the site. The vegetation map published in Mucina and Rutherford (2006) was consulted about the composition of Egoli Granite Grassland. A desktop study of the habitats of the Red List and Orange List species known to occur in the area was done before the site visit.

The study site was visited on 5 November 2009 and the various study units identified (see Figure 2). One or more plots, depending on the size and composition of the plant community, were selected at random from each study unit for detailed study. Each plot, which measured about 10m x 10m, was surveyed in a random crisscross fashion and the plants recorded. Areas where the habitat was suitable for the Red List species known to occur in the quarter degree grid square were examined in detail. The Mixed alien and indigenous vegetation and excavations study unit was not surveyed, only scanned for suitable habitat for Red-list species.

Suitable habitat for Red List species on the neighbouring properties, where accessible, was examined to a distance of 200 m from the boundaries of the study site for the presence of Red List plant species.

6. RESULTS

6.1 Study units

Four study units were identified:

- Drainage line vegetation;
- Mixed alien and indigenous vegetation and excavations;
- Granite outcrop vegetation; and
- *Themeda – Hyparrhenia* grassland.

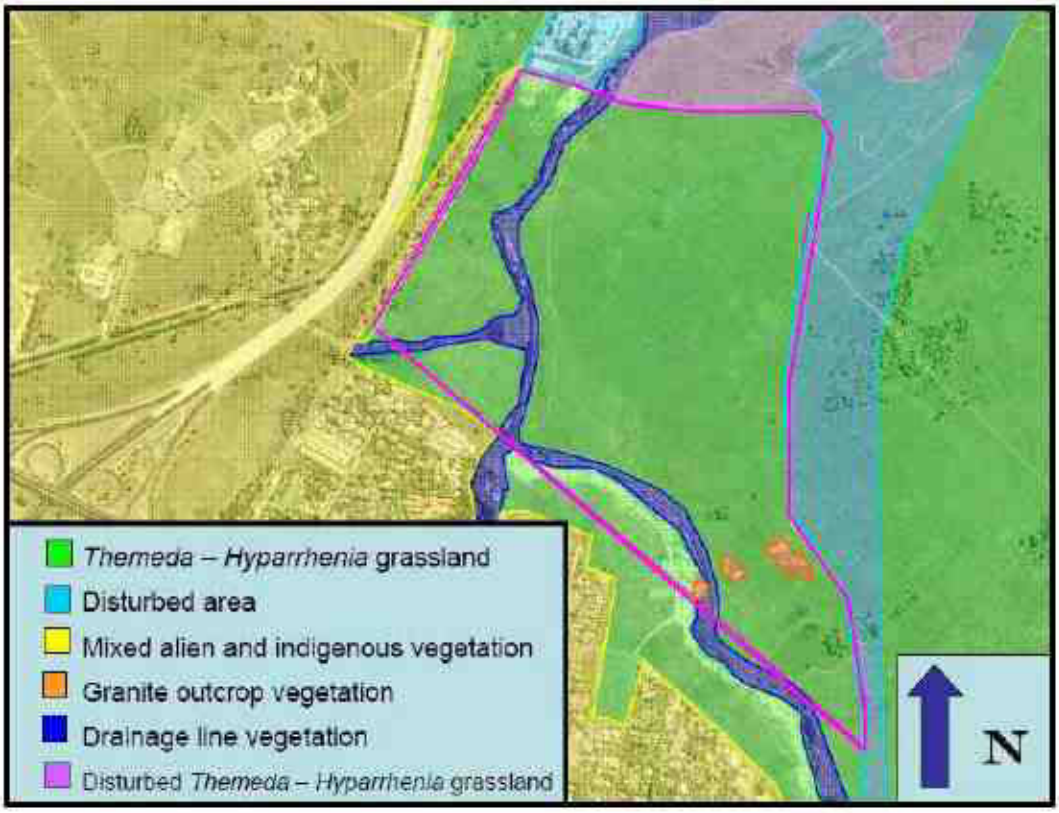

Figure 2: Vegetation Study units on the study site

Tables 3 to 6 list the trees, shrubs, geophytes, herbs and grasses actually found on each of the surveyed areas of the site.

6.2 Medicinal plants

The names of known medicinal plants are marked with numbers to footnotes in Tables 3 to 6 and the footnotes themselves appear at the end of the last table. Of the 221 plant species recorded on the site, 35 species with medicinal properties were found. Their distribution in the various study units is as follows:

Table 1: Number of medicinal species in the various study units

STUDY UNIT	TOTAL NO OF SPECIES IN STUDY UNIT	NO OF MEDICINAL SPECIES IN STUDY UNIT
Drainage line vegetation	48	5
Mixed alien and indigenous vegetation and excavations	Not surveyed	
Granite outcrop vegetation	60	16
Themeda – Hyparrhenia grassland	160	22

6.3 Alien plants

Alien plants are not listed separately, but are included in the lists as they form part of each particular vegetation group. Their names are marked with an asterisk in Tables 3 to 6. Thirty-four alien plant species, of which four species were Category 1 Declared weeds, four were Category 2 Declared invaders and four were Category 3 Declared invaders, were recorded on the site. The number of alien species in each study unit is reflected in table 2.

Table 2: Number of Alien species in each study unit

STUDY UNIT	NO. OF ALIEN SPECIES	CAT 1	CAT 2	CAT 3	NOT DECLARED
Drainage line vegetation	28	4	4	4	16
Mixed alien and indigenous vegetation and excavations	Not surveyed				
Granite outcrop vegetation	4	0	0	0	4
Themeda – Hyparrhenia grassland	12	0	0	0	12

The alien plant names printed in **bold** in the plant tables are those of Category 1 Declared Weeds and the removal of these plants is ***compulsory*** in terms of the regulations formulated under "The Conservation of Agricultural Resources Act" (Act No. 43 of 1983), as amended.

In terms of these regulations, Category 2 Declared invaders may not occur on any land other than a demarcated area and should likewise be removed.

Although the regulations under the above Act require that Category 3 Declared invader plants may not occur on any land or inland water surface other than in a biological control reserve, these provisions shall not apply in respect of category 3 plants already in existence at the time of the commencement of said regulations. If this is the case, a land user must take all reasonable steps to curtail the spreading of propagating material of Category 3 plants.

6.4 Orange List species

The habitat was suitable for all four of the Orange List plant species known to occur in the 2628AA quarter degree grid cell. Two of these species were found.

6.5 Red List species

Thirteen Red List plant species are known to occur in the 2628AA quarter degree grid cell, two of these within 5 km of the site. However, the habitat was suitable only for one of these species, seven specimens of which were found below the earthen weir in the small drainage line below the confluence of the Modderfontein Spruit and the Jukskei River. (See Annexure A for a list of the Red- and Orange List species known to occur in the quarter degree grid cell.)

6.6 Drainage line vegetation

6.6.1 Compositional aspects and Connectivity

This study unit comprised very disturbed vegetation dominated by *Pennisetum clandestinum* (Kikuyu grass) and *Phragmites australis* (Fluitjiesriet). The Modderfontein Spruit was characterised by swift-flowing water and steep sandy banks covered with Kikuyu and patches of *Phagmites australis*. The stream itself was lined with declared invaders such as *Nasturtium officinale* and thickets of trees and reeds that are declared weeds and invaders occurred in patches (see Figure 3). The banks of the Jukskei River were less steep with outcrops of granite and Kikuyu covering most of both banks (see Figure 5). Connectivity with drainage line vegetation upstream and downstream and with natural grassland existed. The species diversity of this study unit was low. Of the 221 plant species recorded on the site, 48 were recorded in the Drainage line vegetation. Of these, only 20 were indigenous species. The following number of species in each life form was noted:

LIFE FORM	NUMBER OF SPECIES
Annual & perennial herbaceous species	24
Tree species	10
Shrubs and dwarf shrubs	3
Grasses	6
Geophytes	2
Sedges	3
Total No of indigenous species	48

6.6.2 Red– and Orange List species

The habitat of this study unit was suitable for one of the Orange List species, but none were found. Seven specimens of the Red List species expected to occur near the drainage line were found. A 200-meter buffer should be kept around the Red List species.

6.6.3 Medicinal and alien species

Five medicinal species were found in this study unit. Twenty-eight of the 35 alien species recorded on the study site were found in the Drainage line study unit. Of these, four were Category 1 Declared weeds, four were Category 2 Declared invaders and four were Category 3 Declared invaders.

6.6.4 Sensitivity

As wetlands form biological filters and drainage lines form corridors for the movement of species, which include pollinators of plant species, this study unit was considered sensitive and should be excluded from development. A rehabilitation plan for the drainage line should be included in the EMP.

Figure 3: Drainage line vegetation along the Modder Spruit

Figure 4: Drainage line vegetation at the confluence of Modder Spruit and Jukskei River. Note the dense Kikuyu grass on the banks.

Figure 5: Drainage line vegetation along the Jukskei River

Table 3: Plants recorded in the Drainage line vegetation

SCIENTIFIC NAME	ALIEN CAT	COMMON NAMES
Abildgaardia ovata		
*Acacia decurrens**	2	Green wattle / Groenwattel
Acacia karroo[1,2]		Sweet thorn / Soetdoring
*Ailanthus altissima**	3	Tree-of-heaven / Hemelboom
Amaranthus hybridus subsp *hybridus**		Common pigweed / Kaapse misbredie
Araujia sericifera*	1	Moth catcher / Motvanger
Argemone ochroleuca*	1	Mexican poppy / Bloudissel
Argyrolobium speciosum		
Artemisia afra[1,2]		Wild wormwood / Wilde-als
Arundo donax*	1	Spanish reed /Spaansriet
Asparagus laricinus		Wild asparagus / Katbos
*Avena fatua**		Common wild oats / Gewone wildehawer
Berkheya radula		Boesmanrietjie
*Bidens bipinnata**		Spanish blackjack / Spaanse knapsekêrel
*Bidens pilosa**		Blackjack / Knapsekêrel
Brassica sp*		Wild rape
*Celtis sinensis**		Chinese nettle tree / Chinese netelboom
*Conyza albida**		Tall fleabane / Vaalskraalhans
*Coreopsis lanceolata**		Tickseed
Cyperus esculentus var *esculentus*		Yellow nutsedge
Datura stramonium*	1	Common thorn apple / Olieboom
Gomphocarpus fruticosus subsp *fruticosus*[1,2]		Milkweed / Melkbos
Imperata cylindrica		Cottonwool grass / Donsgras
*Ipomoea purpurea**	3	Morning glory / Purperwide
Kyllinga erecta var *erecta*		
*Lepidium bonariense**		Pepper weed / Peperbossie
Leucosidea sericea		Ouhout
*Melia azedarach**	3	Syringa / Sering
Menodora africana		Balbossie
*Mirabilis jalapa**		Four o'clock / Vieruurtjie
*Morus alba**	3	Common mulberry / Gewone moerbei
*Nasturtium officinale**	2	Water cress / Bronkhors
*Oenothera rosea**		Pink evening primrose / Pienk aandblom
*Pennisetum clandestinum**		Kikuyu / Kikoejoe
Phragmites australis		Fluitjiesriet
*Physalis viscosa**		Sticky gooseberry / Klewerige appeliefie
Raphanus raphanistrum		Wild radish / Wilderadys
*Robinia pseudoacacia**	2	Black locust / Witakasia
*Rumex crispus**		Curley dock / Krultongblaar
Salix babylonica var *babylonica**	2	Weeping willow / Treurwilg
Salvia runcinata		Wildesalie
Searsia pyroides var *pyroides*[2]		Common wild currant / Taaibos
Setaria sphacelata var *sphacelata*		Small creeping foxtail / Kleinkruipmannagras
*Tagetes minuta**		Tall khaki weed / Lang kakiebos
Trachyandra erythrorrhiza		
Typha capensis[1,2]		Bulrush / Papkuil
*Verbena bonariensis**		Purple top / Blouwaterbossie
Veronica anagallis-aquatica		Water speedwell / Water ereprys

6.7 Mixed alien and indigenous vegetaton and excavations

This study unit was outside, but within 200 meters of the boundaries of the study site and was scanned for suitable habitat for Orange List and Red List species. As most of it comprised gardens with ornamental plants (most of them alien species), roadside vegetation and large excaved and cleared areas such as that of the adjacent quarry and the Gautrain railway line, a survey of this study unit was not deemed necessary. The habitat was not suitable for any of the Orange List or Red List species and this study unit was not considered sensitive.

6.8 Granite outcrop vegetation

6.8.1 Compositional aspects and Connectivity

This study unit comprised outcrops of granite with the vegetation present in cracks and hollows on, between and alongside the rocks. Connectivity with natural grassland existed in all directions, but the connectivity of the grassland itself was limited (see paragraph 6.9.1). The species diversity of this study unit was relatively high if taken into account that large areas of the rock were completely bare of vegetation. Of the 221 plant species recorded on the study site 60 were recorded in the Granite outcrop vegetation study unit. Of these, all but four were indigenous species. The following number of species in each life form were noted:

LIFE FORM	NUMBER OF SPECIES
Annual & perennial herbaceous species	30
Tree species	1
Shrubs and dwarf shrubs	6
Grasses	5
Geophytes	10
Sedges	4
Succulents	4
Total No of indigenous species	60

6.8.2 Red– and Orange List species

The habitat of this study unit was not suitable for any of the Red List species known to occur in the quarter degree grid square, but was suitable for the Orange List *Callilepis leptophylla*, specimens of which were found in a granite outcrop south of the Modderspruit.

6.8.3 Medicinal and alien species

Sixteen of the 35 medicinal species recorded on the study site were found in this study unit. Four alien species were recorded, none of which were declared invaders.

6.8.4 Sensitivity

This study unit was considered sensitive and should be connected via a suitable corridor to an open space area.

Figure 6: Granite outcrops in the southeastern part of the site with the Modder Spruit in the foreground and the construction site of the Gautrain railway line in the background.

Table 4: Plants recorded in the Granite outcrop vegetation

SCIENTIFIC NAME	COMMON NAMES
Acalypha caperonioides	
Albuca setosa	Slymuintjie
Alloteropsis semialata subsp *semialata*	Blackseed grass / Donkersaadgras
Aloe greatheadii var *davyana*[1,2]	Kleinaalwyn
Anthospermum rigidum subsp *rigidum*	
Asparagus cooperi	
Aster harveyanus	Bloublommetjie
Becium obovatum subsp *obovatum* var *obovatum*[2,3]	Cat's whiskers / Katsnor
Berkheya zeyheri subsp zeyheri	
*Bidens bipinnata**	Spanish blackjack / Spaanse knapsekêrel
*Bidens pilosa**	Blackjack / Knapsekêrel
Brachiaria serrata	Velvet grassFluweelgras
Bulbine capitata	
Bulbostylis contexta	
Callilepis leptophylla[2]	Wild daisy / Bergbitterbossie
Cheilanthes involuta var involuta[1,2]	
Chortolirion angolense	
Cleome monophylla	
Commelina modesta	
*Conyza albida**	Tall fleabane / Vaalskraalhans
Crassula capitella subsp *nodulosa*	
Crassula cf *campestris*	
Cyanotis speciosa	Doll's powder puff / Bloupoeierkwassie
Cyperus rupestris var rupestris	
Cyperus semitrifidus	
Dianthus mooiensis subsp *mooiensis* var *mooiensis*[2,3]	Wild pink / Wilde angelier
Diospyros lycioides subsp *guerkei*	Bushveld bluebush / Bosveld-bloubos
Dipcadi cf *papillatum*	
Drimia intricata	Volstruiskos
Elephantorrhiza elephantina[1,2,3]	Elephant's root / Olifantswortel
Gerbera viridifolia	Griekwateebossie
Helichrysum rugulosum[2,3]	
Hypoxis obtusa	Star flower / Gifbol
Indigofera hilaris var *hilaris*	Red indigo bush
Ipomoea oenotherae	
Ipomoea simplex	
Justicia anagalloides	
Ledebouria revoluta[3]	Common ledebouria
Mariscus uitenhagensis	
Melinis nerviglumis	Bristle leaf red top / Steekblaarblinkgras
Myrothamnus flabellifolius[1,2]	Resurrection plant / Bergboegoe
Oldenlandia herbacea var *herbacea*	
Pearsonia cajanifolia subsp *cajanifolia*	
Pellaea calomelanos var *calomelanos*[1,2]	Black cliff brake / Swart kransruigtevaring
Polygala hottentotta[2,3]	Small purple broom
Pygmaeothamnus chamaedendrum var *setulosus*	Sand apple / Goorappel
Raphionacme hirsuta[2]	Khadi root / Khadiwortel
Searsia pyroides var *pyroides*[2]	Common wild currant / Taaibos
Senecio coronatus	Sybossie
Senecio venosus	Besembossie
Sisyranthus randii	
Sphedamnocarpus pruriens subsp galphimiifolius	
Sporobolus stapfianus	Fibrous dropseed / Veselfynsaadgras
*Tagetes minuta**	Tall khaki weed / Lang kakiebos
Talinum caffrum[2]	Porcupine root / Ystervarkwortel
Tephrosia elongata var *elongata*	
Tristachya leucothrix	Hairy trident grass / Harige drieblomgras
Vernonia galpinii	Perskwasbossie
Xerophyta retinervis[1,2]	Monkey's tail / Bobbejaanstert

SCIENTIFIC NAME	COMMON NAMES
Ziziphus zeyheriana[2]	Dwarf buffalo-thorn / Dwerg-blinkblaar-wag-'n-bietjie

6.9 *Themeda – Hyparrhenia* grassland

6.9.1 Compositional aspects and Connectivity

This study unit comprised natural primary grassland with many patches of damp grassland and seepage areas that contained species that favour moist conditions, e.g. *Monopsis decipiens* and *Fimbristylis complanata*. Connectivity with natural grassland was limited by the newly-built Gautrain railway line and by Road R101 and the N1 highway to the west. The Buccleuch township limited connectivity southeast of the site. The species diversity of the *Themeda – Hyparrhenia* grassland was high with 72% of all species recorded on the study site found in this unit. Of the 221 plant species recorded on the study site 160 were recorded here. Of these, 148 were indigenous species. The following number of species in each life form were noted:

LIFE FORM	NUMBER OF SPECIES
Annual & perennial herbaceous species	103
Tree species	1
Shrubs and dwarf shrubs	4
Grasses	24
Geophytes	19
Sedges	7
Succulents	2
Total No of indigenous species	160

6.9.2 Red– and Orange List species

The habitat of the *Themeda – Hyparrhenia* grassland study unit was not suitable for any of the Red List species, but was suitable for two of the Orange List species known to occur in the quarter degree grid cell. One of these, *Hypoxis hemerocallidea* (African Potato) was found sparsely scattered over the entire study unit.

6.9.3 Medicinal and alien species

Twenty-two of the 35 medicinal species recorded on the study site were found in the *Themeda – Hyparrhenia* grassland study unit. Twelve of the 34 alien species recorded on the study site were found in this study unit. None were, however, declared invaders.

6.9.4 Sensitivity

This study unit was considered to be primary Egoli Granite Grassland. However, since the *Themeda – Hyparrhenia* grassland study unit was isolated and not connected to neighbouring grassland, the sensitive status of this study unit is questionable.

Figure 7: *Themeda – Hyparrhenia* grassland with the Jukskei River in the foreground and the Gautrain railway in the background.

Table 5: Plants recorded in the *Themeda – Hyparrhenia* grassland

SCIENTIFIC NAME	COMMON NAMES
Abildgaardia ovata	
Acalypha angustata	Copper leaf / Katpisbossie
Acalypha caperonioides	
Albuca setosa	Slymuintjie
Alloteropsis semialata subsp *semialata*	Blackseed grass / Donkersaadgras
Anthospermum rigidum subsp *rigidum*	
Aristida adscensionis subsp *adscenscionis*	Annual three-awn / Eenjarige steekgras
Aristida congesta subsp *congesta*	Tassle threeawn grass / Katstertsteekgras
Artemisia afra[1,3]	Wild wormwood / Wilde-als
Asparagus cooperi	
Becium obovatum subsp *obovatum* var *obovatum*[2,3]	Cat's whiskers / Katsnor
Bergia decumbens	
Berkheya radula	Boesmanrietjie
Berkheya zeyheri subsp zeyheri	
*Bidens bipinnata**	Spanish blackjack / Spaanse knapsekêrel
*Bidens pilosa**	Blackjack / Knapsekêrel
Brachiaria serrata	Velvet grassFluweelgras
Bulbine capitata	
Cephalaria zeyheriana	Mock scabious
Chamaecrista biensis	
Chironia purpurascens subsp *humilis*	
Chlorophytum calyptrocarpum	
Chlorophytum cooperi	
Chlorophytum fasciculatum	
Chortolirion angolense	
Cleome monophylla	
Commelina africana cf *var barberae*	
Commelina modesta	
*Conyza albida**	Tall fleabane / Vaalskraalhans
Conyza podocephala	
Corchorus asplenifolius	
Cucumis hirsutus	Wild cucumber / Suurkomkommer
Cucumis zeyheri	Wild cucumber / Wilde agurkie
Cyanotis speciosa	Doll's powder puff / Bloupoeierkwassie
Cymbopogon pospischilii	Turpentine grass / Terpentyngras
Cynodon dactylon	Couch grass / Kweek
Cyperus obtusiflorus var *flavissimus*	Geelbiesie
Cyperus obtusiflorus var *obtusiflorus*	Witbiesie
Delosperma herbeum	
Dianthus mooiensis subsp *mooiensis* var *mooiensis*[2,3]	Wild pink / Wilde angelier
Digitaria diagonalis var *diagonalis*	Brown-seed finger grass / Bruinsaadvingergras
Dimorphotheca spectabilis	Blou bietou
Dipcadi sp	
Dipcadi viride	Slymuintjie
Drimia multisetosa	
Elionurus muticus	Wire grass / Draadgras
Eragrostis capensis	Heartseed love grass / Hartjiesgras
Eragrostis chloromelas	Curly leaf / Krulblaar
Eragrostis curvula	Weeping love grass / Oulandsgras
Eragrostis gummiflua	Gum grass / Gomgras
Eriosema burkei var burkei	
Eriosema salignum	Narrow-leaved Eriosema / Smalblaar eriosema
Eulophia hians var *hians*	Ground orchid / Grondorgidee
Euphorbia striata var *striata*	Melkgras
Felicia muricata subsp *muricata*[1,2,3]	White felicia / Blouheuning karooblom
Fimbristylis complanata	
Gazania krebsiana subsp *serrulata*[3]	Common gazania / Botterblom

SCIENTIFIC NAME	COMMON NAMES
Gerbera viridifolia	Griekwateebossie
Gnidia kraussiana var kraussiana[1,2,3]	Harige gifbossie
*Gomphrena celosiodes**	Bachelor's button / Mierbossie
Graderia subintegra	Wild penstemon
Haplocarpha lyrata	
Harpochloa falx	Caterpillar grass / Ruspergras
Helichrysum caespititium	Speelwonderboom
Helichrysum nudifolium var *nudifolium*[1,2]	Hottentot's tea / Hottentotstee
Helichrysum rugulosum[2,3]	
Hermannia grandistipula	
Hermannia lancifolia	
Heteropogon contortus	Spear grass / Assegaaigras
Hibiscus aethiopicus var *ovatus*[2,3]	Common dwarf Hibiscus
Hibiscus microcarpus	
*Hibiscus trionum**	Bladder hibiscus / Terblansbossie
Hyparrhenia hirta	Common thatching grass / Dekgras
Hypericum lalandii	Spindly hypericum / Laland se sintjanskruid
*Hypochaeris radicata**	Hairy wild lettuce / Harige skaapslaai
Hypoxis argentea var *argentea*	Small yellow star flower
Hypoxis hemerocallidea[1,2,3]	African potato
Hypoxis obtusa	Star flower / Gifbol
Hypoxis rigidula var *rigidula*	Silver-leaved star flower / Wilde tulp
Imperata cylindrica	Cottonwool grass / Donsgras
Indigastrum burkeanum	
Indigofera hilaris var *hilaris*	Red indigo bush
Ipomoea bathycolpos	Veldsambreeltjies
Ipomoea crassipes[2,3]	Leafy-flowered Ipomoea / Wildewinde
Ipomoea oblongata[2]	
Ipomoea ommaneyi[2]	Beespatat
Jamesbrittenia aurantiaca	Cape saffron / Saffraanbossie
Justicia anagalloides	
Kohautia amatymbica[2]	Tremble tops
Kohautia virgata	
Kyllinga alba	White button sedge / Witbiesie
Kyllinga erecta var *erecta*	
Lactuca inermis	Wild lettuce
Ledebouria graminifolia	
Ledebouria luteola	
Ledebouria ovatifolia	
Ledebouria revoluta[3]	Common ledebouria
Lotononis calycina	Hairy lotononis
Lotononis foliosa	
Mariscus uitenhagensis	
Melinis nerviglumis	Bristle leaf red top / Steekblaarblinkgras
Melinis repens subsp *repens*	Red top grass
Menodora africana	Balbossie
Merremia palmata	
Monopsis decipiens	Butterfly lobelia / Skoenlapperplant
Monsonia angustifolia	Crane's bill / Angelbossie
Moraea stricta	Bloutulp
Nemesia fruticans	Wilde leeubekkie
Neorautanenia ficifolius	
Nidorella anomala	
Nidorella hottentotica	
Nolletia rarifolia	
*Oenothera rosea**	Pink evening primrose / Pienk aandblom
*Oenothera stricta subsp stricta**	Yellow evening primrose / Geelaandblom
*Oenothera tetraptera**	White evening primrose / Witaandblom
Ornithogalum tenuifolium subsp *tenuifolium*	Bosui
Pavonia burchellii	

SCIENTIFIC NAME	COMMON NAMES
Pelargonium luridum[1,2]	Stalk-flowered Pelargonium / Wildemalva
Pentanisia angustifolia	Wild verbena / Sooibrandbossie
Peucedanum magalismontanum[2]	Wild parsley / Wildepietersielie
Pollichia campestris	Waxberry / Teesuikerbossie
Polygala hottentotta[2,3]	Small purple broom
Raphionacme hirsuta[2]	Khadi root / Khadiwortel
Rhynchosia monophylla	
Rhynchosia totta var *totta*	Yellow carpet bean / Tottabossie
Salvia runcinata	Wildesalie
Scabiosa columbaria[1,2,3]	Wild scabiosa / Bitterbos
Schistostephium crataegifolium	Golden flat flower / Bergkruie
Schrebera alata	Wild jasmine
Senecio affinis	
Senecio erubescens var crepidifolius	
Senecio inaequidens	Canary weed / Geelopslag
Senecio venosus	Besembossie
Seriphium plumosum	Bankrupt bush / Bankrotbos
Setaria nigrirostris	Black seed bristle grass / Swartsaadmannagras
Setaria sphacelata var *sphacelata*	Small creeping foxtail / Kleinkruipmannagras
Sida rhombifolia subsp *rhombifolia*	Arrow leaf Sida / Taaiman
Silene burchellii var *burchellii*	Gunpowder plant / Kruitbossie
Solanum lichtensteinii	Giant bitter appleBitterappel
Solanum panduriforme	Poison apple / Gifappel
Solanum rubetorum	Wildelemoentjie
Sporobolus africanus	Rat's tail dropseed / Taaipol
Sporobolus stapfianus	Fibrous dropseed / Veselfynsaadgras
Striga elegans	Rooiblom
*Tagetes minuta**	Tall khaki weed / Lang kakiebos
Tephrosia elongata var *elongata*	
Tephrosia semiglabra	
Teucrium trifidum	Koorsbossie
Themeda triandra	Red grass / Rooigras
Trachyandra saltii var *saltii*	
Tristachya leucothrix	Hairy trident grass / Harige drieblomgras
Tulbaghia leucantha	Wild garlic / Wilde knoffel
Ursinia nana subsp *leptophylla*	Magriet
*Verbena aristigera**	Fine-leaved verbena / Fynblaar verbena
*Verbena bonariensis**	Purple top / Blouwaterbossie
Vernonia oligocephala[1,2]	Cape vernonia / Blounaaldetee bossie
Vigna unguiculata subsp *stenophylla*	
Wahlenbergia denticulata var *transvaalensis*	
Xysmalobium undulatum[1,2]	Bitterhout
Zornia linearis	

[1] Van Wyk, B-E., Van Oudtshoorn, B. & Gericke, N. 2002.
[2] Watt, J.M. & Breyer-Brandwijk, M.G. 1962.
[3] Pooley, E. 1998.
[4] Van Wyk, B. & Van Wyk P. 1997.

7. FINDINGS AND POTENTIAL IMPLICATIONS

The *Themeda – Hyparrhenia* grassland on the study site was considered primary Egoli Granite Grassland, but its isolation from natural grassland on neighbouring sites does not bode well for its continued pristine status. The Drainage line vegetation and the Granite outcrop vegetation were considered sensitive and should be excluded from development.

Seven specimens of a Red List asphodel species were recorded near the confluence of the Modderfonein Spruit and the Jukskei River. Development within the recommended buffer zone might destroy the population of this Red List species.

8. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

Sufficient information was received and sufficient rain had fallen to accomplish the survey that was done during optimum growing conditions.

Most of the study site was burned during the winter. Most species had sprouted sufficiently to facilitate identification. A few grass species had not yet formed inflorescences.

9. RECOMMENDED MITIGATION MEASURES

The following mitigation measures are proposed by the specialist:

- The red listed *Trachyandra* sp. found must be conserved together with a 200m buffer.
- As many as possible of the Orange List *Hypoxis hemerocallidea* should be relocated to landscaped areas within the proposed development.
- The drainage line vegetation together with a 32m buffer zone must be preserved.
- Disturbance to the drainage line during construction and removal of alien species should be minimized. A plan for the immediate rehabilitation of damage caused to the drainage line should be compiled by a specialist registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science. This rehabilitation plan should form part of the EMP and a record book should be maintained on site to monitor and report on the implementation of the plan.

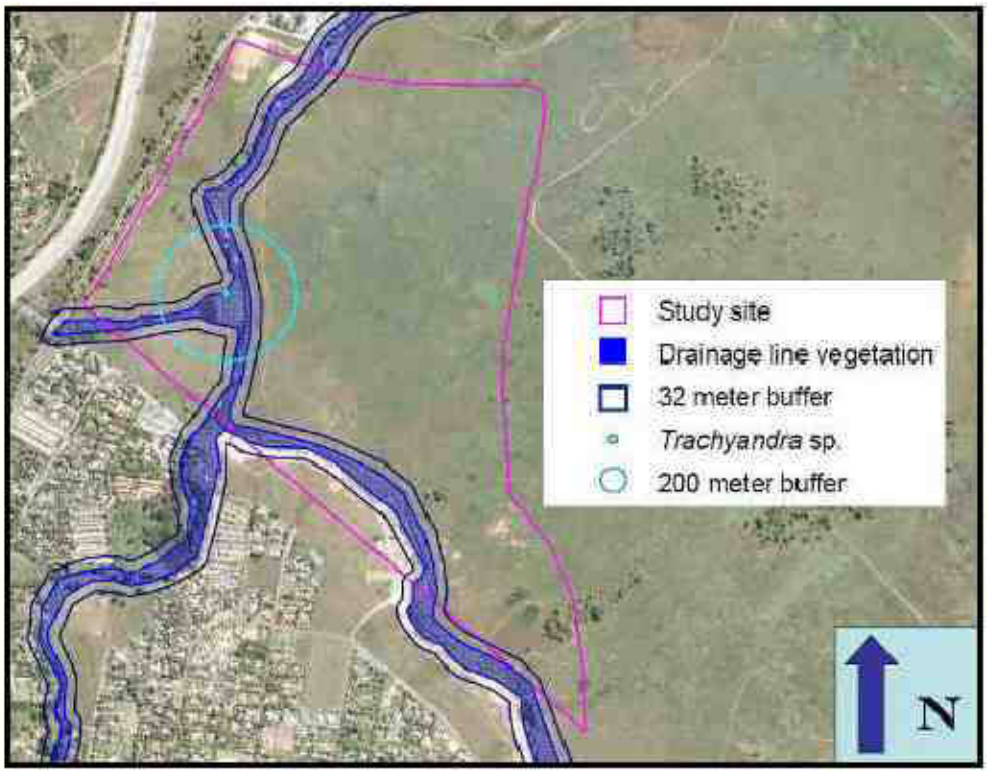

Figure 8: Map of the Drainage line & red listed vegetation together with buffer zones

The following mitigation measures were developed by GDARD (Directorate of Nature Conservation, GDACE, 2008 and 2009) and are applicable to the study site.

- An appropriate management authority (e.g. the body corporate) that must be contractually bound to implement the Environmental Management Plan (EMP) and Record of Decision (ROD) during the operational phase of the development should be identified and informed of their responsibilities in terms of the EMP and ROD.

- All areas designated as sensitive in a sensitivity mapping exercise should be incorporated into an open space system. Development should be located on the areas of lowest sensitivity.
- Development structures should be clustered as close as possible to existing development.
- The open space system should be managed in accordance with an Ecological Management Plan that complies with the *Minimum Requirements for Ecological Management Plans* and forms part of the EMP.
- The Ecological Management Plan should:
    - include a fire management programme to ensure persistence of grassland
    - include an ongoing monitoring and eradication programme for all non-indigenous species, with specific emphasis on invasive and weedy species
    - include a comprehensive surface runoff and storm water management plan, indicating how all surface runoff generated as a result of the development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions
    - ensure the persistence of all Red and Orange List species
    - include a monitoring programme for all Red and Orange List species
    - facilitate/augment natural ecological processes
    - provide for the habitat and life history needs of important pollinators
    - minimize artificial edge effects (e.g. water runoff from developed areas & application of chemicals)
    - include a comprehensive plan for limited recreational development (trails, bird hides etc.) within the open space system
    - include management recommendations for neighbouring land, especially where correct management on adjacent land is crucial for the long-term persistence of sensitive species present on the development site
    - result in a report back to the Directorate of Nature Conservation on an annual basis
    - investigate and advise on appropriate legislative tools (e.g. the NEMA: Protected Areas Act 57 of 2003) for formally protecting the area (as well as adjacent land where it is crucial for the long-term persistence of sensitive species present on the development site)
- The open space system should be fenced off prior to construction commencing (including site clearing and pegging). 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. Access of vehicles to the open space system should be prevented and access of people should be controlled, both during the construction and operational phases. Movement of indigenous fauna should however be allowed (i.e. no solid walls, e.g. through the erection of palisade fencing).
- Information boards should be erected within the development to inform residents of the presence of Red / Orange List species, their identification, conservation status and importance, biology, habitat requirements and management requirements.
- Only indigenous plant species, preferably species that are indigenous to the natural vegetation of the area, should be used for landscaping in communal areas. As far as possible, plants naturally growing on the development site, but would otherwise be destroyed during clearing for development purposes, should be incorporated into landscaped areas. Forage and host plants required by pollinators should also be planted in landscaped areas.
- In order to minimize artificially generated surface stormwater runoff, total sealing of paved areas such as parking lots, driveways, pavements and walkways should be avoided. Permeable material should rather be utilized for these purposes.
- The crossing of natural drainage systems should be minimized and only constructed at

the shortest possible route, perpendicular to the natural drainage system. Where possible, bridge crossings should span the entire stretch of the buffer zone.

10. CONCLUSION

To reduce the impact of the proposed development on the vegetation of the study site, great care should be taken to group residences on smaller lots in certain areas, rather than spreading them out over large areas. Roads, footpaths, services etc should be constructed with great care.

The Granite outcrop vegetation and the drainage line vegetation were deemed sensitive and should be excluded from the proposed development and where possible, these areas must be connected to other natural grassland areas on the neighbouring properties to facilitate connectivity. A 200-meter bufffer should be allowed around the Red List species. Dumping of builders' rubble and other waste in the areas earmarked for exclusion must be prevented, through fencing or other management measures. These areas must be properly managed throughout the lifespan of the project in terms of fire, eradication of exotics etc. to ensure continuous biodiversity.

All Category 1 Declared Weeds, Category 2 and 3 Declared invaders and other alien species must be removed from the site, taking great care when removing the aliens from the Drainage line so that the impact on the drainage line is not aggravated.

Figure 9: Map of the sensitive flora vegetation on site

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ANNEXURE A: Red– and Orange List* plants of the 2628AA q.d.g.c.

Species	Flower season	Suitable habitat	Priority grouping	Conserv status	PRESENCE ON SITE
Adromischus umbraticola subsp *umbraticola*	Sep-Jan	Rock crevices on rocky ridges, usually south-facing, or in shallow gravel on top of rocks, but often in shade of other vegetation.	A2	Near threatened[1]	Habitat not suitable
▲ *Bowiea volubilis subsp volubilis*	Sep-Apr	Shady places, steep rocky slopes and in open woodland, under large boulders in bush or low forest.	B	Vulnerable[2]	Habitat not suitable
Callilepis leptophylla	Aug-Jan & May	Grassland or open woodland, often on rocky outcrops or rocky hillslopes.	N/A	Declining[2]	**FOUND**
Cineraria austrotransvaal-ensis	Mar-Jun	Among 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 rock types quartzite, dolomite & shale, 1400 – 1700m.	A3	Near threatened[1]	Habitat not suitable
Cineraria longipes	Mar-May	Grassland, on koppies, amongst rocks and along seep lines exclusively on basalt on south-facing slopes.	A1	Vulnerable[1]	Habitat not suitable
Delosperma leendertziae	Oct-Apr	Rocky ridges, on rather steep south facing slopes of quartzite in mountain grassveld.	A2	Near Threatened[1]	Habitat not suitable
Delosperma purpureum	Nov-Apr	South-facing slopes, grows in shallow soils among quartzitic rocks of crystalline or coglamoratte type in open or broken shade rarely in shade, in grassland with some trees. .	A1	Endangered[1]	Habitat not suitable
Eucomis autumnalis	Nov-Apr	Damp open grassland and sheltered places.	N/A	Declining[2]	**Habitat suitable**
Gunnera perpensa	Oct-Mar	In cold or cool continually moist localities, mainly along upland streambanks.	N/A	Declining[2]	**Habitat suitable**
Habenaria bicolor	Jan-Apr	Well-drained grassland, at about 1600m.	B	Near Threatened[2]	Habitat not suitable
Habenaria mossii	Mar-Apr	Open grassland on dolomite or in black sandy soil.	A1	Endangered[1]	Habitat not suitable
Holothrix micrantha	Oct	Terrestrial on grassy cliffs, recorded from 1500 to 1800m.	A1	Endangered[1]	Habitat not suitable
Holothrix randii	Sep-Jan	Grassy slopes & rock ledges, usually southern aspects.	B	Near Threatened[2]	Habitat not suitable
Hypoxis hemerocallidea	Sep-Mar	Occurs in a wide range of habitats. From sandy hills on margins of dune forests to open rocky grassland. Also on dry, stony grassy slopes, mountain slopes and plateaux. Appears to be drought and fire tolerant. Grassland and mixed woodland.	N/A	Declining[2]	**FOUND**
Khadia beswickii	Jul-Apr	Open areas on shallow surfaces over rocks in grassland.	A1	Vulnerable[1]	Habitat not suitable
Stenostelma umbelluliferum	Sep-Mar	Deep black turf in open woodland mainly in the vicinity of drainage lines.	A3	Near threatened[1]	Habitat not suitable
▲ *Trachyandra erythrorrhiza*	Sep-Nov	Marshy areas, grassland, usually in black turf marshes.	A3	Near Threatened[1]	**FOUND**

[1] global status
[2] national status
* Orange listed plants have no priority grouping and are designated 'N/A'
▲ Has been recorded from the farm on which the study site is situated / within 5km of the study site. Should suitable habitat be present, it is highly likely that this species could occur on the study site.

ANNEXURE D4aiii:
MAMMAL HABITAT ASSESSMENT

GALAGO ENVIRONMENTAL

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Mammal Habitat Assessment

of

THE REMAINDER OF PORTION 1 OF THE FARM WATERVAL 5 IR

November 2009

Report author: I.L. Rautenbach (Pr.Sci.Nat: Ph.D, T.H.E.D.)

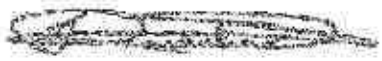
Abstract

For a number of reasons the biological diversity of the site has declined to the point that it is most likely irrevocable. While most (if not all) of the mammals will be displaced by the development, none of the species that survived to date are so rare or endangered that their local displacement will place their conservation in jeopardy.

However, the conservation status of the Modderfontein Spruit is a travesty. Since it is contended that this waterway should be regarded as an open space sensitive system, pollution must be cleared up and remedial steps taken to combat kikuyu infestation and replaced by indigenous wetland vegetation. This will also enhance the ability of the Modderfontein Spruit to again act as a functional dispersal corridor.

Declaration of Independence: I, Ignatius Lourens Rautenbach (421201 5012 00 5) declare that I:

- am committed to biodiversity conservation but concomitantly recognize 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 for Natural Scientific Professions
- act as an independent specialist consultant in the field of zoology
- am subcontracted as specialist consultant by Galago Environmental CC for the proposed project "Mammal Habitat Survey of Farm Waterval 5 IR Remainder of Portion 1" 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 the Galago Environmental CC 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 2006



I.L. Rautenbach

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1. INTRODUCTION

Galago Environmental CC. was appointed to undertake a mammal habitat survey for Part of the Remainder of Portion 1 of the Farm Waterval, which is scheduled for commercial and residential development.

This report focuses on the reigning status of threatened and sensitive mammals likely to occur on the proposed development site. Special attention was paid to the qualitative and quantitative habitat conditions for Red Data species deemed present on the site. The secondary objective of the investigation was to gauge which mammals might still reside on the site and compile a complete list of mammal diversity of the study area.

2. SCOPE AND OBJECTIVES OF THE STUDY

- To qualitatively and quantitatively assess the significance of the mammal habitat components and current general conservation status of the property;
- Comments on ecological sensitive areas;
- Comments on connectivity with natural vegetation and habitats on adjacent sites;
- 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 172.8 ha site (2628AA) is north-east of the Buccleuch suburb and the Buccleuch Interchange, Midrand / Modderfontein. The R101 lays immediately north-west of the site, with the N1 a short distance beyond the R101. To the north is a large quarry with light industries in-between it and the site, whereas the area to the east is undeveloped. The perennial Modderfontein Spruit runs roughly parallel to the R101 through the site, whereas a seasonal drainage line below the Modderfontein Dam No 4 is situated close to Buccleuch. The banks of the Modderfontein Spruit are steep and are furthermore heavily overgrown with rank kikuyu, which have replaced natural wetland vegetation. The spruit is badly polluted with plastic, polystyrene, paper and other refuge. A few patches of reeds are in evidence.

Although the site and the undeveloped areas to its east are undeveloped, the natural grassland is obviously burnt on an annual basis and is ecologically speaking not nearly in a climax condition. A few termitaria have been noted. The substrate consists of dark-brown sandy soil with gravel, and with rocky outcrops in places. The conservation status of the site is ranked as poor in terms of fauna.

The study site falls within the Egoli Granite Grassland veld type of the Grassland biome as defined by Mucina and Rutherford (2006). However, the typical biota of this veld type has been seriously compromised by grazing and fires. The topography

of the area is typical undulating plains of the Highveld Grassland. Trees are few and scattered and are mostly exotic. There are no randjies, rocky outcrops or bat caves. The following GPS coordinates spatially define the site: 26º 02.333'S; 28º 06.535'E.

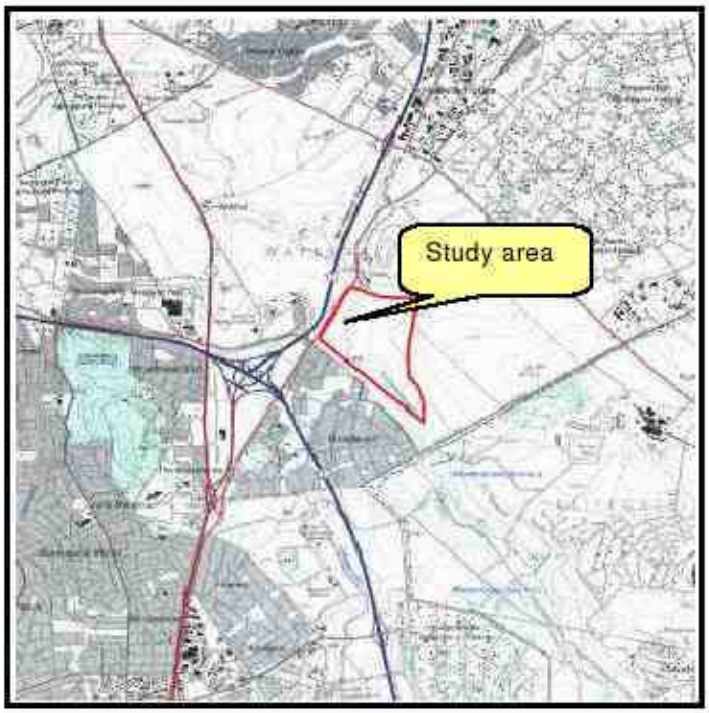

Figure 1: Locality map of the study area

4. METHODS

An eight-hour site visit was conducted on 24 October 2009. During this visit the observed and derived presence of mammals associated with the recognized habitat types of the study site, were recorded. This was done with due regard to the well-recorded known distributions of Southern African mammals, coupled to the qualitative and quantitative nature of recognized habitats.

The 500 meters of adjoining properties was scanned for important fauna habitats.

4.1 Field Surveys

During the site visit mammals were identified by visual sightings through random transect walks. No trapping or mist netting was conducted, as the terms of reference did not require such intensive work. In addition, mammals were also identified by means of spoor, droppings, burrows or roosting sites. Locals were interviewed to confirm occurrences or absences of species.

Three criteria were used to gauge the probability of occurrence of mammals on the study site. These include known distribution range, habitat preference and the qualitative and quantitative presence of suitable habitat.

4.2 Desktop Surveys

As the majority of mammals are secretive, nocturnal, hibernators and/or seasonal, distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of these species based on authoritative tomes, scientific literature, field guides, atlases and databases. This can be done irrespective of season.

The probability of occurrences of **mammal** species was based on their respective geographical distributional ranges and the suitability of on-site habitat. In other words, *high* probability would be applicable to a species with a distributional range overlying the study site as well as the presence of prime habitat occurring on the study site. Another consideration for inclusion in this category is the inclination of a species to be common, i.e. normally occurring at high population densities.

Medium probability pertains to a mammal species with its distributional range peripherally overlapping the study site, or required habitat on the site being sub-optimal. The size of the site as it relates to its likelihood to sustain a viable breeding population, as well as its geographical isolation is also taken into consideration. Species categorised as *medium* normally do not occur at high population numbers, but cannot be deemed as rare. A *low* probability of occurrence will mean that the species' distributional range is peripheral to the study site and habitat is sub-optimal. Furthermore, some mammals categorised as *low* are generally deemed rare.

4.3 Specific Requirements

During the visit the site was surveyed and assessed for the potential occurrence of Red Data and/or ridge and wetland-associated species such as:

Juliana's golden mole (*Neamblosomus juliana*), highveld golden mole (*Amblysomus septentrionalis*), rough-haired golden mole (*Chrysospalax villosus*), African marsh rat (*Dasymys incomtus*), Angoni vlei rat (*Otomys angoniensis*), vlei rat (*Otomys irroratus*), white-tailed rat (*Mystromys albicaudatus*), rock dormouse (*Graphiurus murinus*), forest shrew (*Myosorex varius*), other shrew species, short-eared trident bat (*Cloeotis percivali*), other cave-dwelling bats, African clawless otter (*Aonyx capensis*), spotted-necked otter (*Lutra maculicollis*), marsh mongoose (*Atilax paludinosus*).

5. RESULTS

Known mammal distributions correlate well with biomes as defined by Acocks (1953), Low and Rebelo (1998), Knobel and Bredenkamp (2005) as well as Mucina and Rutherford (2006). However, the local occurrences of mammals are more closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupiculous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of mammal species by evaluating the habitat types within the context of known distribution ranges. Sight records and information from residents or knowledgeable locals audit such deductions.

Mammal Habitat Assessment

From a mammal habitat perspective, two of the four major habitats are present on the site, i.e. terrestrial and aquatic. Both habitats are ecologically disturbed by over-utilization, fires and pollution.

For small mammal populations fires are a catastrophic event, which destroy cover and nourishment and leave populations desolate during winter. As a result of regular fires sensitive species such as the white-tailed rat and rough-haired golden mole became extirpated, whereas populations of more robust species are lower than normal.

The site lacks bat caves or any other structure that could serve as daytime roosts for bat colonies.

The 500-meter zones of adjoining properties vary from a busy road (R101), to the Buccleauch suburb, to undeveloped areas to the east. The latter is in a similar state of ecological disrepair.

Figure 2: A view over the Modderfontein Spruit from its western bank. Note the pollution, and the patch of lush kikuyu and reeds on the opposite bank.

Expected and Observed Mammal Species Richness

Of the 28 mammal species expected to occur on the study site (Table 1), only two were confirmed during the site visit (Table 2). It should be noted that potential occurrences is interpreted as to be possible over a period of time as result of expansion and contractions of population densities and ranges which stimulate migration.

All large and most medium-sized species (aardvark, porcupine) succumbed to encroaching civilization and the various influences on species richness. Also affecting the species richness of the site is that species narrowly dependent on arboreal or rupiculous habitats, had *a priori* to be deleted from the list of possible occurrences since these habitats are absent. Also negatively influencing species richness is the poor state of environment conservation which caused sensitive species (viz. white-tailed rat, African marsh rat, rough-haired golden mole) to disappear.

Table 1 lists the mammals which were observed or deduced to occupy the site, or to be occasional visitors. All feral mammal species expected to occur on the study site (e.g. house mice, house rats, dogs and cats) were omitted from the assessment since these species normally associate with human settlements.

Most of the species of the resident diversity (Table 2) are common and widespread.

Abandoned termitaria are used as refuges by dwarf shrews and dwarf mice, and are thus taken as an indicator of their presence. The three bat species are resilient and thus common. Although there are no daytime roosting opportunities on the site, it is most likely that these bats will commute from other sites where they have found roosting opportunities, to hawk for insects rising over the wetland during summer dusks. Slender and yellow mongooses have shown the ability to co-exist with human activities in peri-urban conditions. Steenbok and duiker have reticent habits and therefore often succeed in persisting in disturbed areas with short grass cover in

close proximity to human activities. Although these two small antelopes are listed, no signs to corroborate their presence were found.

The low diversity is due to low habitat diversity, site size and adjoining areas, and especially quality of conservation.

Threatened and Red Listed Mammal Species

The five Red Data shrews listed are ranked as "Data Deficient", which signify that insufficient field observations are available to make a quantitative assessment of their conservation status. The reddish-grey and the lesser red musk shrews are often found in urban gardens where they take refuge in compost heaps and dense foliage and feed on garden variety insects and molluscs.

The riparian zone of the spruit, disturbed as it is, most probably still offers sanctuary to some of the Red Data shrew species listed, as well as the sensitive vlei rat species.

No other Red Data or sensitive species are deemed present on the site; either since the site is too disturbed (viz. for instance the spotted-necked otter), falls outside the distributional ranges of some species, or does not offer suitable habitat(s). It is contended that the polluted and disturbed nature of the riparian zone is no longer suitable for sensitive species such as the rough-haired golden mole or the white-tailed rat, which are now submitted to be extirpated.

Table 1: The mammals which were observed or deduced to occupy the site
(Systematics and taxonomy as proposed by Bronner et.al [2003] and Skinner and Chimimba [2005])

	SCIENTIFIC NAME	ENGLISH NAME
√	*Lepus saxatilis*	Scrub hare
√	*Cryptomys hottentotus*	African mole rat
√	*Rhabdomys pumilio*	Four-striped grass mouse
*	*Mus indutus*	Desert pygmy mouse
*	*Mus minutoides*	Pygmy mouse
√	*Mastomys natalensis*	Natal multimammate mouse
*	*Mastomys coucha*	Southern multimammate mouse
*	*Aethomys ineptus*	Tete veld rat
?	*Otomys angoniensis*	Angoni vlei rat
?	*Otomys irroratus*	Vlei rat
*	*Gerbilliscus brantsii*	Highveld gerbil
?	*Dendromus melanotis*	Grey pygmy climbing mouse
?	*Dendromus mesomelas*	Brants' climbing mouse
?	*Dendromus mystacalis*	Chestnut climbing mouse
DD?	*Myosorex varius*	Forest shrew
DD?	*Suncus lixus*	Greater dwarf shrew
DD?	*Suncus infinitesimus*	Least dwarf shrew
DD*	*Crocidura cyanea*	Reddish-grey musk shrew
DD*	*Crocidura hirta*	Lesser red musk shrew
*	*Neoromicia capensis*	Cape serotine bat
*	*Scotophilus dinganii*	African yellow house bat
*	*Scotophilus viridis*	Greenish yellow house bat
?	*Genetta genetta*	Small-spotted genet
?	*Genetta tigrina*	SA large-spotted genet
*	*Cynictis penicillata*	Yellow mongoose
*	*Galerella sanguinea*	Slender mongoose

	SCIENTIFIC NAME	ENGLISH NAME
?	*Sylvicapra grimmia*	Common duiker
?	*Raphicerus campestris*	Steenbok

√ Definitely there or have a *high* probability to occur;
* *Medium* probability to occur based on ecological and distributional parameters;
? *Low* probability to occur based on ecological and distributional parameters.

Red Data species rankings as defined in Friedmann and Daly's S.A. Red Data Book / IUCN (World Conservation Union) (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, LR/cd = Lower risk conservation dependent, LR/nt = Lower Risk near threatened, DD = Data Deficient. All other species are deemed of Least Concern.

Table 2: Mammal species positively confirmed from the study site, observed indicators and habitat.

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
L. saxatilis	Scrub hare	Faecal pellets	Short grassland
C.hottentotus	African mole rat	Tunnel systems	Widespread

Both are robust species with high fecundities, as a result of which they are common and widespread. The scrub hare has reticent behaviour whereas the rodent mole's habitat usage renders it difficult to control.

6. FINDINGS AND POTENTIAL IMPLICATIONS

The biotic and abiotic properties of the study site have declined dramatically. That coupled with various facets of encroaching development and the relatively small and isolated nature renders the site beyond conservation redemption.

The proposed development will not result in a loss of ecological sensitive and important habitat units, ecosystem function (e.g. reduction in water quality, soil pollution), loss of mammal habitat, nor of loss/displacement of threatened or protected species.

However, the polluted nature of the Modderfontein Spruit urgently needs attention along its entire length. In fact, it is suggested below that the spruit and the riparian zone are recognized as a sensitive open space area.

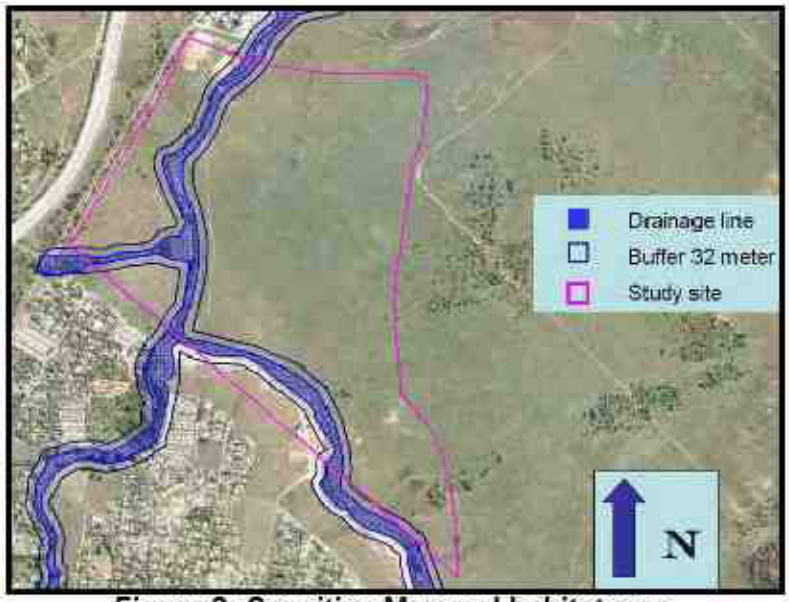

Figure 3: Sensitive Mammal habitat map

7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

A site visit augmented by a desktop survey is deemed sufficient to support the findings presented here. The Galago Environmental team has extensive experience, especially in Gauteng, and has access to relevant literature sources and data bases. It is most unlikely that results from an intensive field survey deploying trapping and netting will deviate significantly from the findings derived here.

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are to some extent made on reasonable and informed assumptions built on *bone fide* information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage. Galago Environmental can thus not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

8. RECOMMENDED MITIGATION MEASURES

The following mitigation measures were developed by GDACE (Directorate of Nature Conservation, GDACE, 2008 and 2009) and are applicable to the study site. **Where appropriate, the specialist's specific elaborations are given in brackets.**

- An appropriate management authority (e.g. the developer) that must be contractually bound to implement the Environmental Management Plan (EMP) and Record of Decision (ROD) during the operational phase of the development should be identified and informed of their responsibilities in terms of the EMP and ROD.
- All areas designated as sensitive in a sensitivity mapping exercise should be incorporated into an open space system (*in this instance the Modderfontein Spruit and its riparian zone).* Development should be located on the areas of lowest sensitivity (*the rest of the site*).
- The open space system should be managed in accordance with an Ecological Management Plan that complies with the *Minimum Requirements for Ecological Management Plans* and forms part of the EMP.
- The Ecological Management Plan should:
    - include a fire management programme to ensure persistence of grassland
    - include an ongoing monitoring and eradication programme for all non-indigenous species (*viz. kikuyu)*, with specific emphasis on invasive and weedy species
    - include a comprehensive surface runoff and storm water management plan, indicating how all surface runoff generated as a result of the development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any

demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions
    - ensure the persistence of all Red and Orange List species
    - include a monitoring programme for all Red and Orange List species
    - facilitate/augment natural ecological processes
    - provide for the habitat and life history needs of important pollinators
    - minimize artificial edge effects (e.g. water runoff from developed areas & application of chemicals)
    - include a comprehensive plan for limited recreational development (trails, bird hides etc.) within the open space system
    - include management recommendations for neighbouring land, especially where correct management on adjacent land is crucial for the long-term persistence of sensitive species present on the development site
    - result in a report back to the Directorate of Nature Conservation on an annual basis
    - investigate and advise on appropriate legislative tools (e.g. the NEMA: Protected Areas Act 57 of 2003) for formally protecting the area (as well as adjacent land where it is crucial for the long-term persistence of sensitive species present on the development site)
- The open space system should be fenced off prior to construction commencing (including site clearing and pegging). 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. Access of vehicles to the open space system should be prevented and access of people should be controlled, both during the construction and operational phases. Movement of indigenous fauna should however be allowed (i.e. no solid walls, e.g. through the erection of palisade fencing).
- Information boards should be erected within the development to inform residents of the presence of Red / Orange List species, their identification, conservation status and importance, biology, habitat requirements and management requirements.
- Outside lighting should be designed to minimize impacts on fauna. All outside lighting should be directed away from sensitive areas. Fluorescent and mercury vapour lighting should be avoided and sodium vapour (yellow) lights should be used wherever possible.
- Only indigenous plant species, preferably species that are indigenous to the natural vegetation of the area, should be used for landscaping in communal areas. As far as possible, plants naturally growing on the development site, but would otherwise be destroyed during clearing for development purposes, should be incorporated into landscaped areas. Forage and host plants required by pollinators should also be planted in landscaped areas.
- In order to minimize artificially generated surface storm water runoff, total sealing of paved areas such as parking lots, driveways, pavements and walkways should be avoided. Permeable material should rather be utilized for these purposes.
- The crossing of natural drainage systems should be minimized and only constructed at the shortest possible route, perpendicular to the natural drainage system. Where possible, bridge crossings should span the entire stretch of the buffer zone.

Roads / Pipelines / Powerlines

- The appropriate agency should implement an ongoing monitoring and

eradication program for all invasive and weedy plant species growing within the servitude.

- 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.
- Any post-development re-vegetation or landscaping exercise should use species indigenous to South Africa. Plant species locally indigenous to the area are preferred. As far as possible, indigenous plants naturally growing along the route, but would otherwise be destroyed during construction, should be used for re-vegetation / landscaping purposes.
- Where a road / pipeline/ power line is to traverse a wetland, measures are required to ensure that the road / pipeline/ power line has minimal effect on the flow of water through the wetland, e.g. by using a high level clear span bridge or box culverts rather than pipes.
- Prior to construction, fences should be erected in such a manner to prevent access and damage to any sensitive areas identified in a sensitivity mapping exercise.
- Sealing of surfaces under a bridge or gabion construction should be avoided.
- Disturbance to any wetlands during construction should be minimized. A plan for the immediate rehabilitation of damage caused to wetlands should be compiled by a specialist registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science. This rehabilitation plan should form part of the EMP and a record book should be maintained on site to monitor and report on the implementation of the plan.

The following recommended mitigatory measures apply to roads and pipelines:

- Engineering measures are recommended to lower the risk of spillages into any wetlands located within 200m of the road/railway/pipeline.

The following recommended mitigatory measures apply to roads:

- Appropriate road design and traffic control measures are recommended to reduce air pollution and animal mortality.
- All storm water structures should be designed so as to block amphibian and reptile access to the road surface.
- A comprehensive surface runoff and storm water management plan should be compiled, indicating how all surface runoff generated as a result of the road development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions. This plan should form part of the EMP.
- Where roads traverse streams/rivers, an underpass should provide for the movement of aquatic as well as terrestrial species through the inclusion of appropriate buffer zones within the underpass (a 32m buffer zone from the edge of the riparian zone recommended for rivers within the urban edge).
- Suitable terrestrial underpasses should be provided to facilitate safe movement of animals, specifically where roads traverse provincially important species/climate change corridors or ridges or habitat suitable for any Red/Orange List amphibian/ reptile/ mammal species. The number and spacing of underpasses will need to be determined by a specialist registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) in the fields of Ecological / Zoological Science. All underpasses should be dressed with a layer of sand (minimum 10cm), should be a minimum of 1.5m

high and 1.0m wide so as to facilitate maintenance access and should be provided with small grates in the road surface to allow light penetration into the underpass. Underpasses should be accessible to maintenance staff and should be cleared of accumulated material at least at the start of each rainy season.

- Where roads traverse natural corridors such as streams and ridges, traffic control measures are recommended (e.g. 60km/h speed limits, speed traps, rumble strips and speed bumps).

9. CONCLUSION

The biological diversity of the hemmed-in site has declined to the point that it is most likely irrevocable. Connectivity with sites in a better state of ecological health is virtually non-existent, hence an influx of former residents are unlikely until the dispersal abilities of the Modderfontein Spruit is restored. No other migration opportunities exist. While most (if not all) of the mammals will be displaced, none of the species that survived to date are so rare or endangered that their local displacement will place their conservation in jeopardy.

However, the conservation status of the Modderfontein Spruit is a travesty. Since it is contended that this waterway should be regarded as an open space sensitive system, pollution must be cleared up and remedial steps taken to combat kikuyu infestation and replaced by indigenous wetland vegetation. This will also enhance the ability of the Modderfontein Spruit to again act as a functional dispersal corridor.

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ANNEXURE D4aiv:
AVIFAUNA HABITAT ASSESSMENT

GALAGO ENVIRONMENTAL

Fauna and Flora Specialists

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Avifauna Habitat Assessment

of

PART OF THE REMAINDER OF PORTION 1 OF THE FARM WATERVAL 5 IR (WATERVAL VALLEY)

November 2009

Report author: Mr. R.F. Geyser
Report verified/reviewed by: Dr A.C. Kemp (Pr. Sci. Nat. Zoology)

VERIFICATION STATEMENT

Mr R. Geyser is not registered as a Professional Natural Scientist with the S.A. Council for Natural Scientific Professions. This statement serves to verify that the bird report compiled by Mr R.F. Geyser has been prepared under my supervision, and I have verified the contents thereof.

Declaration of Independence: I, Alan Charles Kemp (4405075033081) declare that I:

- am committed to biodiversity conservation but concomitantly recognize 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 for Natural Scientific Professions
- act as an independent specialist consultant in the field of zoology
- am subcontracted as specialist consultant by Galago Environmental CC for the proposed Waterval Valley on Part of the Remainder of Portion 1 of the farm Waterval 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 the Galago Environmental CC 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 2006

A.C. Kemp

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1. INTRODUCTION

Galago Environmental CC. was appointed to undertake an avifaunal habitat survey for Waterfall Valley on Part of the Remainder of Portion 1 of the farm Waterval 5 IR, which is scheduled for residential development.

This report focuses on the current status of Red Data or Near Threatened species likely to occur on the proposed development site.

2. SCOPE AND OBJECTIVES OF THE STUDY

- To qualitatively and quantitatively assess the significance of the avifauna habitat components and current general conservation status of the property;
- To comment on ecologically sensitive areas;
- To comment on connectivity with natural vegetation and habitats on adjacent sites;
- To provide a list of birds that occur or might occur, and to identify species of conservation importance;
- To highlight potential impacts of the proposed development on the avifauna 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 site, 172.8 ha in extent, is situated within the 2628AA quarter degree grid cell (q.d.g.c) within the Gauteng Province, northeast and bordering the northern suburb of Buccleuch, and northeast of the Buccleuch interchange and south of Halfway House (26°02'27.4"S 28°06'54.0"E). The Modderfonteinspruit and Jukskei River join each other on the south-western boundary of the study site before the Jukskei River enters the suburb of Buccleuch (26°02'42.1"S 28°06'34.7"E). The study site also borders the R101 (Old Pretoria Road) to the northwest.

The Modderfontein conservancy also known as the Modderfontein Conservation Park is situated to the southeast of the study site (26°03'34"S 28°07'30"E). This 900 ha park covers diverse habitat, including open grassland, mixed woodland, large stands of alien trees, extensive wetland and reed-lined ponds as well as streams that run through the property (Marais & Peacock, 2008). The Modderfontein Spruit runs through this park and enters the study site and the south-eastern corner of the study site (26°03'06"S 28°07'05"E).

The largest portion of the study site consists of open natural grassland with scattered trees, with both permanent streams and non-permanent seasonal streams that run through the property. The Gautrain line development runs along the eastern boundary of the site.

The study site is situated within the Mesic Highveld Grassland Bioregion of the Grassland Biome and more specifically within the Egoli Granite Grassland vegetation type according to Mucina and Rutherford (2006).

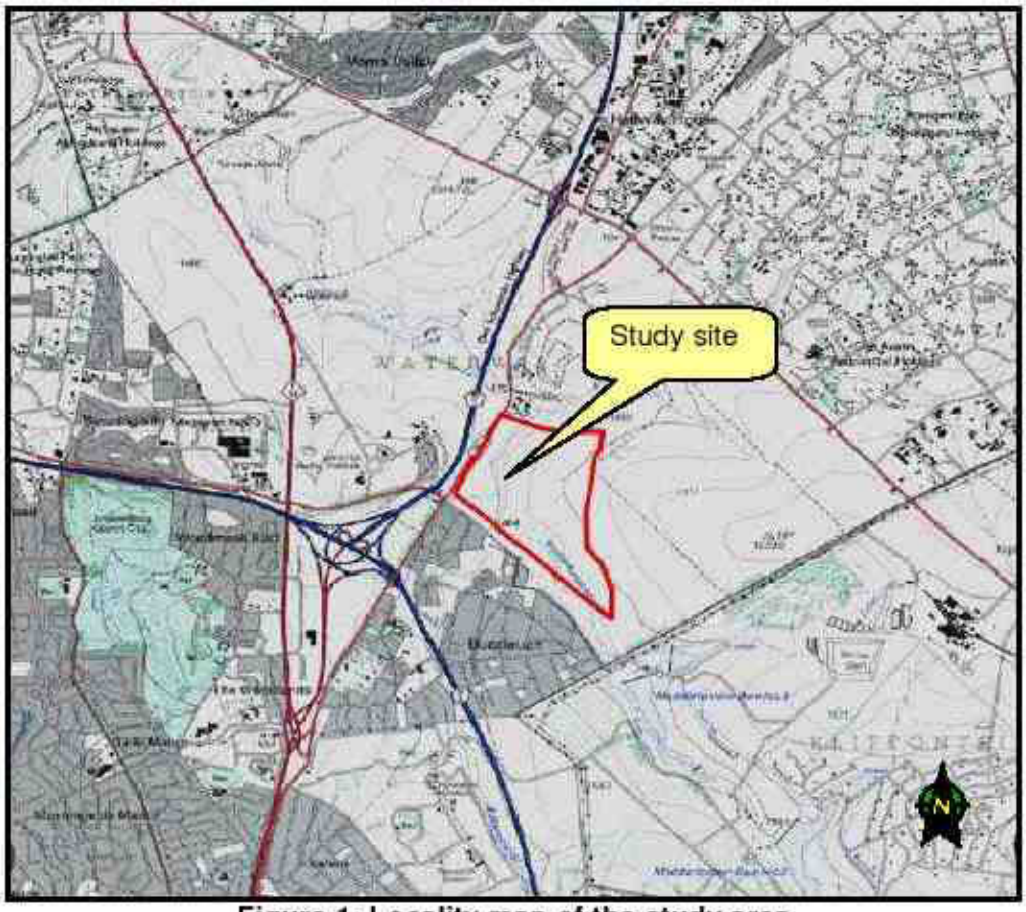

Figure 1: Locality map of the study area

4. METHODS

An eight-hour site visit was conducted on 24 October 2009 to record the presence of bird species associated with the habitat systems on the study site and to identify possible sensitive areas.

4.1 Field Surveys

Birds were identified visually, using 10X42 Bushnell Legend binoculars and a 20X-60X Pentax spotting scope, and by call, and where necessary were verified from Sasol Birds of Southern Africa (Sinclair *et al.*, 2005) and Southern African Bird Sounds (Gibbon, 1991).

The 500 meters of adjoining properties were scanned for important avifauna habitats.

During the site visit birds were identified by visual sightings through random transect walks. No trapping or mist netting was conducted as the terms of reference did not require such intensive work. In addition, birds were also identified by means of feathers, nests, signs, droppings, burrows or roosting sites. Locals were interviewed to confirm occurrences or absences of species.

4.2 Desktop Surveys

The presence of suitable habitats was used to deduce the presence or absence of species based on authoritative tomes, scientific literature, field guides, atlases and databases. This can be done irrespective of season.

The occurrence of key bird species was verified according to distribution records obtained during the Southern African Bird Atlas period from 1981 to 1993 (Harrison *et al* 1997) as well as records from 1974 to 1987 according to Tarboton *et al* (1987).

The occurrence and historic distribution of these birds, including all Red Data bird species for the 2628AA q.d.g.c, were verified according to Harrison *et al* (1997) and Tarboton *et al* (1987). The reporting rate based on Harrison *et al.* (1997) was scored between 0 – 100% and was calculated as follows: Total number of cards on which a species was reported during the Southern African Bird Atlas period X 100 ÷ total number of cards for a particular q.d.g.c. (Harrison *et al.*, 1997). It is important to note that a q.d.g.c. covers a large area. A q.d.g.c, for example 2628AA, covers an area of ±27 X 25 kilometres (±693 km²) and it is possible that suitable habitat will exist for a certain Red Data species within this general and surrounding area. However, the specific habitat found on site may not suit the particular Red Data species although it was recorded for the q.d.g.c. For example, Cape Vulture occurs along the Magaliesberg but will not favour the habitat found within the Pretoria CBD, both of which are both in the same q.d.g.c. Red Data bird species were categorised according to Barnes (2000).

The latest data was also taken from the SABAP2 website that contains records of bird species observed within pentads that fall within the q.d.g.c. This project started on 1 July 2007 and is currently on-going. The study site and surrounding areas fall within the 2600_2805 pentad.

The biodiversity index gives an indication of which habitat will hold the richest bird diversity on site. This is calculated on the sum of the probability of occurrence: 5 = present on site, 4 = not observed on site but has a high probability of occurring on site, 3 = medium, 2 = low, 1 = very low and 0 = not likely to occur, of bird species within a specific habitat system on site.

4.3 Specific Requirements

During the site visit, the study site was surveyed visually and assessed for the potential occurrence of priority Red Data avifauna according to GDACE requirements for Biodiversity assessments, Version 2 as well as other Red Data bird species: The priority Red Data bird species are as follows:

- Half-collared Kingfisher (*Alcedo semitorquata*)
- African Grass-Owl (*Tyto capensis*)
- White-bellied Korhaan (*Eupodotis senegalensis*)
- Blue Crane (*Anthropoides paradiseus*)
- African Finfoot (*Podica senegalensis*)
- Cape Vulture (*Gyps coprotheres*)
- African Marsh-Harrier (*Circus ranivorus*)
- Martial Eagle (*Polemaetus bellicosus*)
- Secretarybird (*Sagittarius serpentarius*)
- Lesser Kestrel (*Falco naumanni*)
- Greater Flamingo (*Phoenicopterus ruber*)

- Lesser Flamingo (*Phoenicopterus minor*)
- White-backed Night-Heron (*Gorsachius leuconotus*)
- Black Stork (*Ciconia nigra*)

No particular reference was made to the possible occurrence of any specific Red Data bird species that might occur on the study site.

5. RESULTS

5.1 Avifaunal Habitat Assessment:

Three major bird habitat systems were identified. A short description of each habitat type is as follows ranked from most to least important. Figure 2 illustrates these habitat systems utilised by bird species expected to occur on the study site.

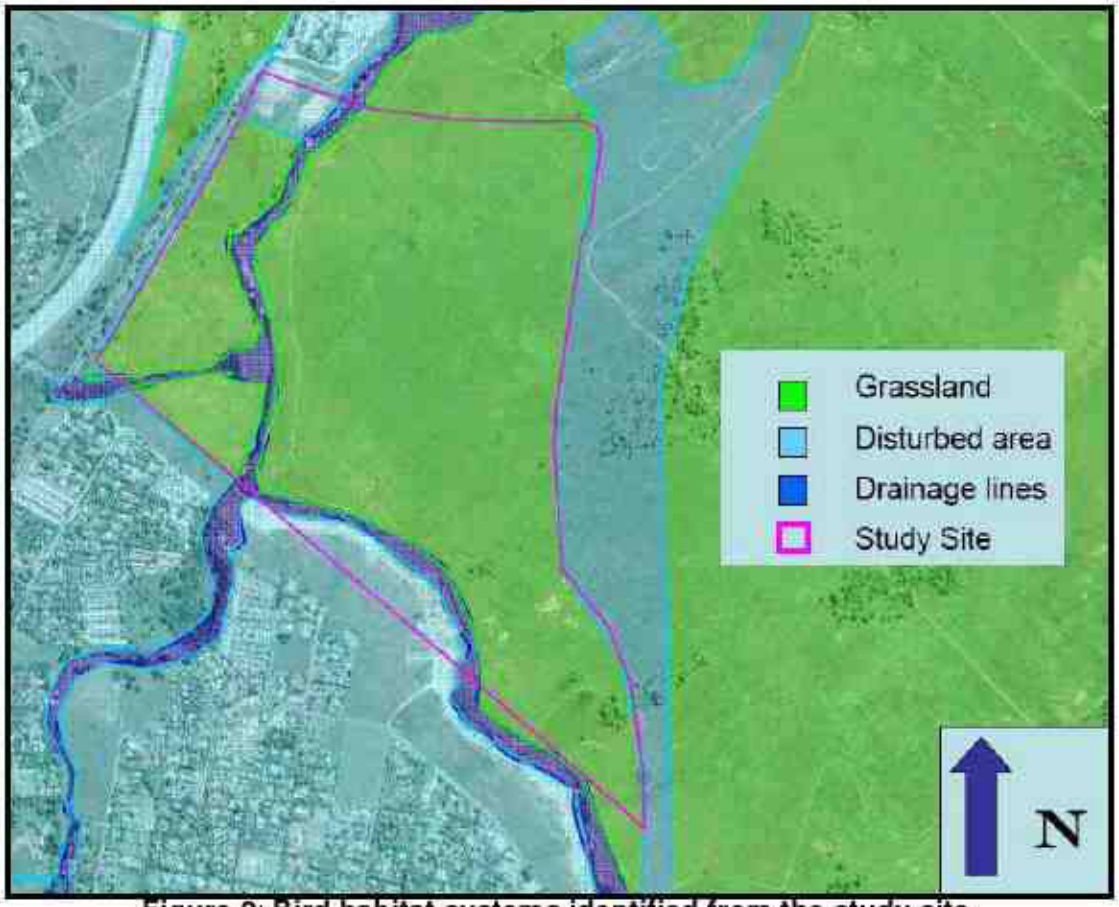

Figure 2: Bird habitat systems identified from the study site.

5.1.1 Open grassland:

The largest portion of the study site consists of open natural grassland dominated by *Hyparrhenia hirta* grass with scattered shrubs and solitary exotic and indigenous trees. Some degree of disturbance is visible on this open grassland through past and present human activities (Figures 3, 4, 5). Natural exposed granite rock is also visible in this area. Human presence on site is rather high with a network of human tracks that criss-cross the area. The Gautrain main workshop and assembly development point is situated on the eastern border of the study site (Figure 6).

Figure 3: Open grassland on the eastern side of the Jukskei River.

Figure 4: Open grassland habitat between the Jukskei River and the R101 west of the Jukskei River.

Figure 5: Open grassland between the Modderfontein Spruit and the suburb of Buccleuch.

Figure 6: Open grassland northeast of the Modderfontein Spruit with scattered shrub and trees and the Gautrain development in the background.

Open grassland is the most important habitat type for South Africa's threatened bird species in the region with a proportional importance of 27%. The highest diversity of threatened bird species occurs within this grassland habitat of which many are in the highest category of threat (Barnes 2000).

The presence and abundance of bird species in this habitat will vary from season to season - lush and green in summer after summer rains and dry, brown or burnt during winter. The area will favour ground-living bird species such as lapwings, francolins, pipits, longclaws, larks and chats. These birds either hunt for insects and/or breed on the ground, in burrows or between the grasses and exposed rocks. Seed eating bird species such as weavers, waxbills, manikins, canaries and bishops that breed in the riparian habitat during summer will make use of the open grassland habitat for feeding during winter when the grass is in seed. During the summer they will forage amongst the grass and flowering plants for insects and worms when they feed their young. Widowbirds, waxbills and cisticolas will also breed in the taller and denser grass during summer especially close to the river and riparian systems.

Some sunbirds will feed on the nectar of some of the taller flowing plants. Storks such as White Stork *Ciconia ciconia* and egrets and herons such as Cattle Egret *Bubulcus ibis* and Black-headed Heron *Ardea melanocephala* will forage on the open grassland for mainly grasshoppers. Aerial feeding birds such as martins, swifts and swallows will hunt for insects over the grasslands.

The exposed rock and rocky outcrops that give the typical impression of rocky highveld grassland protects some low woody plants from fire, but are small in area and might favour species such as Wailing Cisticola *(Cisticola lais)*, chats and Bokmakierie *(Telophorus zeylonus)* that might breed and forage between the rocks and within the vegetation that grows between these exposed rocks.

The isolated and scattered trees will only favour a small variety of woodland birds. Birds such as weavers and shrikes will breed is some of these solitary trees and hawking bird species such as shrikes and small birds of prey species will use the trees and shrub to perch on and scan the immediate area for prey species such as grasshoppers and small rodents.

The *Acacia karroo* woodland bush clumps that occur where there is strong underground water present will favour the more common bird species typically associated with a woodland habitat. This area generally includes a variety of the more common arboreal passerines like warblers, shrikes, sunbirds, sparrows, firefinches, waxbills and weavers, as well as arboreal non-passerines like doves, cuckoos and mousebirds. Many bird species make use of the thorny nature of *Acacia* trees to build their nests. *Acacia* trees generally attract many insects and in turn attract a good diversity of typical "Bushveld" bird species.

5.1.2 River and riparian vegetation:

The Jukskei River runs through the western area of the study site flanked by open grassland on both sides of the river. This is mainly an open river system with a mixture of exposed granite rock within the river (Figure 7), steep banks and reed beds with isolated trees such as *Salix babylonica* (Weeping Willow) (Figure 8) and open exposed sand banks (Figure 9) with scattered trees on its banks. There is no mentionable overgrowing riparian vegetation. The open river system is probably as a result of flash floods generated by the runoff water from the suburb of Buccleuch and other suburbs further downstream and flush water generated from upstream suburban areas along the Modderfontein Spruit. The only overgrowing riparian vegetation worth mentioning that will suit some Red Data bird species (mentioned further below) occurs on the south-western border of the study site at the confluence of the Jukskei River and Modderfontein Spruit (Figures 10,11 &12) and further south out of the site within Buccleuch. However, the riparian vegetation here mainly consists of exotic and alien tree species, such as *Eucalyptus*, with dense housing development almost on the banks of the Jukskei River just above the prescribed 100-year flood-line.

Figure 7: Exposed granite rocks forming pools within the Jukskei River.

Figure 8: Reeds growing on the steep banks of the Jukskei River.

Figure 9: Exposed sandbanks of the Jukskei River with domestic pollution present on both banks.

Figure 10, Figure 11 & Figure 12: Dense riparian vegetation at the confluence of the Jukskei River and Modderfontein Spruit.

Dense woodland vegetation occurs on the banks of the Modderfontein Spruit and this vegetation is mainly restricted to the confluence of the Jukskei and Modderfontein Spruit (Figures 10 and 12). Further upstream the Modderfontein Spruit consists of a narrow and shallow non-permanent drainage line that probably only flows strongly during the summer rain season with exposed granite rock in some places and mainly reeds and long grass that grow on its steep banks (Figure 13).

Figure 13: The Modderfontein Spruit is a narrow small river system with mainly reeds that grow on its banks.

Some of the more common woodland bird species will roost, breed and forage in the riparian vegetation close to and at the confluence of the Jukskei River and Modderfontein Spruit as well as the dense almost impenetrable shrub vegetation such as the *Leucosidea sericea* (Old- or Troutwood) (Figure 14) and reeds.

Figure 14: Dense *Leucosidea sericea* shrub that grows on the banks of the Modderfontein Spruit.

Figure 15: *Acacia karoo* bush clumps occur in areas with strong underground water.

Birds such as bishops, weavers, cisticolas and warblers will breed and roost in the reeds growing on the banks of the spruit as well as feed on insects that live within the reeds, tall grass and semi-aquatic vegetation. The reeds will also favour a number of warbler species for breeding, roosting and foraging purposes.

Fish are likely to occur within the Jukskei River and Modderfontein Spruit and will thus attract bird species that feed on them as well as frogs and crabs. This food source will attract bird species such as Hadeda Ibis, kingfishers, herons, egrets, cormorants and Hamerkop. Ducks and grebes will occur on the open water and edges of the Jukskei River and to a lesser extent on the open water areas of the Modderfontein Spruit.

The indigenous woodland bush clumps that occur close to the Jukskei River (Figure 16) will favour the more common bird species typically associated with a woodland habitat. This woodland is included as part of the riparian vegetation.

Figure 16: Indigenous woodland bush clumps that occur close to the Jukskei River.

This area also generally includes a variety of the more common arboreal passerines like warblers, shrikes, sunbirds, sparrows, firefinches, waxbills and weavers as well as arboreal non-passerines like doves, cuckoos and woodpeckers.

5.1.3 Disturbed areas:

A small disturbed area is present in the northern corner of the study site which consists of diggings and areas where large scale dumping occurs.

This area will only attract the more common bird species associated with disturbed open space and birds that are able to adapt to areas transformed by man (Figure 17).

Figure 17: Disturbed area on the proposed development site.

5.2 Observed and Expected Species Richness

Of the 336 bird species recorded for the 2628AA q.d.g.c. 154 (45.8 %) are likely to occur on site and 46 (29.8 %) of these bird species were actually observed on the study site during the survey. The latest data indicates that 113 bird species were observed within the 2600_2805 pentad (SABAP2).

The bird biodiversity index indicates that the largest bird diversity is likely to occur within the river and riparian habitat system on the study site with a biodiversity index (BI) of 461 followed by the open grassland (BI 310) and the disturbed areas (BI 218).

The bird species listed in Table 1 are in species order according to *Roberts - Birds of Southern Africa* VIIth edition (Hockey *et al*, 2005). Those actually observed on site (**in bold**) or are likely to occur within the specific habitat(s) found on site. This does not include overflying birds or rare vagrants. The reporting (R) rate (%) is according to Harrison *et al.* (1997) is also represented by colour codes for each species as follows: Yellow = Very Low, Light Orange = Low, Dark Orange = Medium and Red = High, with reference to the specific habitat systems found on site. The habitat preferences, **OG = Open Grassland, RR = River and Riparian vegetation** and **DA = Disturbed Areas** is indicated next to the reporting rate with its possibility of occurrence in the specific habitats on site rated as 5 = present, 4 = High, 3 = Medium, 2 = Low, 1 = Very low, and 0 = Not likely to occur.

Table 1: Bird species observed and that are likely to occur on the study site.

SCIENTIFIC NAME	ENGLISH NAME	R RATE (%)*	HABITAT PREFERENCE		
		2628AA	OG	RR	DA
Scleroptila levaillantoides	Orange River Francolin	3	1	0	0
Pternistis swainsonii	Swainson's Spurfowl	25	4	3	2
Numida meleagris	**Helmeted Guineafowl**	48	5	4	3
Dendrocygna viduata	White-faced Duck	7	0	2	0
Alopochen aegyptiaca	**Egyptian Goose**	66	0	5	0
Anas sparsa	African Black Duck	32	0	4	0
Anas undulata	**Yellow-billed Duck**	42	0	5	0
Anas erythrorhyncha	Red-billed Teal	8	0	2	0
Indicator indicator	Greater Honeyguide	3	0	2	0
Indicator minor	Lesser Honeyguide	10	0	3	0
Dendropicos fuscescens	Cardinal Woodpecker	15	0	3	0
Tricholaema leucomelas	Acacia Pied Barbet	4	0	1	0
Lybius torquatus	Black-collared Barbet	69	2	4	0
Trachyphonus vaillantii	**Crested Barbet**	65	1	5	1
Upupa africana	African Hoopoe	61	4	4	3
Phoeniculus purpureus	Green Wood-Hoopoe	59	0	4	0
Alcedo semitorquata	Half-collared Kingfisher (NT)	<1	0	1	0
Alcedo cristata	Malachite Kingfisher	6	0	3	0
Halcyon albiventris	Brown-hooded Kingfisher	8	1	4	1
Megaceryle maximus	Giant Kingfisher	7	0	2	0
Ceryle rudis	Pied Kingfisher	14	0	3	0
Merops bullockoides	**White-fronted Bee-eater**	<1	2	5	3
Merops apiaster	European Bee-eater	13	4	4	2
Colius striatus	Speckled Mousebird	80	0	4	3
Urocolius indicus	**Red-faced Mousebird**	53	4	5	4
Chrysococcyx caprius	**Diderick Cuckoo**	25	5	5	4
Centropus burchellii	Burchell's Coucal	33	0	4	1
Cypsiurus parvus	**African Palm-Swift**	25	5	5	4
Apus affinis	Little Swift	42	4	4	4
Apus caffer	**White-rumped Swift**	32	5	5	4
Corythaixoides concolor	Grey Go-away-bird	59	0	3	0
Tyto alba	Barn Owl	7	2	2	2
Bubo africanus	Spotted Eagle-Owl	18	3	3	2
Asio capensis	Marsh Owl	3	1	2	0
Columba livia	Rock Dove	62	2	3	2
Columba guinea	Speckled Pigeon	49	3	3	3
Streptopelia senegalensis	**Laughing Dove**	96	5	5	5
Streptopelia capicola	Cape Turtle-Dove	85	4	4	4
Streptopelia semitorquata	**Red-eyed Dove**	42	4	5	4
Afrotis afraoides	Northern Black Korhaan	7	2	0	0
Gallinula chloropus	Common Moorhen	36	0	3	0
Tringa nebularia	**Common Greenshank**	1	0	5	0
Tringa glareola	Wood Sandpiper	6	0	4	0
Actitis hypoleucos	Common Sandpiper	5	0	2	0
Burhinus capensis	Spotted Thick-knee	31	4	3	2
Charadrius tricollaris	**Three-banded Plover**	20	3	5	2
Vanellus armatus	**Blacksmith Lapwing**	55	4	5	4
Vanellus senegallus	**African Wattled Lapwing**	33	5	4	1

SCIENTIFIC NAME	ENGLISH NAME	R RATE (%)* 2628AA	HABITAT PREFERENCE		
			OG	RR	DA
Vanellus coronatus	**Crowned Lapwing**	81	5	3	4
Larus cirrocephalus	Grey-headed Gull	33	0	2	0
Elanus caeruleus	Black-shouldered Kite	37	4	4	4
Milvus migrans	Black Kite	11	2	2	2
Accipiter minullus	Little Sparrowhawk	<1	0	2	0
Buteo vulpinus	Steppe Buzzard	8	3	3	1
Falco naumanni	Lesser Kestrel (VU)	<1	1	0	0
Falco rupicoloides	Greater Kestrel	4	2	0	0
Falco amurensis	Amur Falcon	1	2	0	0
Tachybaptus ruficollis	Little Grebe	34	0	3	0
Anhinga rufa	African Darter	21	0	3	0
Phalacrocorax africanus	Reed Cormorant	51	0	4	0
Egretta garzetta	Little Egret	13	0	3	0
Ardea cinerea	Grey Heron	34	0	3	0
Ardea melanocephala	Black-headed Heron	54	4	4	3
Ardea purpurea	**Purple Heron**	11	0	5	0
Bubulcus ibis	Cattle Egret	66	4	4	3
Butorides striata	Green-backed Heron	2	0	1	0
Ixobrychus minutus	Little Bittern	1	0	1	0
Scopus umbretta	**Hamerkop**	17	0	3	0
Plegadis falcinellus	Glossy Ibis	19	0	3	0
Bostrychia hagedash	**Hadeda Ibis**	90	3	5	4
Threskiornis aethiopicus	**African Sacred Ibis**	54	0	5	0
Ciconia ciconia	White Stork	2	2	1	0
Oriolus larvatus	Black-headed Oriole	3	0	2	0
Dicrurus adsimilis	Fork-tailed Drongo	4	1	3	1
Terpsiphone viridis	African Paradise-Flycatcher	11	0	4	0
Dryoscopus cubla	Black-backed Puffback	10	1	3	0
Laniarius ferrugineus	Southern Boubou	6	0	3	0
Telophorus zeylonus	**Bokmakierie**	58	5	4	2
Corvus albus	**Pied Crow**	71	5	4	3
Lanius collaris	Common Fiscal	87	4	4	4
Riparia paludicola	Brown-throated Martin	14	2	3	0
Riparia cincta	Banded Martin	2	2	0	0
Hirundo rustica	**Barn Swallow**	34	5	5	3
Hirundo albigularis	White-throated Swallow	31	4	4	2
Hirundo cucullata	**Greater Striped Swallow**	31	5	5	4
Hirundo abyssinica	**Lesser Striped Swallow**	18	4	5	3
Hirundo spilodera	South African Cliff-Swallow	5	2	2	0
Hirundo fuligula	Rock Martin	13	2	2	2
Delichon urbicum	Common House-Martin	7	3	3	3
Pycnonotus tricolor	**Dark-capped Bulbul**	88	3	5	4
Stenostira scita	Fairy Flycatcher	4	0	2	0
Sphenoeacus afer	Cape Grassbird	<1	0	1	0
Bradypterus baboecala	Little Rush-Warbler	5	0	2	0
Acrocephalus baeticatus	**African Reed-Warbler**	5	0	5	0
Acrocephalus arundinaceus	Great Reed-Warbler	2	0	2	0
Acrocephalus gracilirostris	Lesser Swamp-Warbler	9	0	3	0
Phylloscopus trochilus	Willow Warbler	12	0	4	0

SCIENTIFIC NAME	ENGLISH NAME	R RATE (%)* 2628AA	HABITAT PREFERENCE		
			OG	RR	DA
Sylvia borin	Garden Warbler	4	0	1	0
Zosterops virens	Cape White-eye	79	2	4	2
Cisticola lais	Wailing Cisticola	4	2	0	0
Cisticola tinniens	**Levaillant's Cisticola**	25	2	5	1
Cisticola fulvicapilla	**Neddicky**	16	3	5	2
Cisticola juncidis	**Zitting Cisticola**	16	5	5	3
Cisticola aridulus	**Desert Cisticola**	4	5	3	2
Cisticola textrix	**Cloud Cisticola**	6	5	0	0
Cisticola ayresii	Wing-snapping Cisticola	3	2	0	0
Prinia subflava	**Tawny-flanked Prinia**	25	4	5	4
Prinia flavicans	**Black-chested Prinia**	16	5	3	5
Mirafra africana	**Rufous-naped Lark**	12	5	2	2
Mirafra fasciolata	Eastern Clapper Lark	1	2	0	0
Chersomanes albofasciata	Spike-heeled Lark	4	3	0	0
Calandrella cinerea	Red-capped Lark	4	3	0	0
Psophocichla litsitsirupa	Groundscraper Thrush	1	2	1	0
Turdus libonyanus	Kurrichane Thrush	2	0	3	0
Turdus smithi	Karoo Thrush	86	0	4	0
Sigelus silens	Fiscal Flycatcher	49	1	4	1
Muscicapa striata	Spotted Flycatcher	3	0	2	0
Cossypha caffra	**Cape Robin-Chat**	70	1	5	2
Saxicola torquatus	African Stonechat	18	4	4	4
Oenanthe pileata	Capped Wheatear	7	3	0	0
Onychognathus morio	Red-winged Starling	2	2	3	1
Lamprotornis nitens	Cape Glossy Starling	57	3	4	3
Spreo bicolor	Pied Starling	13	3	0	1
Creatophora cinerea	Wattled Starling	<1	1	1	0
Acridotheres tristis	**Common Myna (INT)**	95	4	5	5
Chalcomitra amethystina	Amethyst Sunbird	31	3	4	1
Cinnyris talatala	White-bellied Sunbird	17	1	3	3
Ploceus capensis	Cape Weaver	23	2	3	1
Ploceus velatus	**Southern Masked-Weaver**	92	5	5	5
Quelea quelea	Red-billed Quelea	3	2	2	2
Euplectes afer	Yellow-crowned Bishop	7	2	3	2
Euplectes orix	**Southern Red Bishop**	51	4	5	4
Euplectes albonotatus	White-winged Widowbird	1	2	3	1
Euplectes ardens	**Red-collared Widowbird**	6	3	5	2
Euplectes progne	Long-tailed Widowbird	16	4	3	1
Amblyospiza albifrons	Thick-billed Weaver	5	0	2	0
Sporaeginthus subflavus	Orange-breasted Waxbill	7	2	3	1
Ortygospiza atricollis	African Quailfinch	6	2	3	0
Amadina erythrocephala	Red-headed Finch	1	1	1	1
Estrilda astrild	**Common Waxbill**	14	3	5	4
Lagonosticta rhodopareia	Jameson's Firefinch	<1	0	1	0
Spermestes cucullatus	Bronze Mannikin	2	2	3	1
Vidua macroura	Pin-tailed Whydah	17	4	4	4
Passer domesticus	**House Sparrow (INT)**	68	0	0	5
Passer melanurus	**Cape Sparrow**	94	4	5	5
Passer diffusus	Southern Grey-headed Sparrow	13	3	4	4

SCIENTIFIC NAME	ENGLISH NAME	R RATE (%)* 2628AA	HABITAT PREFERENCE		
			OG	RR	DA
Motacilla capensis	**Cape Wagtail**	72	3	5	3
Macronyx capensis	**Cape Longclaw**	20	5	2	0
Anthus cinnamomeus	**African Pipit**	15	5	0	2
Anthus leucophrys	Plain-backed Pipit	1	1	0	0
Crithagra mozambicus	Yellow-fronted Canary	3	0	2	1
Crithagra atrogularis	Black-throated Canary	24	4	4	4
Crithagra gularis	Streaky-headed Seedeater	13	0	2	0
Emberiza tahapisi	Cinnamon-breasted Bunting	3	2	0	1
	Biodiversity Index		310	461	218

*The reporting rate is calculated as follows: Total number of cards on which a species was reported X 100 ÷ total number of cards for a particular quarter degree grid cell. **INT** = Introduced or alien birds species to Southern Africa.

Red Data Species Categories for the birds (Barnes, 2000)
RE = Regionally extinct, **CR** = Critically Endangered **EN** = Endangered, **VU** = Vulnerable, **NT** = Near-threatened.

The biodiversity index gives an indication of which habitat will hold the richest bird diversity on site. The colour codes for each species are represented as follows: The colour codes for each species are represented as follows: Yellow = Very Low, Light Orange = Low, Dark Orange = Medium and Red = High. The likelihood of occurrence of each species on site in the specific habitat systems are as follows: 5 = present, 4 = High, 3 = Medium, 2 = Low, 1 = very low, and 0 = Not likely to occur.

5.3 Threatened and Red Listed Bird Species

The following Red Data bird species were recorded for the 2628AA q.d.g.c. according to Harrison *et al.* (1997) and Tarboton *et al* (1987) (Table 2).

Table 2: Red Data bird species recorded for the 2628AA q.d.g.c.

SCIENTIFIC NAME	ENGLISH NAME	REPORTING RATE (%)* 2628AA JOHANNESBURG
Alcedo semitorquata	Half-collared Kingfisher (NT)	<1(T)
Tyto capensis	African Grass-Owl (VU)	1(Tb)
Neotis denhami	Denham's Bustard (VU)	(T)
Eupodotis caerulescens	Blue Korhaan (NT)	(T)
Eupodotis senegalensis	White-bellied Korhaan (VU)	2(T)
Balearica regulorum	Grey Crowned Crane (VU)	(T)
Anthropoides paradiseus	Blue Crane (VU)	1(T)
Crex crex	Corn Crake (VU)	<1(T)
Rostratula benghalensis	Greater Painted-snipe (NT)	<1
Glareola nordmanni	Black-winged Pratincole (NT)	<1(T)
Circus ranivorus	African Marsh-Harrier (VU)	<1(Tb)
Circus macrourus	Pallid Harrier (NT)	(T)
Aquila rapax	Tawny Eagle (VU)	(T)
Aquila ayresii	Ayres's Hawk-Eagle (NT)	<1(T)
Polemaetus bellicosus	Martial Eagle (VU)	(T)
Sagittarius serpentarius	Secretarybird (NT)	1(Tb)
Falco naumanni	Lesser Kestrel (VU)	<1(Tb)
Falco biarmicus	Lanner Falcon (NT)	1(Tb)
Falco peregrinus	Peregrine Falcon (NT)	(T)
Gorsachius leuconotus	White-backed Night-Heron (VU)	(T)

SCIENTIFIC NAME	ENGLISH NAME	REPORTING RATE (%)* 2628AA JOHANNESBURG
Phoenicopterus ruber	Greater Flamingo (NT)	1(T)
Phoenicopterus minor	Lesser Flamingo (NT)	<1(T)
Mycteria ibis	Yellow-billed Stork (NT)	<1
Ciconia nigra	Black Stork (NT)	<1(T)
Ciconia episcopus	Woolly-necked Stork (NT)	(T)
Ephippiorhynchus senegalensis	Saddle-billed Stork (EN)	<1
Leptoptilos crumeniferus	Marabou Stork (NT)	<1(T)
Mirafra cheniana	Melodious Lark (NT)	<1(T)
Buphagus erythrorhynchus	Red-billed Oxpecker (NT)	(T)
	Very Low :	**18**
	Low :	**1**
	Medium :	**0**
	High :	**0**
	TOTAL :	**19**
	Tarboton :	**21**
	Tarboton breeding:	**5**
		26

*The reporting rate is calculated as follows: Total number of cards on which a species was reported X 100 ÷ total number of cards for a particular quarter degree grid cell. T = Bird species recorded as present (light blue) and Tb = bird species recording as breeding (dark blue) for the q.d.g.c. according to Tarboton (1987). Bird species with both reporting rates and T or Tb were recorded for the q.d.g.c. according to both Harrison *et al.* (1997) and Tarboton *et al.* (1987). The colour codes for each species are represented as follows: yellow = very low, light orange = low, dark orange = medium and red = high with reference to the specific habitat systems found on site.

Red Data Species Categories for the birds (Barnes, 2000)
RE = Regionally extinct, **CR** = Critically Endangered **EN** = Endangered, **VU** = Vulnerable, **NT** = Near-threatened.

A total of 29 Red Data bird species have been recorded within the 2628AA q.d.g.c. (Tarboton *et al.*, 1987; Harrison *et al.*, 1997) (Table 2). Ten of these appear to have disappeared from the area or were not subsequently recorded for this q.d.g.c. during the time of the Southern African Bird Atlas Project. It is unlikely that they will ever occur in this region except maybe on rare occasions or in protected areas. Five of these species used to breed within the said q.d.g.c (Tarboton, 1987) and none have been recorded breeding for the q.d.g.c. during the period of the Southern African bird atlas project. Most of the Red Data species that have been recorded indicate a low to very low reporting rate. This decline in breeding species is probably due to the large extent of development that has taken place during a short space of time.

5.4 Summary of the Red Data bird species

Table 3 provides a list of the Red Data bird species recorded for the 2628AA q.d.g.c. according to Harrison *et al.* (1997) and an indication of their likelihood of occurrence on the study site based on habitat and food availability.

Table 3: Red Data bird species assessment for the 2628AA q.d.g.c.

SCIENTIFIC NAME	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	STATUS AND LIKELIHOOD OF OCCURRENCE ON STUDY SITE
*Alcedo semitorquata** (Half-collared Kingfisher) (NT)	**None on site:** Requires fast-flowing streams, rivers and estuaries, usually with dense marginal vegetation (Maclean, 1993), especially perennial streams and smaller rivers with overhanging riparian vegetation on its banks. Nests in sand/earth banks (Tarboton *et al.* 1987) and requires riverbanks in which to excavate nest tunnels (Harrison *et al.* 1997a). Most typically occurs along fast-flowing streams with clear water and well-wooded riparian growth, often near rapids. It most frequently favours broken escarpment terrain and requires at least 1 km up and down stream of undisturbed river and riparian vegetation while breeding. It occurs from sea-level to 2000 m.a.s.l. in southern Africa. Usually perches low down on the banks of rivers and streams, often on exposed roosts as well as exposed rock and low overhanging tree branches.	Highly unlikely Due to insufficient riparian vegetation. Will mainly move through the area via the Jukskei River and Modderfontein Spruit. Uncommon in Gauteng and easily overlooked (Marais & Peacock, 2008)
*Tyto capensis** (African Grass-Owl) (VU)	**None on site:** Occurs predominately in rank grass, typically but not always at fairly high altitudes. Breeds mainly in permanent and seasonal vleis which it vacates while hunting or during post-breeding although it will sometimes breed in any area of long grass, sedges or even weeds (Van Rooyen, pers comm.) and not necessarily associated with wetlands (Tarboton *et al.* 1987) although this is more the exception than the rule. Foraging mainly confined to tall grassland next to their wetland vegetation and rarely hunts in short grassland, wetlands or croplands nearby (Barnes, 2000). Mainly restricted to wet areas (marshes and vleis) where tall, dense grass and / or sedges occur. Prefers permanent or seasonal vleis and vacates the latter when these dried up or are burnt. Roosts and breeds in vleis but often hunt elsewhere e.g. old lands and disturbed grassland although this is suboptimal habitat conditions (Tarboton *et al.* 1987). May rarely occur in sparse *Acacia* woodland where patches of dense grass cover are present (Harrison *et al.* 1997a).	Highly unlikely No suitable breeding, roosting and foraging habitat were identified along the Jukskei River and Modderfontein Spruit. The banks of the rivers are too steep and no marsh habitat occurs. Uncommon and secretive resident in Gauteng (Marais & Peacock, 2008)
*Eupodotis senegalensis** (White-bellied Korhaan) (VU)	**Yes:** Occurs in fairly tall, dense grassland, especially sour and mixed grassland, in open or lightly wooded, undulating to hilly country. In winter, occasionally on modified pastures and burnt ground (Harrison *et al.* 1997a).	Highly unlikely Due to high human presence on site and disturbance surrounding the study site. Scarce in Gauteng and secretive resident; widespread (Marais & Peacock, 2008)

SCIENTIFIC NAME	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	STATUS AND LIKELIHOOD OF OCCURRENCE ON STUDY SITE
*Anthropoides paradiseus** (Blue Crane) (VU)	**None on site:** Midlands and highland grassland, edge of Karoo, cultivated land and edges of vleis (Maclean, 1993). Nests in both moist situations in vleis which have short grass cover and in dry sites far from water, usually exposed places such as on hillsides; forages in grassland and cultivated and fallow lands; roosts communally in the shallow water of pans and dams (Tarboton *et al.* 1987). Short dry grassland, being more abundant and evenly disturbed in the eastern 'sour' grassland, where natural grazing of livestock is the predominant land use. Prefers to nest in areas of open grassland (Barnes, 2000) In the fynbos biome it inhabits cereal croplands and cultivated pastures and avoids natural vegetation. By contrast, it is found in natural vegetation in the Karoo and grassland biomes, but it also feeds in crop fields (Hockey *et al.* 2005).	Highly unlikely Due to the small extent of the grassland, disturbance surrounding the study site and high human presence. Localised but common in the south-eastern Gauteng (Marais & Peacock, 2008)
Crex crex (Corn Crake) (VU)	**None on site:** Rank grassland and savanna, dry grassland bordering marshes and streams, including long grass areas of seasonally flooded grassland and, occasionally, wet clay patches and soft mud fringing ponds. In Acacia savanna, occurs mostly where trees are small and scattered, and grass dense often tussocky, 0.7 – 1.5 m tall (Hockey *et al.* 2005).	Highly unlikely Due to a lack of suitable foraging habitat. Rare summer visitor
Rostratula benghalensis (Greater Painted-snipe) (NT)	**None on site:** Dams, pans and marshy river flood plains. Favours waterside habitat with substantial cover and receding water levels with exposed mud among vegetation, departing when water recedes beyond the fringes of vegetation. Rare in seasonally flooded grassland and palm savanna (Hockey *et al.*, 2005).	Highly unlikely Due to a lack of suitable foraging habitat. Uncommon visitor and resident (Marais & Peacock, 2008)
Glareola nordmanni Black-winged Pratincole (NT)	**None on site:** A non-breeding overland migrant to southern Africa. In southern Africa winter quarters, prefers open grassland, edges of pans and cultivated fields, but most common in seasonally wet grasslands and pan systems. Attracted to damp ground after rains, also to agricultural activities, including mowing and ploughing, and to newly flooded grassland (Hockey *et al.* 2005).	Highly unlikely Might only pass through the area on rare occasions. Erratic summer migrant sometimes in large flocks (Marais & Peacock, 2008)
*Circus ranivorus** (African Marsh-Harrier) (VU)	**None on site:** Almost exclusively inland and coastal wetlands (Hockey *et al.* 2005). Wetland and surrounding grasslands. Most highveld wetlands > 100 ha support a breeding pair (Tarboton & Allan 1984). Nests in extensive reed beds often high above water. Forages over reeds, lake margins, floodplains and occasionally even woodland. Almost entirely absent from areas below 300 mm of rainfall (Harrison et al., 1997a). Marsh, vlei, grassland (usually near water); may hunt over grassland, cultivated lands and open savanna (Maclean, 1993). Dependant on wetlands, particularly permanent wetlands for breeding, roosting and feeding. May utilise small wetlands 1-2 ha in extent for foraging, but larger wetlands are required for breeding (Barnes, 2000).	Highly unlikely There is no suitable foraging, breeding or roosting habitat for this species in the study site. Declining resident of large vleis, occurs mainly in south-eastern Gauteng (Marais & Peacock, 2008)

SCIENTIFIC NAME	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	STATUS AND LIKELIHOOD OF OCCURRENCE ON STUDY SITE
Aquila ayresii (Ayres's Hawk-Eagle) (NT)	**None on site:** Dense woodland and forest edge, often in hilly country. Often roosts in *Eucalyptus* stands or other tall trees in its prime distribution range (Hockey *et al.* 2005).	Highly unlikely There is no suitable habitat for this species on the study site. Rare in Gauteng (Marais & Peacock, 2008). Non-breeding summer visitor to South Africa. Regular in large northern cities and towns (Johannesburg, Pretoria and Polokwane)
*Sagittarius serpentarius** (Secretarybird) (NT)	**None on site:** Open grassland with scattered trees, shrubland, open *Acacia* and *Combretum* savanna (Hockey *et al.* 2005). Restricted to large conservation areas in the region. Avoids densely wooded areas, rocky hills and mountainous areas (Hockey *et al.* 2005 & Barnes, 2000). Requires small to medium-sized trees with flat crown for nesting, and often roosts in similar locations. Nesting density only about 150 km²/pair (n = 4, Kemp, 1995).	Highly unlikely Due to the small extent of the study site and the disturbance surrounding it. Uncommon in open areas within Gauteng (Marais & Peacock, 2008)
*Falco naumanni** (Lesser Kestrel) (VU)	**Yes:** Non-breeding Palaearctic migrant. Forages preferentially in pristine open grassland but also hunts in converted grassland such as small scale pastures provided the conversion is not as total as in plantation forestry or in areas of consolidated agricultural monoculture (Barnes, 2000; Hockey *et al.* 2005) such as maize, sorghum, peanuts, wheat, beans and other crops (Tarboton & Allan, 1984) where they hunt for large insects and small rodents but avoids wooded areas except on migration. They roost communally in tall trees, mainly *Eucalyptus*, in urban areas (Barns, 2000) often in towns or villages, but also in farm lands (per sobs). Favour a warm, dry, open or lightly wooded environment, and are concentrated in the grassy Karoo, western fringes of the grassland biome and southeast Kalahari. Generally avoids foraging in transformed habitats but occurs in some agricultural areas, including croplands, in fynbos and Renosterveld of the Western Cape (Hockey *et al.* 2005). Large numbers congregate in sweet and mixed grasslands of the Highveld regions.	Unlikely Only on rare occasions. Localised summer migrant (Marais & Peacock, 2008)
Falco biarmicus (Lanner Falcon) (NT)	**None on site:** Most frequent in open grassland, open or cleared woodland, and agricultural areas. Breeding pairs generally favour habitats where cliffs available as nest and roost sites, but will use alternative sites such as trees, electricity pylons and buildings if cliffs are absent (Hockey *et al.* 2005). Mountains or open country from semi desert to woodland and agricultural land, also cities (Maclean, 1993), even on forest-grassland ecotones. Generally a cliff nesting species and its wider distribution is closely associated with mountains with suitable cliffs. Able to breed on lower rock faces than *Falco peregrinus* (Peregrine Falcon) and also utilise the disused nests of other species such as crows, other raptor and stork, on cliffs, in	Highly unlikely Due to a lack of suitable breeding habitat. Uncommon resident in open areas in Gauteng (Marais & Peacock, 2008)

SCIENTIFIC NAME	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	STATUS AND LIKELIHOOD OF OCCURRENCE ON STUDY SITE
	trees and on power pylons and also quarry walls (Tarboton *et al.* 1987). Generally prefers open habitats e.g. alpine grassland and the Kalahari, but exploits a wide range of habitats – grassland, open savanna, agricultural lands, suburban and urban areas, rural settlements – in both flat and hilly or mountainous country. Also breeds in wooded and forested areas where cliffs occur (Harrison *et al.* 1997a).	
*Phoenicopterus ruber** (Greater Flamingo) (NT)	**None on site:** Breeds at recently flooded, large, eutrophic wetlands (favoured foraging habitat), shallow salt pans; at other times, at coastal mudflats, inland dams, sewage treatments works, small ephemeral pans and river mouths (Hockey *et al.* 2005). Usually breeds colonially on mudflats in large pans (Harrison *et al.* 1997a). Shallow pans, especially saline pans when they have water; also occasionally on other bodies of shallow water such as dams and vleis (Tarboton *et al.* 1987). Large bodies of shallow water, both inland and coastal; prefers saline and brackish water (Maclean 1993). Occasionally forages along sandy coasts.	Highly unlikely Due to a lack of suitable foraging and breeding habitat. Mainly restricted to the south-eastern Gauteng (Marais & Peacock, 2008)
*Phoenicopterus minor** (Lesser Flamingo) (NT)	**None on site:** Primarily open, shallow eutrophic, wetlands and coastal lagoons and may occur on water bodies which are more saline and more alkaline than those used by *Phoenicopterus ruber* (Greater Flamingo). Breeds on saline lakes, salt pans and mudflats far out in pans and lakes (Harrison *et al.* 1997a). Non-breeding birds aggregate at coastal mudflats, salt works and sewage treatment works where salinities are high. Small, ephemeral freshwater wetlands very important for birds dispersing from breeding grounds (Hockey *et al.*, 2005). Shallow pans, especially saline pans when they contain water (Tarboton *et al.*, 1987). Large brackish or saline inland and coastal waters (Maclean, 1993).	Highly unlikely Due to a lack of suitable foraging and breeding habitat. Mainly restricted to the south-western and south-eastern Gauteng (Marais & Peacock, 2008)
Mycteria ibis (Yellow-billed Stork) (NT)	**None on site/:** Utilises diverse wetland (permanent and seasonal) habitats, including alkaline and freshwater lakes, river, dams, pans, flood plains, large marshes, swamps, estuaries, margins of lakes or rivers, flooded grassland and small pools or streams where there are areas of shallow water free of emergent vegetation (Tarboton *et al.*, 1987); less often marine mudflats and estuaries (Hockey *et al.*, 2005). Nests colonially on large trees adjacent to productive wetlands, but only locally and erratically during ideal conditions.	Highly unlikely Due to a lack of suitable habitat Common at large wetlands within Gauteng; erratic elsewhere (Marais & Peacock, 2008)
*Ciconia nigra** (Black Stork) (NT)	**None on site:** Dams pans, flood plains shallow of rivers, pools in dry riverbeds, estuaries and sometimes on marshland and flooded grassland; uncommon at seasonal pans lacking fish. Associated with mountainous regions (Hockey *et al.*, 2005) where they nest (Maclean, 1993) on cliffs (Harrison *et al.* 1997a). Feeds in shallow water, but occasionally on dry land, in streams and rivers, marshes, floodplains, coastal estuaries and large and small dams; it is typically seen at pools in large rivers.	Highly unlikely Due to a lack of suitable breeding and foraging habitat.

SCIENTIFIC NAME	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	STATUS AND LIKELIHOOD OF OCCURRENCE ON STUDY SITE
Leptoptilos crumeniferus (Marabou Stork) (NT)	**None on site:** Occurs in both aquatic and terrestrial habitats, favouring open and semi-arid areas; largely absent from forest areas and true deserts. Common at wetlands, including dams, pans and rivers, and in wildlife reserves and ranching areas (Hockey *et al.*, 2005).	Highly unlikely Due to a lack of suitable habitat. Rare visitor to Gauteng
Mirafra cheniana Melodious Lark (NT)	**None on site:** Occurs in grassland dominated by *Themeda triandra* grass in South Africa. Occasionally in planted pastures of *Eragrostis curvula* and *E. tef*. Avoids wet lowlands, favouring fairly short grassland (< 0.5 m), with open spaces between tussocks, at 550 – 1 750 m.a.s.l. with annual rainfall of between 400 – 800 mm p/a (Hockey *et al.*, 2005).	Unlikely Due to a lack of suitable habitat. Localised resident in Gauteng (Marais & Peacock, 2008) where suitable habitat occur

*Priority Red Data bird species according to GDACE.

6. FINDINGS AND POTENTIAL IMPLICATIONS

The following Red Data bird species were observed within the Modderfontein Conservation area according to Marais & Peacock (2008).

Half-collared Kingfisher (*Alcedo semitorquata*)

Criteria for IUCN threatened category: A1c, A2c; B1+2b,c,d,e; C1 Status: Near-Threatened
Habitat: See table 3 above.
Threat: Widespread degradation of its habitat by siltation, erosion, pollution, water extraction and clearing of riparian vegetation (Barnes, 2000).
On-site conclusion: According to Marais and Peacock (2008) a stream running through the property is particularly good for kingfishers, including Half-collared Kingfishers. However the river and lack of riparian vegetation habitat system on the study site does not offer suitable habitat for this species. High levels of pollution in the river could also have a negative effect on the presence of this species. They are more likely to move up and down the river system to more suitable habitat up and down stream from the study site and the river and a buffer zone of 50 m must be provided from the edge of the riparian zone for both the Jukskei River and Modderfontein Spruit.

African Grass-Owl (*Tyto capensis)*

Criteria for IUCN threatened category: A2c; C1. Status: Vulnerable.
Habitat: Stable 3 above.
Threat: Land-use change, habitat loss and fragmentation of their ecological requirements are the largest factors that negatively impact this species (Barnes 2000).
On-site conclusion: According to Marais and Peacock (2008) the rank grassland adjacent to the wetlands within the Modderfontein Conservation Park are inhabited by both Marsh and African Grass-Owls. However the African Grass-Owls are unlikely to occur on the study site due to a lack of suitable breeding and roosting habitat. No other suitable habitat was identified for this species surrounding the study site. African Grass-Owls that could possibly occur within the park could forage along the

vegetation that grows along the Modderfontein Spruit and possibly also along the Jukskei River.

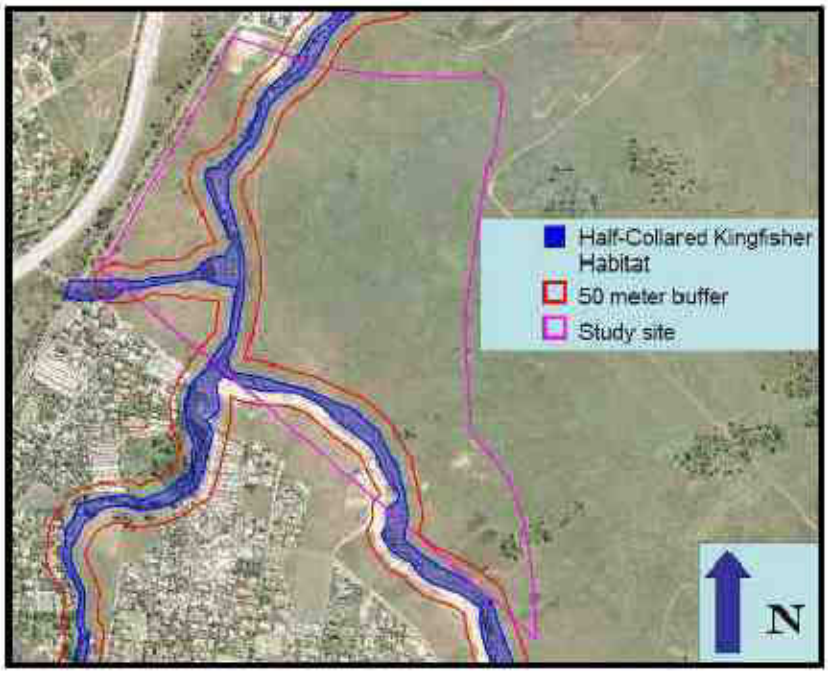

Figure 18: Map showing the Half-Corrared Kingfisher habitat and 50m buffer zone

Blue Crane (*Anthropoides paradiseus)*

Criteria for IUCN threatened category: A1a,c,d,e; A2b,c; Status: Vulnerable.
Habitat: See table 3 above.
Threat: Grassland loss through land-use alternation combined with agrochemical poisoning is the main reasons for this species population decline.
On site conclusion: According to Marais and Peacock (2008) despite the ongoing urbanisation in the surrounding metropolitan area, Blue Crane still persist at Modderfontein Conservation Park, having bred annually in the reserve for several decades. The open grassland on the study site could offer foraging habitat for this species but due to the high level of human presence on the study site and the Gautrain development on the eastern border of the study site it is unlikely that Blue Cranes will make use of the open grassland for foraging purposes. The Blue Crane might more than likely only forage on suitable grassland on site during rare occupations and should they still be present within the park they will probably be restricted to the area within the boundary of the park where this species is less disturbed.

Despite the presence of above-mentioned Red Data avifauna species within the Modderfontein Conservancy Park none of them were observed within the 2600_2805 pentad according to the SABAP2 data. This could be an indication that these Red Data species don't or rarely forage outside of the boundaries of the conservation park. Access to the conservation park is very restricted and only a selected few birders have access to it. None of the mentioned Red Data avifauna has been observed in the past during previous and limited visits to the conservation park (pers obs). The records of birds were probably from areas surrounding the conservancy and should the Red Data avifauna mentioned above forage in areas surrounding the conservation park, they would have appeared on the SABAP2 list of avifauna for the 2600_2805 pentad (SABAP2).

7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

The general assessment of species rests mainly on the 1987 atlas for birds of the then Transvaal (Tarboton et al., 1987) and comparison with the 1997 SABAP 1 atlas (Harrison et al., 1997), so any limitations in either of these studies will by implication also affect this survey and conclusions.

8. RECOMMENDED MITIGATION MEASURES

The following mitigation measures are proposed by the specialist:

- A minimum buffer of 50m from the riparian zone of the Modderfontein Spruit and Jukskei River should be left undisturbed on both sides to act as future foraging habitat for African Grass-Owls and Half-collared King-fishers.
- No activity such as temporary housing, temporary ablution, disturbance of natural habitat, storing of equipment or any other use of the buffer/flood zone whatsoever, may be permitted during the construction phase. The demarcated buffer/flood zone must be fenced during the construction phase to prevent any misinterpretation or disturbance of the demarcated no-go zone.
- Development should take place outside of the main breeding season of the Half-collared Kingfisher - September – March. Thus construction should be limited between April and July.
- The owner / managing agent must commit in writing to the long-term implementation of an ecological management plan and must be audited by GDARD annually.
- Domestic pets must be excluded from areas of good quality bird habitat.
- No surface stormwater generated as a result of the development may be directed directly into the river. For this purposes a stormwater and flood retention pond should be constructed as part of the surface runoff and stormwater management plan. This surface stormwater management plan should be retained outside of the demarcated buffer/flood zone and should not impact on the natural hydrology and morphology of the river and the riparian zone.
- Special care needs to be taken to prevent surface stormwater rich in sediments and other pollutants from entering the river. In order to prevent erosion, mechanisms are required for dissipating water energy.
- Large indigenous trees should be left as part of the landscaping.
- It is important to keep a series of undisturbed granite koppies and ridges as natural as possible to insure future bird diversity on site.
- Where possible **work should be restricted to one area at a time**. This will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories.
- **No vehicles must be allowed to move in or across the wet areas or drainage line, river or spruit and possibly get stuck.** This leaves visible scars and destroys habitat. It is important to conserve areas where there are tall reeds or grass and areas were there is short grass and mud.
- The contractor must ensure that no fauna species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- It is suggested that where work is to be done close to the river or spruit, these areas **be fenced off during construction** to prevent heavy machines and

trucks from trampling the plants, compacting the soil and dumping in the system.

- During the construction phase noise must be kept to a minimum to reduce the impact of the development on the fauna residing on the site.
- Alien and invasive plants must be removed.

The following mitigation measures were developed by GDACE (Directorate of Nature Conservation, GDACE, 2008 and 2009) and are applicable to the study site.

- All areas designated as sensitive in a sensitivity mapping exercise should be incorporated into an open space system. Development should be located on the areas of lowest sensitivity.
- Development structures should be clustered as close as possible to existing development.
- The open space system should be managed in accordance with an Ecological Management Plan that complies with the *Minimum Requirements for Ecological Management Plans* and forms part of the EMP.
- The Ecological Management Plan should:
    - include an ongoing monitoring and eradication programme for all non-indigenous species, with specific emphasis on invasive and weedy species
    - include a comprehensive surface runoff and storm water management plan, indicating how all surface runoff generated as a result of the development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions
    - facilitate/augment natural ecological processes
    - minimize artificial edge effects (e.g. water runoff from developed areas & application of chemicals)
    - include a comprehensive plan for limited recreational development (trails, bird hides etc.) within the open space system
    - include management recommendations for neighbouring land, especially where correct management on adjacent land is crucial for the long-term persistence of sensitive species present on the development site
    - result in a report back to the Directorate of Nature Conservation on an annual basis
    - investigate and advise on appropriate legislative tools (e.g. the NEMA: Protected Areas Act 57 of 2003) for formally protecting the area (as well as adjacent land where it is crucial for the long-term persistence of sensitive species present on the development site)
- The open space system should be fenced off prior to construction commencing (including site clearing and pegging). 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. Access of vehicles to the open space system should be prevented and access of people should be controlled, both during the construction and operational phases. Movement of indigenous fauna should however be allowed (i.e. no solid walls, e.g. through the erection of palisade fencing).
- Information boards should be erected within the development to inform

residents of the presence of Red / Orange List species, their identification, conservation status and importance, biology, habitat requirements and management requirements.

- Construction activities should be timed to coincide with the period when the Red List bird species that could potentially occur on site are unlikely to be breeding.
- In order to minimize artificially generated surface stormwater runoff, total sealing of paved areas such as parking lots, driveways, pavements and walkways should be avoided. Permeable material should rather be utilized for these purposes.
- The crossing of natural drainage systems should be minimized and only constructed at the shortest possible route, perpendicular to the natural drainage system. Where possible, bridge crossings should span the entire stretch of the buffer zone.

9. CONCLUSION

The river and riparian habitat does not offer ideal breeding, foraging and/or roosting habitat for the Half-collared Kingfisher and the African Grass-Owl. Half-collared Kingfishers are more likely to move through the area along the Modderfontein Spruit and Jukskei River. African Grass-Owls from the Modderfontein Conservation Park could, on rare occasions, forage along the grassland area on the banks of the Modderfontein Spruit and/or Jukskei River. The open grassland habitat on site does offer ideal foraging habitat for some Red Data avifauna species but it is doubtful if they will make use of the grassland due to the high disturbance rate caused by human presence on site and the surrounding Gautrain, mining and housing developments and disturbance caused by roads and traffic. The riparian zone and buffer zone of 50m on both sides of the Modderfontein Spruit and Jukskei River should be left undisturbed and undeveloped. (See Figure 19 for the Avifauna sensitivity map)

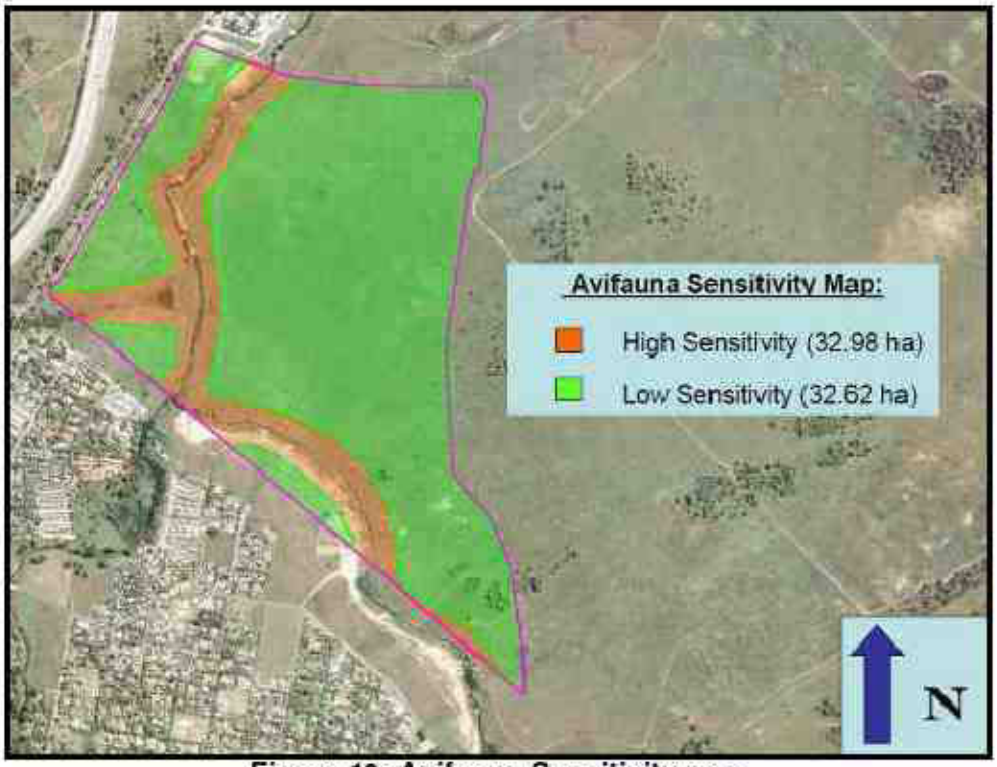

Figure 19: Avifauna Sensitivity map

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ANNEXURE D4av:
HERPETOFAUNA HABITAT ASSESSMENT

GALAGO ENVIRONMENTAL

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Herpetofauna
Habitat Assessment

of

THE REMAINDER OF PORTION 1 OF THE FARM WATERVAL 5 IR

November 2009

Report edited by: Vanessa Marais (BL Landscape Architecture)
Report author: J.C.P. van Wyk (Pr.Sci.Nat: M.Sc.)

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1. INTRODUCTION

Galago Environmental CC was appointed to undertake a reptile and amphibian habitat survey for the remainder of Portion 1 of the Farm Waterval 5 IR (elsewhere referred to as the study site), scheduled for commercial and residential housing development.

The objective was to compile a study on the herpetological fauna of the site, with special attention to Red Data species that occur or may occur on the site and their habitat requirements. This survey focuses on the current status of threatened herpetofauna species occurring, or which are likely to occur on the proposed development site, and a description of the available and sensitive habitats on the site.

2. OBJECTIVES OF THE HABITAT STUDY

- To assess the current status of the habitat component and current general conservation status of the property;
- To highlight potential impacts of the development on the herpetofauna of the study site; and
- To provide management recommendations to mitigate negative impacts and enhance positive impacts should the proposed development be approved.

3. SCOPE OF STUDY

This report:

- Is a survey of reptile and amphibian habitats, with comments on preferred habitats;
- Identifies and describes particular ecologically sensitive areas;
- Evaluates the conservation importance and significance of the site with special emphasis on the current status of resident threatened species;
- Offers recommendations to reduce or minimise impacts, should the proposed development be approved.

4. STUDY AREA

The study site lies in the quarter degree grid cell 2628AA along the R101 Road (Old Pretoria Road), north-west of the Buccleuch suburb, in Johannesburg; Gauteng Province. The entire area is 172.8 hectares in extent. The R101 Road forms the western border, the Buccleuch suburb the southern border, the Gautrain railway line the western border and a quarry forms part of the northern border of the study site.

The study site is situated within the Bankenveld as described by Acocks (1988). Low and Rebelo (1996) described the vegetation of the area as Rocky Highveld Grassland vegetation type. On the new vegetation map of South Africa (Mucina & Rutherford 2006) the area falls within the Egoli Granite Grassland Vegetation Unit.

The Jukskei River and Modderfontein Spruit flow through the property and the riparian zone has a few indigenous and many exotic trees. Kikuyu grass is

prominent on both banks of these perennial streams. A small stream flows from the south-westernly direction of the Buccleuch Interchange, where the N1, N3 and M1 roads join, into the Jukskei River. A manmade dam wall was constructed in this stream to form an artificial wetland. On the south side of the study site, the Modderfontein Spruit also flows into the Jukskei River.

Termitaria, especially dead termitaria, which normally provide ideal retreats for small reptiles and amphibians, are present in reasonable numbers. There are also small stands of indigenous trees. A stand of *Acacia karroo* trees occurs near the south-western border of the study site. Near the two perennial streams there are quite a few rocky outcrops, especially on the northern side of Modderfontein Spruit. On the western side of the study site, near the R101, there is also one very large and quite a few small areas covered in building rubble, which also provide excellent habitat for rupiculous reptiles. The remaining natural vegetation of the area is currently not utilised as grazing and is in a fairly good condition.

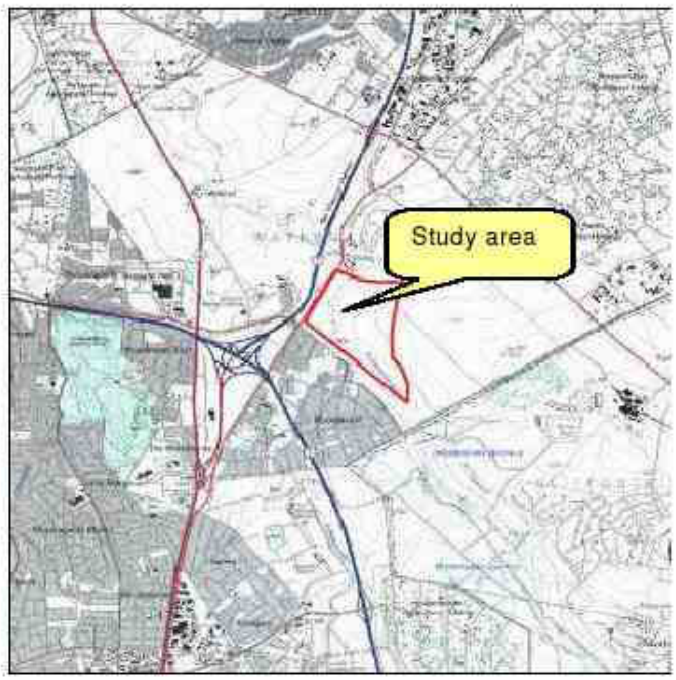

Figure 1: Locality map of the study area

5. METHODS

An eight hour visit was conducted on 31 October 2009. During this visit the observed and derived presence of reptiles and amphibians associated with the recognized habitat types of the study site were recorded. This was done with due regard to the well-recorded known distributions of Southern African vertebrates, coupled with the qualitative and quantitative nature of recognised habitats.

The 500 meters of adjoining properties were scanned for important fauna habitats.

5.1.1 Field Surveys

During the site visits, reptiles and amphibians were identified by visual sightings through random transect walks. No trapping was conducted, as the terms of reference did not require such intensive work.

Three criteria were used to gauge the probability of occurrence of reptiles and amphibian species on the study site. These include known distribution range, habitat preference and the qualitative and quantitative presence of suitable habitat.

5.1.2 Desktop Surveys

As the majority of reptiles and amphibians are either secretive, nocturnal, poikilothermic and/or seasonal, distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of these species based on authoritative tomes, scientific literature, field guides, atlases and data bases. This can be done with a high level of accuracy irrespective of season.

The probability of the occurrence of **reptile and amphibian** species was based on their respective geographical distributional ranges and the suitability of on-site habitats. In other words, *high* probability would be applicable to a species with a distributional range overlying the study site as well as the presence of prime habitat occurring on the study site. Another consideration for inclusion in this category is the inclination of a species to be common to the area, i.e. normally occurring at high population densities.

Medium probability pertains to a reptile or amphibian species with its distributional range peripherally overlapping the study site, or required habitat on the site being sub-optimal. The size of the site as it relates to its likelihood to sustain a viable breeding population, as well as its geographical isolation are also taken into consideration. Species categorized as *medium* normally do not occur at high population numbers, but cannot be deemed as rare.

A *low* probability of occurrence will imply that the species' distributional range is peripheral to the study site and habitat is sub-optimal. Furthermore, some reptiles and amphibians categorized as *low* are generally deemed to be rare.

Based on the impressions gathered during the site visit, as well as publications, such as *FitzSimons' Snakes of Southern Africa* (Broadley, 1990), *Field Guide to Snakes and other Reptiles of Southern Africa* (Branch, 1998), *A Guide to the Reptiles of Southern Africa* (Alexander and Marais, 2007), *Amphibians of Central and Southern Africa* (Channing 2001), *Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland* (Minter, *et al*, 2004) and *A Complete Guide to the Frogs of Southern Africa* (Du Preez & Carruthers, 2009), a list of species which may occur on the site was compiled. The latest taxonomic nomenclature was used. The vegetation type was defined according to the standard handbook by Mucina and Rutherford (eds) (2006).

5.13 Specific Requirements

During the visit the site was surveyed and assessed for the potential occurrence of Red Data and/or wetland-associated species such as:

- Giant Bullfrogs (*Pyxicephalus adspersus*);
- Striped Harlequin Snake (*Homoroselaps dorsalis*)

The Southern African Python (*Python natalensis*) is unlikely to occur on the study site.

6. RESULTS

The local occurrences of reptiles and amphibians are closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupiculous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of reptile and amphibian species by evaluating the habitat types within the context of known distribution ranges. From a herpetological habitat perspective, it was established that all four major habitats are naturally present on the site. Excellent manmade rupiculous habitat is also provided by building rubble. Sight records were also used.

Figure 2: A view southwards of the study site. Excellent manmade rupiculous habitat in the form of building rubble in the foreground and a stand of *Acacia karroo* trees, which occurs near the south-western border of the study site, in the background.

Quite a few *Trinervitermes* termitaria were observed all over the study site especially on the south-western side of the Jukskei River. A few dead logs of mainly exotic *Eucalyptus* trees or debris deposited during floods by the Jukskei River and Modderfontein Spruit, were spotted. Near the south-western border, next to the Gautrain railway line, there is a small plantation of *Eucalyptus* trees. Quite a few of these trees have been chopped down.

Reptiles:
The study site falls outside the natural range of the Southern African python. The striped harlequin snake has been recorded in this quarter degree cell (Transvaal Museum Records) and quite a few moribund termitaria, where this species is most likely to be found, are present on the study site. It is very difficult to confirm whether this cryptic snake is present on the study site, but it is quite likely.

Amphibians:
The findings concerning bullfrog habitat are based on the presence of a potential breeding site (26°02'54"S; 28°06'56"E) on the western side of the study site near the Jukskei River. A manmade wetland has been created in a small stream, which flows from the Buccleuch Interchange towards the Jukskei River. The wetland on the study site is suitable for mating (<9cm), although the deep water may be too cool for egg and larval development. The terrain around this wetland appears to be fairly suitable as a dispersal area, which combines feeding and aestivation. It is essential that the soil must be suitable for burrowing on a daily basis during the short activity period at the beginning of the rainy season and for deeper retreats during the resting periods. This potential breeding site on the study site has three barriers which might hinder bullfrog movement. On the western side there is the very busy R101 Road (Old Pretoria Road), which will result in many road mortalities during the breeding season; to the south of the study site there is the Buccleuch Suburb and to the east lies the perennial Jukskei River, which would act as a natural barrier.

Figure 3: A view of a manmade potential breeding site for bullfrogs. This breeding site for bullfrogs has been created in a small stream, which flows from the Buccleuch Interchange towards the Jukskei River.

Of the 40 reptile species expected to occur on the study site (Table 1), none were confirmed during the site visit. Of the possible 15 amphibian species expected to occur on the study site (Table 1), two were confirmed during the site visits (Table 2). Both frog species were confirmed through tadpoles that were observed on the study site.

Table 1 lists the reptiles and amphibians which were observed or deduced to occupy the site. The American red-eared terrapin (*Trachemys scripta elegans*) is the only feral reptile or amphibian that has been known to occur in Gauteng (De Moor and Bruton, 1988), but with only a few populations it is not expected to occur on the site.

The species assemblage is typical of what can be expected in a fairly natural environment, with sufficient habitat to sustain populations. Most of the species of the resident diversity (Table 1) are fairly common and widespread (viz. the marsh terrapin, common brown water snake, brown house snake, mole snake, common egg eater, rinkhals, puff adder, Cape skink, Montane speckled skink, water monitor, guttural toad, raucous toad, red toad, bubbling kassina, Boettger's caco, common platanna and the common river frog).

The relatively high species richness is due to the size of the study site, habitat diversity along the Jukskei River, Modderfontein Spruit, the small stream from the Buccleuch Interchange and in the fairly large manmade pond/wetland.

The natural grasslands were heavily grazed in the past and are thus ecologically disturbed, but at the time of the site visit the basal cover was lush in some places and would provide adequate nourishment and cover for small terrestrial herpetofauna. Considering that the grasslands are not currently being used, burning is clearly not part of the range management protocol.

The perennial Jukskei River and Modderfontein Spruit are in a fairly good condition. The water quality of the small stream is fair, but oil pollution, most probably from the R101 and other main roads was also observed at one place in this stream. As a whole, the water of all three streams appeared to be healthy as evidenced by aquatic life observed. Unfortunately a great deal of rubbish, especially plastic items, was observed at the flood line areas of the Jukskei River and Modderfontein Spruit. The riparian zone features many exotic trees and kikuyu grass, which grows on its banks, while the adjacent wetland pond consists of dense stands of reeds and semi-aquatic vegetation. All these sources would provide ample habitat for moisture-reliant reptiles such as the marsh terrapin, brown water snake, green water snake and water monitor. The three streams of different sizes and the wetland/pond provide adequate breeding habitat for all possible amphibian species. It is important to note that the three streams, as a system, form an indispensable dispersal corridor.

Figure 4: A view of the Jukskei River.
Note the great deal of rubbish, especially plastic items, at the river's flood line and the kikuyu grass on the river's banks.

The 500 meters of adjoining properties to the west and east mirror the ecological conditions described for the study site, but formidable barriers such as the Gautrain railway line to the east and the R101 and N1 National Road make migration almost impossible. The northwestern corner, east of the Jukskei River, is a fair area for migration. Connectivity as a whole is poor and real opportunities for migration only exist, along the three water systems. The Modderfontein Spruit is connected with the Modderfontein Conservation Area, which has water bodies such as the John Voelcker Dam and the Moddderfontein Dam no.4.

Figure 5: Red data Reptile and Amphibian Habitat map

Table 1: Reptile and Amphibian diversity.

The species observed or deduced to occupy the site. Systematic arrangement and nomenclature according to Branch (1998), Alexander and Marais (2007), Minter, *et.al* (2004) & Du Preez and Carruthers (2009).

	SCIENTIFIC NAME	ENGLISH NAME
	CLASS: REPTILIA	**REPTILES**
	Order: TESTUDINES	**TORTOISES & TERRAPINS**
	Family: Pelomedusidae	**Side-necked Terrapins**
√	*Pelomedusa subrufa*	Marsh or Helmeted Terrapin
	Order: Squamata	**SCALE-BEARING REPTILES**
	Suborder:Lacertilia	**LIZARDS**
	Family: Gekkonidae	Geckos
√	*Lygodactylus capensis*	Cape Dwarf Gecko
√	*Pachydactylus affinis*	Transvaal Thick-toed or Transvaal Gecko
*	*Pachydactylus capensis*	Cape Thick-toed of Cape Gecko
	Family: Agamidae	Agamas
*	*Agama aculeate*	Ground Agama
?	*Agama atra*	Southern Rock Agama
	Family: Scincidae	**Skinks**
√	*Trachylepis capensis*	Cape Skink
√	*Trachylepis punctatissima*	Montane Speckled Skink
√	*Trachylepis varia*	Variable Skink
?	*Panaspis wahlbergii*	Wahlberg's Snake-eyed Skink
	Family:Lacertidae	**Old World Lizards or Lacertids**
?	*Pedioplanis lineoocellata*	Spotted Sand Lizard
?	*Ichnotropis squamulosa*	Common Rough-scaled Lizard
	Family: Gerrhosauridae	**Plated Lizards**
?	*Gerhosaurus flavigularis*	Yellow-throated Plated lizard
	Family: Cordyidae	
?	*Cordylus vittifer*	Transvaal Girdled Lizard
	Family: Varanidae	**Monitors**
?	*Varanus albigularis*	Rock Monitor
√	*Varanus niloticus*	Water Monitor
	Suborder: SERPENTES	**SNAKES**
	Family: Typhlopidae	**Blind Snakes**
?	*Typhlops bibronii*	Bibron's Blind Snake
?	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake
	Family: Leptotyphlopidae	**Thread Snakes**
*	*Leptotyphlops conjunctus*	Cape Thread or Worm Snakes
*	*Leptotyphlops scutifrons*	Peter's Thread or Worm Snake
	Family: Atractaspididae	**African burrowing Snakes**
?	*Aparallactus capensis*	Cape or Black-headed Centipede Eater
	Family: Colubridae	**Typical Snakes**
√	*Lycodonomorphus rufulus*	Common Brown Water Snake
√	*Lamprophis capensis*	Brown House Snake
*	*Lamprophis inornatus*	Olive House Snake
?	*Lamprophis aurora*	Aurora House Snake

	SCIENTIFIC NAME	ENGLISH NAME
√	*Lycophidion capense*	Cape or Common Wolf Snake
?	*Duberria lutrix*	Common Slug Eater
√	*Pseudaspis cana*	Mole Snake
?	*Prosymna sundevallii*	Sundevall's Shovel-snout
*	*Psammophylax rhombeatus*	Spotted Skaapsteker
?	*Psammophylax tritaeniatus*	Striped Skaapsteker
√	*Psammophis brevirostris*	Short-snouted Grass or Sand Snake
√	*Psammophis crucifer*	Crossed Whip Snake
?	*Philothamnus hoplogaster*	Green water snake
√	*Dasypeltis scabra*	Common or Rhombic Egg Eater
*	*Crotaphopeltis hotamboeia*	Herald Snake
	Family: Elapidae	**Cobras, Mambas and Others**
?	*Elapsoidea sunderwallii*	Sundevall's Garter Snake
√	*Hemachatus haemachatus*	Rinkhals
	Family: Viperidae	**Adders**
√	*Causus rhombeatus*	Rhombic Night Adder
√	*Brits arietans*	Puff Adder
	Class: AMPHIBIA	**AMPHIBIANS**
	Order: ANURA	**FROGS**
	Family: Pipidae	**Clawed Frogs**
√	*Xenopus laevis*	Common Platanna
	Family: Bufonidae	**Toads**
?	*Amietaophrynus garmani*	Eastern Olive Toad
√	*Amietaophrynus gutturalis*	Guttural Toad
√	*Amietaophrynus rangeri*	Raucous Toad
√	*Schismaderma carens*	Red Toad
	Family: Hyperoliidae	**Reed frogs**
√	*Kassina senegalesis*	Bubbling Kassina
?	*Semnodactylus weali*	Rattling Frog
	Family: Phrynobatrachidae	**Puddle Frogs**
*	*Phrynobatrachus natalenis*	Snoring Puddle Frog
	Family: Pyxicephalidae	
√	*Cocosternum boettgeri*	Boettger's Caco or Common Caco
√	*Amietia angolensis*	Common River Frog
*	*Amietia fuscigula*	Cape River Frog
NT?	*Pyxicephalus adspersus*	Giant Bullfrog
*	*Strongylopus fasciatus*	Stripe Stream Frog
√	*Tomopterna cryptotis*	Tremolo Sand Frog
√	*Tomopterna natalensis*	Natal Sand Frog

√ Definitely there or have a *high* probability to occur;
* *Medium* probability to occur based on ecological and distributional parameters;
? *Low* probability to occur based on ecological and distributional parameters.

Red Data species rankings as defined in Friedmann and Daly's S.A. Red Data Book / IUCN (World Conservation Union) (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, LR/cd = Lower risk conservation dependent, LR/nt = Lower Risk near threatened, DD = Data Deficient. All other species are deemed of Least Concern.

Table 2: Reptile and Amphibian species positively confirmed on the study site, observed indicators and habitat.

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
Amietaophrynus gutturalis	Guttural Toad	Sight record of tadpoles (Gosner stage 24) [Gosner, 1960]	Stream
Amietia angolensis	Common River Frog	Sight record of tadpoles (Gosner stage 26 – 36)	Stream

Both these frog species listed in Table 2, are very common on the study site and elsewhere in its range.

7. FINDINGS AND POTENTIAL IMPLICATIONS

Reptiles and amphibians

Generally the proposed development will not result in a loss of ecologically sensitive and important habitat units, ecosystem function or loss of critical faunal habitat (given application of the mitigation measures suggested below). However, considering the scale of the proposed development, loss/displacement of some fauna is a foregone conclusion, particularly that of terrestrial species.

However, maintaining (and even improving) the conservation integrity of the Jukskei River, Modderfontein Spruit and the small stream from the Buccleuch Interchange system is imperative. The system should be regarded as sensitive (see the mitigation measures cited below), as such providing indispensable habitat for Red Listed and sensitive species as well as serving as a dispersal corridor.

8. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are to some extent made on reasonable and informed assumptions built on *bone fide* information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. Galago Environmental can therefore not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

9. RECOMMENDED MITIGATION MEASURES

The following mitigation measures are proposed by the specialist.

- Should Bullfrogs or any herpetological species be encountered during the construction phase of the proposed development, these should be relocated to natural grassland areas in the vicinity.
- The contractor must ensure that no herpetofauna species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- Alien and invasive plants must be removed, especially along the Jukskei River and Modderfontein Spruit.

The following mitigation measures were developed by GDARD (Directorate of Nature Conservation, GDACE, 2008 and 2009) and are applicable to the study site. **Where appropriate, this specialist's specific elaborations are given in brackets.**

- An appropriate management authority (e.g. the body corporate) that must be contractually bound to implement the Environmental Management Plan (EMP) and Record of Decision (ROD) during the operational phase of the development should be identified and informed of their responsibilities in terms of the EMP and ROD.
- All areas designated as sensitive in a sensitivity mapping exercise should be incorporated into an open space system. Development should be located on the areas of lowest sensitivity. (*Jukskei River, Modderfontein Spruit and the small stream from the Buccleuch Interchange system and a 32 metres buffer zone are considered as sensitive and should thus be treated as an open space system*)
- The open space system (the three water sources and buffer zone) should be managed in accordance with an Ecological Management Plan that complies with the *Minimum Requirements for Ecological Management Plans* and forms part of the EMP.
- The Ecological Management Plan should:
    - include a fire management programme to ensure persistence of grassland
    - include an ongoing monitoring and eradication programme for all non-indigenous species, with specific emphasis on invasive and weedy species
    - include a comprehensive surface runoff and storm water management plan, indicating how all surface runoff generated as a result of the development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions
    - ensure the persistence of all Red and Orange List species
    - include a monitoring programme for all Red and Orange List species
    - facilitate/augment natural ecological processes

- provide for the habitat and life history needs of important pollinators*
- minimize artificial edge effects (e.g. water runoff from developed areas & application of chemicals)
- include a comprehensive plan for limited recreational development (trails, bird hides etc.) within the open space system
- include management recommendations for neighbouring land, especially where correct management on adjacent land is crucial for the long-term persistence of sensitive species present on the development site
- result in a report back to the Directorate of Nature Conservation on an annual basis
- investigate and advise on appropriate legislative tools (e.g. the NEMA: Protected Areas Act 57 of 2003) for formally protecting the area (as well as adjacent land where it is crucial for the long-term persistence of sensitive species present on the development site)

- The open space system should be fenced off prior to construction commencing (including site clearing and pegging). 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. Access of vehicles to the open space system should be prevented and access of people should be controlled, both during the construction and operational phases. Movement of indigenous fauna should however be allowed (i.e. no solid walls, e.g. through the erection of palisade fencing).
- When Giant Bullfrogs / Giant Bullfrog habitat will be retained in an open space system of a development situated within the urban edge, Giant Bullfrogs should be prevented from leaving the site and entering unsuitable habitat through the erection of an impermeable wall or appropriately designed fence prior to construction commencing. The wall/fence should be solid (i.e. without openings) below ground to the level of the foundations and for at least 20cm above ground.
- Information boards should be erected within the development to inform residents of the presence of Red / Orange List species, their identification, conservation status and importance, biology, habitat requirements and management requirements.

The following recommended mitigatory measures apply to roads:

- All storm water structures should be designed so as to block amphibian and reptile access to the road surface.*
- A comprehensive surface runoff and storm water management plan should be compiled, indicating how all surface runoff generated as a result of the road development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions. This plan should form part of the EMP.*
- Where roads traverse streams/rivers, an underpass should provide for the movement of aquatic as well as terrestrial species through the inclusion of

appropriate buffer zones within the underpass (a 32m buffer zone from the edge of the riparian zone recommended for rivers within the urban edge).

- Suitable terrestrial underpasses should be provided to facilitate safe movement of animals, specifically where roads traverse provincially important species/climate change corridors or ridges or habitat suitable for any Red/Orange List amphibian/ reptile species. The number and spacing of underpasses will need to be determined by a specialist registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) in the fields of Ecological / Zoological Science. All underpasses should be dressed with a layer of sand (minimum 10cm), should be a minimum of 1.5m high and 1.0m wide so as to facilitate maintenance access and should be provided with small grates in the road surface to allow light penetration into the underpass. Underpasses should be accessible to maintenance staff and should be cleared of accumulated material at least at the start of each rainy season.
- A barrier (either prefab concrete wall or galvanized sheeting that extends as a continuous sheet above ground for at least 40cm and below ground for at least 30cm) that will physically block animals from accessing the road surface should be constructed for a distance of 200m on either side of all aquatic and terrestrial underpasses. Holes under barriers should be routinely filled in and areas directly adjacent to the barrier should be kept free of vegetation.
- Where roads are routed past expected or confirmed Giant Bullfrog breeding areas, road signs warning motorists to slow down on account of Giant Bullfrogs should be erected (in accordance with applicable legislation).
- Where roads traverse natural corridors such as streams and ridges, traffic control measures are recommended (e.g. 60km/h speed limits, speed traps, rumble strips and speed bumps).

10. CONCLUSION

The Jukskei River, Modderfontein Spruit, the small stream from the Buccleuch Interchange system and the wetland has a high sensitivity and high conservation value. A 32 metres buffer zone from the edge of the riparian zone must therefore be implemented and conserved. This implies that species narrowly adapted to these habitats will receive adequate protection, especially given the terms and conditions of the Ecological Management Plan.

It is quite possible that Giant Bullfrogs may occur and breed on the site and it is critical that the wetland and surroundings are protected.

The striped harlequin snake has been recorded from this quarter degree cell and suitable habitat for this species exists in the form of numerous moribund termitaria. Though it is very difficult to confirm whether this cryptic snake is indeed present on the study site, it is quite possible.

If the development should go ahead, an important indirect effect would be the likely impact that the proposed development might have on the surface water runoff and water quality downstream. This could have a negative impact on the herpetofauna, but the effects could be ameliorated by the construction of retention ponds, which would retard discharge into the Jukskei River, Modderfontein Spruit and the small

stream from the Buccleuch Interchange system and improve the water quality of the discharge.

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ANNEXURE D4b:

PRESENT ECOLOGICAL ASSESSMENT OF AQUATIC RESOURCES

PRESENT ECOLOGICAL ASSESSMENT OF THE AQUATIC RESOURCES IN THE VICINITY OF THE PROPOSED WATERFALL VALLEY RESIDENTIAL DEVELOPMENT, MIDRAND.

Prepared for:

Bokamoso Landscape Architects and Environmental Consultants

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EXECUTIVE SUMMARY

Based on the findings of this aquatic ecological PES assessment it is the opinion of the aquatic ecologists that the proposed development be permitted to proceed provided that the recommendations made in this report are adhered to and that additional impacts on the riverine resources are minimised and mitigated.

Scientific Aquatic Services was appointed by Bokamoso Landscape Architects and Environmental Consultants to conduct a Present Ecological State (PES) assessment of the aquatic resources in the vicinity of the proposed Waterfall Valley Residential Development in Midrand. The assessment includes an aquatic ecological assessment, riparian delineation and RDL mammal assessment.

The purpose of the aquatic ecological assessment was to survey the general habitat integrity, habitat conditions for aquatic macro-invertebrates, aquatic macro-invertebrate community integrity and fish community integrity. The protocols of applying the necessary indices were strictly adhered to and all work was undertaken by an accredited assessor.

In the riparian delineation it was endeavoured to determine the boundary of the riparian zone, and to determine the position of a suitable buffer around the river areas, on the subject property since construction within this area will not only prove difficult in some areas but will impinge on riverine habitats, which are generally considered as sensitive habitats with higher levels of biodiversity and ecological functioning.

The following key findings are highlighted pertaining to the study:

Catchment Limpopo **Quaternary Catchment** A21C **Ecoregion** Highveld **Weather condition:** Cloudy and Cool	Aerial photograph of the subject property and assessmen points. 
WV1 (Jukskei)	**WV2 (Modderfontein)**
Site description: Representative.	**Site description:** Representative.
Water quality: pH 7.59 Conductivity 45.0 mS/m Temperature 23.1 °C Dissolved Oxygen 3.2 mg/L	**Water quality:** pH 7.91 Conductivity 141.8 mS/m Temperature 21.4 °C Dissolved Oxygen 5.1 mg/L
SASS5 Index: **Class F** (Critically Modified) SASS5 Score 35 No. of Taxa 9 ASPT Score 3.9	**SASS5 Index:** **Class F** (Critically Modified) SASS5 Score 37 No. of Taxa 10 ASPT Score 3.7
Habitat suitability: **IHAS Score** 64 Inadequate	**Habitat suitability:** **IHAS Score** 71 Adequate
Habitat Integrity **IHIA Score:** 64.2 **Class C** (Moderately modified)	**Habitat Integrity** **IHIA Score:** 64.2 **Class C** (Moderately modified)
Riparian Vegetation Index **RVI Score:** 7.55 **Class E** (Seriously modified)	**Riparian Vegetation Index** **RVI Score:** 8.88 **Class D/E** (Largely modified)
Fish Assemblage Index **Class F** Expected Score 117 Observed Score 0 Relative Score 0	**Fish Assemblage Index** **Class F** Expected Score 117 Observed Score 16.5 Relative Score 14.1%
Impacts and Threats Flow and bed modification, Odour Algal proliferation Litter	**Impacts and Threats** Flow and bed modification. Erosion is significant.

Impact minimisation

The points below serve to summarise the measures deemed necessary in order to ensure protection of the riparian and aquatic resources and to ensure environmental protection during the construction phase of the proposed development:

- These aquatic resources are situated in a highly urbanised area and it is likely that flows have already been severely affected due to channel and bed modifications, and as well as by large amounts of urban runoff. It is considered essential that runoff from the proposed development be well attenuated to prevent additional impacts from erosion, resulting from urban runoff in the catchment. This is necessary to ensure the ongoing viability of the aquatic communities within and downstream of the proposed development.
- Adequate stormwater management must be incorporated into the design of the proposed development in order to prevent erosion and the associated sedimentation of the riparian zones.
    - Sheet runoff from paved surfaces and access roads needs to be curtailed.
    - Runoff from paved surfaces should be slowed down by the strategic placement of berms.
    - The buffer zones should be left undisturbed to allow the climax terrestrial vegetation community to establish in these areas.
    - As much vegetation growth as possible should be promoted within the proposed development area in order to protect soils and to reduce the percentage of the surface area which is paved. In this regard special mention is made of the need to use indigenous vegetation species as the first choice during landscaping.
    - Any discharge of runoff into the river system must be done in such a way as to prevent erosion. In this regard special mention is made of the use of energy dissipating structures in storm water discharge. Consideration to the use of attenuation facilities must also be given.
- Crossings (if any) must ensure that the creation of turbulent flow in the system is minimised, in order to prevent downstream erosion. No support pillars should be constructed within the active channel of any of the drainage features on the subject property.
- The duration of impacts on the stream should be minimised as far as possible by ensuring that the duration of time in which flow alteration and sedimentation will take place is minimised.
- All areas affected by construction should be rehabilitated upon completion of the construction phase of the development. Areas should be reseeded with indigenous grasses as required.
- During the construction phase, no vehicles should be allowed to indiscriminately drive through any riparian areas.

- During construction no dumping of waste and no stockpiling of materials within the riparian areas as well as associated buffer zones should take place.
- No fires should be permitted near the construction area.
- If any spills occur, they should be immediately cleaned up.
- All alien vegetation in the riparian zone should be removed upon completion of construction.
- The allocated 32 meter buffer around riparian zones should be maintained as private or public open space.
- It must be insured that connectivity of the river upstream and downstream of the proposed development are maintained.

The points below serve to summarise the measures deemed necessary in order to ensure protection of the riparian and aquatic resources, and to ensure environmental protection during the operational phase of the proposed development.

- Any areas where bank failure is observed, due to the effects of any crossings, should be immediately repaired by reducing the gradient of the banks to a 1:3 slope.
- Bank vegetation cover should be monitored to ensure that sufficient vegetation is present to bind the bankside soils and prevent further bankside erosion.
- Alien vegetation control along the wetland and riparian features needs to be controlled for the life of the proposed development.

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Scientific Aquatic Services was appointed by Bokamoso Landscape and Environmental Consultants to conduct a Present Ecological State assessment of the aquatic resources in the vicinity of the proposed Waterfall Valley residential development, Midrand. The assessment includes an aquatic ecological assessment, riparian and wetland zone delineation and an RDL wetland mammal assessment.

The purpose of the aquatic ecological assessment was to survey the general habitat integrity, riparian vegetation integrity, habitat conditions for aquatic macro-invertebrates, aquatic macro-invertebrate community integrity and fish community integrity. The study area is located within the Central Highveld Water Management Area (quaternary catchment A21C). This report serves to document the condition at the time of sampling to indicate the state of the riverine ecological integrity in summer, at a time when high flows are experienced and prior to the proposed development taking place.

The following was considered in the selection of suitable sites for assessing the level of aquatic ecological integrity on the aquatic resources in the vicinity of the study area.

- The site location in relation to the existing infrastructure and activities in the area.
- Consideration was given to the position of the proposed development site in order to assist in defining the Present Ecological State and any impacts in this area.
- Accessibility with a vehicle in order to allow for the transport of equipment.
- Sites were selected where there were good habitat conditions with a good level of diversity, suitable for supporting a diverse aquatic community.

Two points were assessed and are indicated in the figure below, which shows the assessment point in red.

Table 1: Geographic information pertaining to the assessment site

Site	Description	GPS co-ordinates	
		South	East
WV1	Representative of the Jukskei River	26°2'15.68"S	28°6'40.18"E
WV2	Representative of the Modderfonteinspruit.	26°2'47.16"S	28°6'49.68"E

In the riparian delineation it was endeavoured to determine the boundary of the river areas, and to determine the position of a suitable buffer around the areas on the subject property, since construction within this area will not only prove difficult in some areas, but will impinge on riverine habitat which are generally considered as sensitive habitats with higher levels of biodiversity.

It is the objective of the study to provide detailed information to guide the proposed development in the vicinity of the riparian areas to ensure that the ongoing functioning of the river is facilitated with specific mention of the following:

- to ensure that connectivity of the riparian areas is maintained between the areas upstream and downstream of the proposed development;
- to ensure ongoing functioning of the river areas in the vicinity of the proposed development;
- to ensure that permanent, seasonal and temporary wetland zone functionality is maintained through provision of measures ensuring that soil wetting conditions are maintained; and
- to ensure that no incision and canalisation of the river system takes place because of the proposed development.

Figure 1: Aerial photograph depicting the assessment points selected in the vicinity of the study area.

2. AQUATIC ECOLOGICAL DESCRIPTION

2.1 Ecoregions

When assessing the ecology of any area (aquatic or terrestrial), it is important to know which ecoregion the study area is located within. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often available on this level of assessment to guide the study being undertaken.

The study area falls within the Central Highveld Ecoregion, which can be considered to contain high aquatic biodiversity and a sensitive aquatic community. The study area falls within the A21B quaternary catchment. Refer to Figure 2.

2.2 Ecostatus

Water resources are generally classified according to the degree of modification or level of impairment. The classes used by the South African River Health Program (RHP) are presented in the table below and will be used as the basis of classification of the systems in this field and desktop study, as well as future field studies.

Table 2: Classification of river health assessment classes in line with the RHP

Class	Description
A	Unmodified, natural.
B	Largely natural, with few modifications.
C	Moderately modified.
D	Largely modified.
E	Extensively modified.
F	Critically modified.

Studies undertaken by the Institute for Water Quality Studies assessed all quaternary catchments as part of the Resource Directed Measures for Protection of Water Resources. In these assessments, the Ecological Importance and Sensitivity (EIS), Present Ecological Management Class (PEMC), and Desired Ecological Management Class (DEMC) were defined, and serve as a useful guideline in determining the importance and sensitivity of aquatic ecosystems prior to assessment, or as part of a desktop assessment.

This database was searched for the quaternary catchment of concern (A21B) in order to define the EIS, PEMC and DEMC. The findings are based on a study undertaken by Kleynhans (1999)

as part of "A procedure for the determination of the ecological reserve for the purpose of the national water balance model for South African rivers". The results of the assessment are summarised in the table below.

Table 3: Summary of the ecological status of quaternary catchment A21C based on Kleynhans 1999

Catchment	Resource	EIS	PEMC	DEMC
A21C	Jukskei	Moderate	CLASS C (Class D based on desktop certainty)	Class C: Moderately sensitive systems

The points below summarise the impacts on the aquatic resources in this quaternary catchment:

- The aquatic resources within this quaternary catchment have been very highly affected by bed and flow modifications.
- A very high impact from the introduced fish species, including *Carassius auratus* and *Clarius garipinus*, which is likely to affect populations water clarity, quality and possibly habitat.
- A very high impact form inundation, caused by weirs, is likely.
- Riparian zones and stream bank conditions are considered to be highly impacted due to alien vegetation encroachment and incision.
- A moderate impact on water quality from urban runoff and contamination with sewage effluent is also deemed likely.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a moderate diversity of habitat types, increasing their ecological sensitivity and importance.
- The site has no importance in terms of conservation.
- In terms of rare and endangered species importance, the system is very highly important for the conservation of *Opsaridium peringueyi*.
- The riverine resources have a high sensitivity to flow requirements with the species *Chiloglanis pretoriae* and *Opsaridium peringueyi* being flow dependant.
- The area has a low importance in terms of migration of aquatic species.
- The area has a very high importance in terms of the rare and endemic species conservation *Opsaridium peringueyi*.
- The ecology of the area is considered to be moderately sensitive to changes in water quality. The area has moderate importance as a source of refugia for aquatic species.

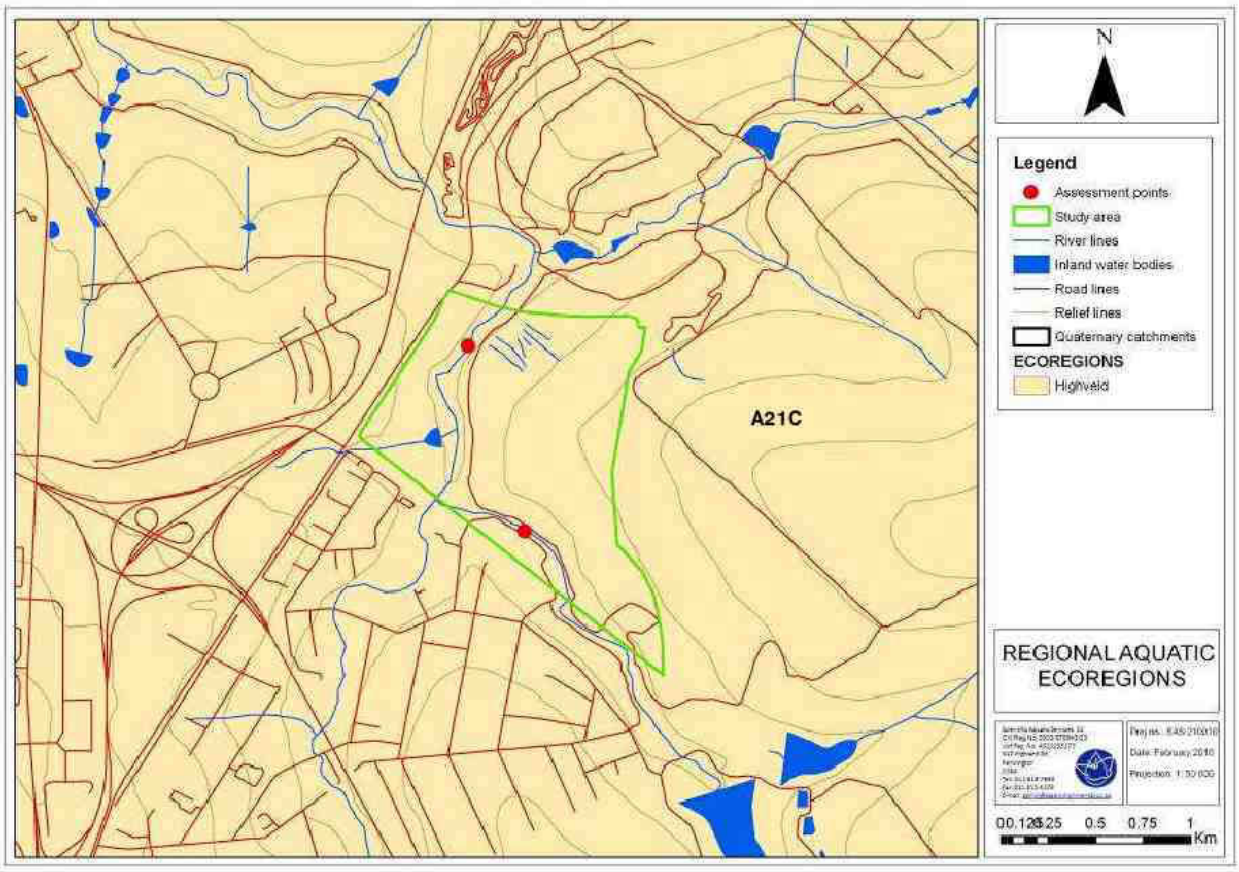

Figure 2: A map of the ecoregions of the area.

3. METHOD OF INVESTIGATION

The assessment of the PES of the system, as well as possible impacts due to the proposed development, was based on comparisons between observed conditions and the theoretical reference conditions based on desktop information reviews, and from historical data for the area.

The sections below describe the methodology used to assess the aquatic ecological integrity of the various sites, based on water quality, instream and riparian habitat condition and biological impacts and integrity.

3.1 Visual Assessment

The assessment sites were investigated in order to identify visible impacts, with specific reference to impacts from surrounding activities and any effects activities occurring upstream in the catchment. Both natural constraints placed on ecosystem structure and function, as well as anthropogenic alterations to the system, were identified by observing conditions and relating them to professional experience. Photographs of each site were taken to provide visual indications of the conditions at the time of assessment. Factors which were noted in the site specific visual assessments included the following:

- stream morphology;
- instream and riparian habitat diversity;
- stream continuity;
- erosion potential;
- depth flow and substrate characteristics;
- signs of physical disturbance of the area; and
- other life forms reliant on aquatic ecosystems.

3.2 Physico Chemical Water Quality Data

On site testing of biota specific water quality variables took place. Parameters measured include pH, electrical conductivity, dissolved oxygen concentration and temperature. The results of on-site biota specific water quality analyses were used to aid in the interpretation of the data

obtained by the biomonitoring. Results are discussed against the guideline water quality values for aquatic ecosystems (DWAF 1996 vol. 7).

3.3 Habitat Suitability

The Invertebrate Habitat Assessment System (IHAS) was applied according to the protocol of McMillan (1998). This index was used to determine specific habitat suitability for aquatic macro-invertebrates, as well as to aid in the interpretation of the results of the South African Scoring System version 5 (SASS5) scores. Scores for the IHAS index were interpreted according to the guidelines of McMillan (1998) as follows:

- <65%: habitat diversity and structure is inadequate for supporting a diverse aquatic macro-invertebrate community.
- 65%-75%: habitat diversity and structure is adequate for supporting a diverse aquatic macro-invertebrate community.
- >75% habitat diversity and structure is highly suited for supporting a diverse aquatic macro-invertebrate community.

3.4 Riparian Vegetation Index (RVI)

The riparian vegetation index (RVI), a standard methodology incorporated into the biomonitoring of rivers and riparian zones, is the application of the Riparian Vegetation Index (RVI) (Kemper, 2001), which is a DWAF-approved biomonitoring tool currently being utilised for the national River Health Programme. The RVI is designed to give an indication of the Present Ecological State of the riparian zones as well as their present functionality.

A "walk-about" was undertaken to assess the species composition, community structures and the degree of exotic vegetation encroachment for each site during the field assessment.

3.5 Habitat Integrity

It is important to assess the habitat of each site, in order to aid in the interpretation of the results of the community integrity assessments by taking habitat conditions and impacts into consideration. The general habitat integrity of the site should be discussed based on the application of the Intermediate Habitat Integrity Assessment for Kemper (1999). The

Intermediate Habitat Integrity Assessment (IHIA) protocol, as described by Kemper (1999), should be used for site specific assessments. This is a simplified procedure, which is based on the Habitat Integrity approach developed by Kleynhans (1996). The IHIA is conducted as a first level exercise, where a comprehensive exercise is not practical. The Habitat Integrity of each site should be scored according to 12 different criteria which represent the most important (and easily quantifiable) anthropogenically induced possible impacts on the system. The instream and riparian zones should be analysed separately, and the final assessment should be made separately for each, in accordance with Kleynhans' (1999) approach to Habitat Integrity Assessment. Data for the riparian zone are, however, primarily interpreted in terms of the potential impact on the instream component. The assessment of the severity of impact of modifications is based on six descriptive categories with ratings. Analysis of the data should be carried out by weighting each of the criteria according to Kemper (1999). By calculating the mean of the instream and riparian Habitat Integrity scores, an overall Habitat Integrity score can be obtained for each site. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitats of the site. The method classifies Habitat Integrity into one of six classes, ranging from unmodified/natural (Class A), to critically modified (Class F).

Table 4: Classification of Present State Classes in terms of Habitat Integrity [Based on Kemper 1999]

Class	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural, with few modifications. A small change in natural habitats and biota may have taken place but the basic ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Extensively modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances, basic ecosystem functions have been destroyed and the changes are irreversible.	<20

3.6 Aquatic Macro-Invertebrates

Aquatic Macro-invertebrates were sampled using the qualitative kick sampling method called SASS5 (South African Scoring System version 5) (Dickens and Graham, 2001). The SASS5 method has been specifically designed to comply with international accreditation protocols. This

method is based on the British Biological Monitoring Working Party (BMWP) method and has been adapted for South African conditions by Dr. F. M. Chutter. The assessment was undertaken according to the protocol as defined by Dickens & Graham (2001). All work was done by an accredited SASS5 practitioner.

The SASS5 method was designed to incorporate all available biotypes at a given site and to provide an indication of the integrity of the of the aquatic macro-invertebrate community through recording the presence of various macro-invertebrate families at each site, as well as consideration of abundance of various populations, community diversity and community sensitivity. Each taxon is allocated a score according to its level of tolerance to river health degradation (Dallas, 1997).

This method relies on churning up the substrate with your feet and sweeping a finely meshed SASS net, with a pore size of 1000 micron mounted on a 300 mm square frame, over the churned up area several times. In stony bottomed flowing water biotopes (rapids, riffles, runs, etc.) the net downstream of the assessor and the area immediately upstream of the net is disturbed by kicking the stones over and against each other to dislodge benthic invertebrates. The net was also swept under the edge of marginal and aquatic vegetation to cover from 1-2 meters. Identification of the organisms was made to family level (Thirion *et al.*, 1995; Davies & Day, 1998; Dickens & Graham, 2001; Gerber & Gabriel, 2002).

Interpretation of the results of biological monitoring depends, to a certain extent, on interpretation of site-specific conditions (Thirion *et.al*, 1995). In the context of this investigation it would be best not to use SASS5 scores in isolation, but rather in comparison with relevant habitat scores. The reason for this is that some sites have a less desirable habitat or fewer biotopes than others do. In other words, a low SASS5 score is not necessarily regarded as poor in conjunction with a low habitat score. Also, a high SASS5 score, in conjunction with a low habitat score, can be regarded as better than a high SASS5 score in conjunction with a high habitat score. A low SASS5 score, together with a high habitat score, would be indicative of poor conditions. The IHAS Index is valuable in helping to interpret SASS5 scores and the effects of habitat variation on aquatic macro-invertebrate community integrity.

Classification of the system took place by comparing the present community status to reference conditions which reflect the best conditions that can be expected in rivers, streams within a specific area, and reflect natural variation over time. SASS and ASPT reference conditions were obtained from Dallas (2007), as presented in Figure 3 below. Reference conditions are stated

as a SASS score of 230 and an ASPT score of 6.7. Sites were classified according to the classification system for the Central Highveld Ecoregion according to Dallas (2007), as well as the classification system of Dickens & Graham 2001.

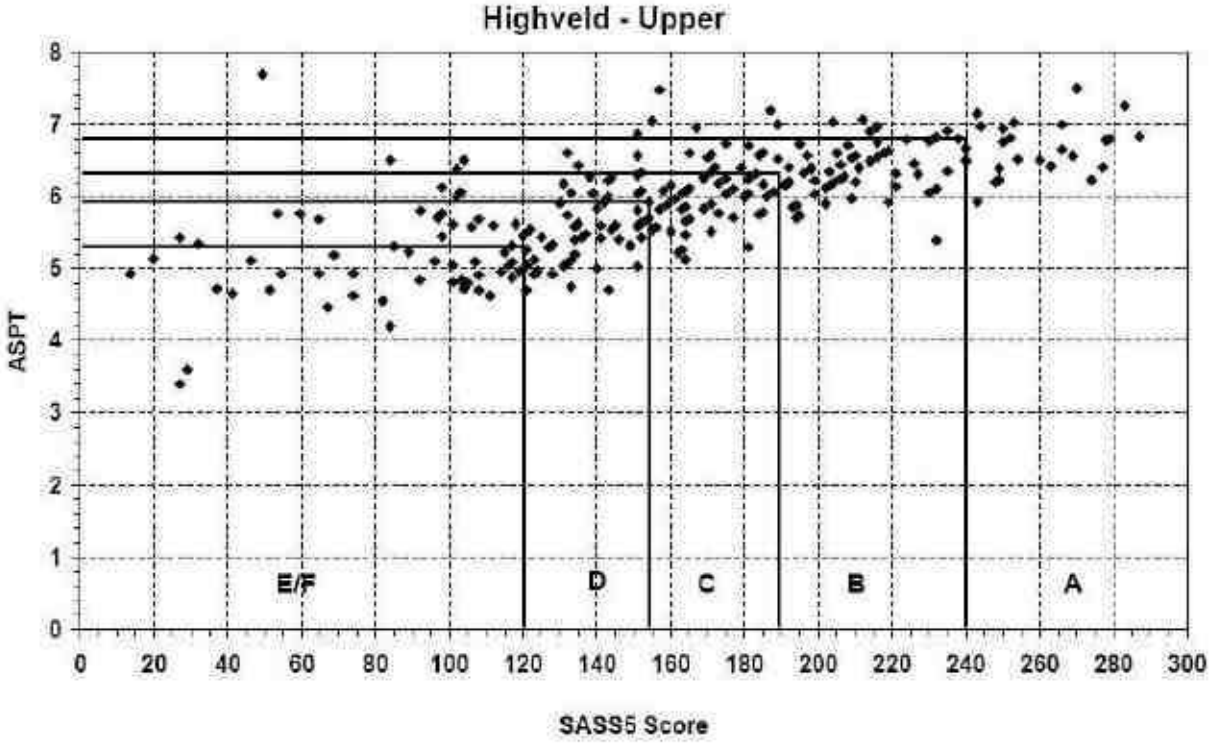

Figure 3: SASS5 Classification using biological bands calculated from percentiles for the Highveld Ecoregion, Dallas, 2007.

Table 5: Definition of Present State Classes in terms of SASS scores as presented in Dickens & Graham (2001)

CLASS	DESCRIPTION	SASS SCORE%	ASPT
A	Unimpaired. High diversity of taxa with numerous sensitive taxa.	160-170 >170	>7 >6
B	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.	121-160 141-170	>7 5-7
C	Moderately impaired. Moderate diversity of taxa.	91-120 121-140	<7 <7
D	Largely impaired. Mostly tolerant taxa present.	61-90	<6
E	Severely impaired. Only tolerant taxa present.	30-60	Variable
F	Critically impaired. Very few tolerant taxa present.	<30	Variable

3.7 Fish Community Integrity

Whereas macro-invertebrate communities are good indicators of localised conditions in a river over the short-term, fish being relatively long-lived and mobile;

- are good indicators of long-term influences;
- are good indicators of general habitat conditions;
- integrate effects of lower trophic levels and
- are consumed by humans (Uys *et al.*, 1996).

The Fish Assemblage Integrity Index (FAII) was applied according to the protocol of Kleynhans (1999). Fish species identified were compared to those expected to be present at the site, which were compiled from a literature survey including Skelton 2007. Fish samples were collected by means of a fixed generator driven electro-fishing device.

Table 6: Intolerance ratings for naturally occurring indigenous fish species with natural ranges included in the study area (Kleynhans, 2003).

SPECIES NAME	COMMON NAME	INTOLERANCE RATING	COMMENTS
Anguilla marmorata	Madagascar mottled eel	2.8	Not expected at the site due to downstream migration barriers
Anguilla bengalensis labiates	African mottled eel	2.9	Not expected at the site due to downstream migration barriers
Barbus anoplus	Chubbyhead barb	2.6	Widespread in the region
Barbus motebensis	Marico barb	3.1	limited distribution in headwaters of the Crocodile and Steelpoort branches of the Limpopo River systems
Barbus Paludinosis	Straightfin Barb	1.8	Widespread
Barbus trimaculatus	Threespot Barb	2.2	Common in many river systems of southern Africa
Barbus unitaeniatus	Longbeard barb	1.7	Widely distributed in southern Africa
Chiloglanis pretoriae	Shortspine Suckermouth or Rock catlet	4.9	Widespread (Incomati, Limpopo & Zambezi)
Clarias gariepinus	*Sharptooth Catfish*	1.2	Most widely distributed fish in Africa.
Cyprinus carpio	Carp	1.4	Widespread alien species
Gambusia affinis	Mosquito fish	2.0	Widespread
Labeobarbus polylepis	Smallscale yellowfish	3.1	Widespread but unlikely to occur at the site
Labeobarbus marequensis	Largescale yellowfish	2.6	Widespread but unlikely to occur at the site
Labeo cylindricus	Redeye labeo	3.1	Widespread
Labeo molybdinus	Leaden labeo	3.2	Middle and lower Zambezi and

SPECIES NAME	COMMON NAME	INTOLERANCE RATING	COMMENTS
			south towards the Tugela River
Micropterus salmoides	Largemouth bass	2.2	Widespread alien species
Opsaridium peringueyi	Southern Barred minnow	4.5	Considered rare
Oreochromis mossambicus	Blue Kurper	1.3	Widespread
Pseudocrenilabrus philander	Southern mouthborooder	1.3	Widespread
Tilapia sparrmanii	Banded Tilapia	1.3	Widespread

Tolerant: 1-2 **moderately tolerant :> 2-3** **Moderately Intolerant: >3-4** **Intolerant: >4**

Table 7: Definition of Present State Classes in terms of FAII scores according to the protocol of Kleynhans (1999)

Class	Description	Relative FAII score (% of expected)
A	Unmodified, or approximates natural conditions closely.	90-100
B	Largely natural, with few modifications.	80-89
C	Moderately modified. A lower than expected species richness and the presence of most intolerant species.	60-79
D	Largely modified. A clearly lower than expected species richness and absence of intolerant and moderately tolerant species	40-59
E	Seriously modified. A strikingly lower than expected species richness and a general absence of intolerant and moderately intolerant species	20-39
F	Critically modified. An extremely lowered species richness and an absence of intolerant and moderately intolerant species	<20

3.8 Wetland Delineation

For the purposes of this investigation, a wetland was defined according to the definition in the National Water Act as: "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

Wetland/riparian zone delineation took place according to the method presented in the final draft of "A practical field procedure for identification and delineation of wetlands and riparian areas" published by the department of Water Affairs and Forestry in 2005. The foundation of the method is because wetlands have several distinguishing factors including the following:

- The presence of water at or near the ground surface
- Distinctive hydromorphic soils
- Vegetation adapted to saturated soils

- The presence of alluvial soils in stream systems

By observing the evidence of these features, in the form of indicators, wetlands can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF 2005).

Wetlands and riparian zones can be divided into three zones (DWAF 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant part of the rainy season and the temporary zone surrounds the seasonal zone and is only saturated for a short period of the year, but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soils and the growth of wetland vegetation. The object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

- Three river systems flow through the subject property namely the Modderfonteinspruit, an unnamed tributary of the Jukskei River and the Jukskei River itself. These showed similarity regarding wetland and terrestrial vegetation and wetland vegetation could therefore be used as primary wetland indicator. *Hyparrhenia tamba, Eragrostis gummiflua* and *Imperata cylindrica* were the most informative indicator species and thus used to determine temporary zone boundaries.
- Due to the incised nature of the rivers, terrain units were useful in identifying the temporary zone boundaries and used as a secondary wetland indicator. This was especially helpful in areas where the temporary zone could not be determined with the use of vegetation as indicator.
- Seepage zones were identified in the vicinity of the unnamed tributary of the Jukskei River. These seepage zones are supplemented by stormwater runoff from nearby roads elevating the degree of development of wetland areas in the vicinity of the tributary. The soil form as well as stream soil wetness were therefore informative indicators for the determination of the temporary zone boundary within seepage areas. For the soil form indicator the presence of gleyed soils (most of the iron has been leached out of the soil leading to a greyish/greenish/bluish colour) and mottling were investigated to aid in identifying areas with wetland characteristics. Due to the degree of incision of the remainder of the study area, stream soil wetness and soil form were of limited use with the delineation process on the Modderfonteinspruit, and the Jukskei River themselves.

3.9 Wetland Mammal Assessment

3.9.1 Desktop Study

Prior to the field assessment being completed, a desktop study was undertaken to gather background information regarding the site and any sensitive faunal species that may be affected by the proposed development: This involved:

- Consulting maps, aerial photographs and digital satellite images in order to determine broad habitats and sensitive sites;
- Contacting the relevant authorities, and
- A literature review concerning: habitat and food requirements for the wetland mammal species of concern; field signs for the species of concern; vegetation types; and floral and faunal species distributions;

3.9.2 Habitat Assessment

Wetland mammal sampling is a difficult and time consuming activity. For example, one reliable and extensively utilised method of catching rodents, which many of the species of concern for this study are, is by Sherman traps. However, the low density in which many rodent species occur mean that even these traps have a very low success rate; on average for a 100 traps set in the Savanna, less than 15 will actually catch a specimen. Given the time constraints of this project it was decided that to complement the direct and indirect observations, a habitat and food availability assessment would also be completed. This would provide a rapid and accurate assessment that would indicate if the wetland mammal species of concern could occur on the site and therefore if further investigation was warranted. The habitat and food availability assessment involved investigating the site on foot while recording the vegetation present and noting any other physical structures that could be of importance.

3.10 Assumptions and Limitations

The following points serve to indicate the assumptions and limitations of this study.

- ***Reference conditions are unknown:*** The composition of aquatic biota in the study area, prior to major disturbance, is unknown. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available.

- ***Temporal variability:*** The data presented in this report are based on a single site visit, undertaken late autumn (12 May 2009). The effects of natural seasonal and long-term variation in the ecological conditions and aquatic biota found in the streams are, therefore, unknown.
- ***Ecological assessment timing:*** Aquatic and terrestrial ecosystems are dynamic and complex. It is likely that aspects, some of which may be important, could have been overlooked. A more reliable assessment of the biota would require seasonal sampling, with sampling being undertaken under both low flow and high flow conditions.

4. RESULTS AND INTERPRETATION

4.1 Visual Assessment

A photographic record of each site was made in order to provide a visual record of the condition as observed during the field assessment. The photographs taken are presented below together with a table summarising the observations for the various criteria made during the visual assessment undertaken on each of the sites.

Figure 4: Upstream view of the WV1 site, indicating the disturbed nature of the riparian vegetation and some bank erosion.

Figure 5: Downstream view of the WV1 site indicating the high level of flow at this point and the disturbed nature of the riparian vegetation.

Figure 6: Downstream view of the WV2 site, indicating the significant erosion at this point.

Figure 7: Upstream view of the WV2 site indicating the bank instability at this point.

Table 8: Description of the location of the Assessment sites in the study area

SITE	WV1	WV2
Riparian zone characteristics	The riparian zone is severely impacted with indigenous vegetation removal and alien encroachment being evident and significant erosion identified on the right bank.	The riparian zone is in fair condition although some impact from mowing and a severe impact due to alien encroachment are evident.
Algal presence	Significant algal proliferation was evident at the time of sampling.	No algal proliferation was evident at the current time.
Visual indication of an impact on aquatic fauna	The distinct discoloration of the water indicates that an impact on water quality has occurred. Litter was severe in the stream, with signs of eutrification evident as well.	Incision and sedimentation of the stream has led to impacts on instream habitat.
Depth characteristics	Under the current high flow conditions, the river consists of deeper runs and riffle areas.	Under the current flow conditions, the stream consists of pools, shallow riffles and runs, with a number of gravel and sand deposits.
Flow condition	Under the current high flow conditions, there is little diversity of flow types with strong flows throughout.	Under the high flow conditions, the stream consists of moderately fast flowing runs.
Water clarity	Some discoloration of the water due to suspended solids as well as suspended phytoplankton has occurred.	The water was clear at the time of assessment.
Water odour	A distinct sewage odour was evident.	No odours were evident.
Erosion potential	A significant potential for erosion is present under high flow conditions, due to the steep nature of the banks. Some bank failure has taken place in the past.	Significant potential for erosion is present under high flow conditions, due to the incised nature of the banks. A fair amount of bank failure has taken place in the past.

4.2 Physico-Chemical Water Quality

The table below records the biota specific water quality of each assessment site.

Table 9: Biota specific water quality data of the two sites assessed.

SITE	COND mS/m	pH	D. O. mg/l	TEMP °C
WV1	45.0	7.59	3.2	23.1
WV2	141.8	7.91	5.1	21.4

- General water quality at WV1 can be considered to be severely impaired,

- Limited amounts of dissolved salts are present in the system, however, eutrification is evident.
- The pH is slightly alkaline and no impact on the aquatic community due to altered pH conditions is deemed likely.
- Dissolved oxygen levels are extremely low. This will prevent many of the aquatic community members from colonising the area.
- Temperature can be regarded as normal for the time of year and time of assessment.
- The poor water quality at this site is most likely due to the introduction of urban runoff into the system further up in the catchment as well as sewage entering the system.

- General water quality at WV2 can be considered significantly impaired.
- A significant increase in the dissolved salt concentration from natural conditions is evident.
- The pH is slightly alkaline and this will impact on the diversity and abundance of the aquatic communities present.
- Some impact on dissolved oxygen levels is likely and is most likely because of the introduction of urban runoff into the system further up in the catchment. This is likely to affect more sensitive aquatic community members.
- Temperature can be regarded as normal for the time of year and time of assessment.

4.3 Riparian Vegetation Index (RVI)

The RVI is designed to give an indication of the Present Ecological State of the riparian zones, as well as their present functionality. Two RVI sites were chosen within the study area. One site located at the Modderfonteinspruit (WV2) and one at the Jukskei River site (WV1). The unnamed tributary also situated within the subject property boundaries is considered a channeled valley bottom wetland and not representative of a true river system; as a result, a third RVI site was not deemed necessary.

Both assessment sites can be described as being single channels, approximately four meters wide and two meters deep, with soil and sandy substrate dominating the river bottom. Both the left- and right hand-banks show extensive signs of incision and erosion.

A list of the floral species observed during the assessment is presented in the table that follows, but is briefly described below. The vegetation encountered at both assessment sites where relatively uniform. A low diversity of indigenous species was encountered, with the majority of

indigenous species identified being grass species such as *Hyparrhenia tamba, Eragrostis gummiflua* and *Imperata cylindrica*. Exotic tree species with a high affinity for water, like *Salix babylonica*, encroach upon the riparian zone. In stream, vegetation mainly consisted of the invader *Arundo donax*. For a list of the vegetation observed at these sites, consult the following table.

The RVI score for the Modderfonteinspruit was found to be 8.88 (out of a possible 20), a value which falls within the boundary of a class E/D (Largely modified) stream. RVI score for the Jukskei River was 7.55 (out of a possible 20); class E (Extensive loss of the natural habitat). The reason for these sites receiving these low values comes mostly from the low abundance of indigenous riparian species and the impacts on the stream by erosion with special mention of earth moving projects close to the Jukskei River. The calculation and results for the RVI are presented in Appendix 1.

Table 10: Dominant riparian vegetation species noted during the riparian vegetation assessment. Exotic species are marked by an asterisk.

Trees/shrubs	Forbs	Grasses/sedges/reeds
*Salix babylonica**	*Bidens pilosa**	*Pennisetum clandestinum**
	*Conyza bonariensis**	*Hyparrhenia hirta*
	Asteraceae sp.	*Hyparrhenia tamba*
	Helichrysum nudifolium	*Eragrostis gummiflua*
	*Tagetes minuta**	*Imperata cylindrica*
	*Verbena bonariensis**	*Arundo donax*
	Persicaria attenuata	*Typha capensis*
		Themeda triandra

4.4 Habitat Assessment

- There are several fairly large impacts on the habitat at the WV1 site.
- Instream impacts included large impacts from water quality, flow, bed and channel modifications and also solid waste disposal. Overall, the site achieved a 75.1% score for instream integrity.
- The largest riparian zone impacts were bank erosion and channel modifications, coupled with indigenous vegetation removal and exotic vegetation encroachment. Less significant impacts from flow modifications were observed.

- Overall, the site achieved a 53.2% score for riparian integrity.
- The site obtained an IHIA rating of 64.2%, which indicates moderately modified (class C conditions). The site, therefore, falls within the DEMC for the quaternary catchment.
- No further impacts on the habitat in the system should take place and actions should be taken to avoid any further degradation. In this regard special mention is made of the need to attenuate storm water runoff from the proposed development.
- From the results of the application of the IHIA to the WV2 site, it is evident that there are several fairly large impacts on the riparian habitat of the area, with bed, flow and channel and bank erosion. Lesser impacts include indigenous vegetation removal and channel modifications. Overall, the site achieved a 56.4% score for riparian integrity.
- The largest instream impacts were water quality modifications and flow, bed and channel modifications. Overall, the site achieved a 72.0% score for instream integrity.
- The site obtained an IHIA rating of 64.2%, which indicates moderately modified (class C conditions). The site, therefore, falls within the DEMC for the quaternary catchment.
- No further impacts on the habitat in the system should therefore take place and careful planning of the attenuation of storm water from the proposed development will be required.

The table below presents a summary of the results obtained from the application of the IHAS Index to the sites. This index determines habitat suitability, with particular reference to the requirements of aquatic macro-invertebrates. The results obtained from this assessment will aid in defining the habitat condition.

Table 11: A summary of the results obtained from the application of the IHAS index to the assessment sites.

SITE	WV1	WV2
IHAS score	64	71
IHAS Adjustment score (illustrative purposes only)	+22	+22
McMillan, 1998 IHAS description	Habitat diversity and structure is slightly below the levels regarded as being adequate for supporting a diverse aquatic macro-invertebrate community under the current low flow conditions.	Habitat diversity and structure is adequate for supporting a diverse aquatic macro-invertebrate community under the current low flow conditions.
Stones habitat characteristics	Areas of cobble are present both in current in a fair diversity of flow conditions. The rocky habitat can be regarded as being suitable for supporting a diverse and sensitive aquatic macro-invertebrate community. Some stones out of current are also present. Rocky substrate is generally free of sediment deposition however algal proliferation affects the site significantly.	Areas of cobble are present both in current in a fair diversity of flow conditions. The rocky habitat can be regarded as being suitable for supporting a diverse and sensitive aquatic macro-invertebrate community. Rocky substrate is generally free of sediment deposition.
Vegetation habitat characteristics	There was an abundance of marginal vegetation available which is suitable for supporting a diversity of aquatic macro-invertebrates under the current flow conditions.	There was a limited abundance marginal vegetation was overhanging into the water at the time of assessment.
Other habitat characteristics	There were no gravel, sand or mud biotopes present at the site at the time of the assessment.	There was extensive gravel, sand or mud deposits present in the area. The presence of these biotopes will improve the diversity of the aquatic community significantly with some specialized taxa expected to occur.
IHAS general stream characteristics	A wide stream consisting of fast strong flows at the time of assessment. The water in the system was discoloured at the time of assessment. Riparian vegetation is severely disturbed. Bankside cover is good but bank instability is evident.	A shallow, narrow stream consisting of fast flowing glides at the time of assessment. The water in the system was clear at the time of assessment. Riparian vegetation is dominated by grasses with isolated small shrubs and reeds. Bankside cover is inadequate for supporting bank stability.

4.5 Aquatic Macro-invertebrates

The results of the aquatic macro-invertebrate assessment according to the SASS5 index are summarised in the tables below. Table 11 indicates the results obtained at the sites per biotope sampled. Table 12 summarises the findings of the SASS assessment based on the analyses of the data for the sites, as well as interpretation of the data.

Table 12: Biotope specific summary of the results obtained from the application of the SASS5 index to each site.

PARAMETER	SITE	STONES	VEGETATION	GRAVEL, SAND AND MUD	TOTAL
SASS5 Score	WV1	28	29	-	35
Taxa		7	8	-	9
ASPT		4	3.6	-	3.9
SASS5 Score	WV2	13	29	4	37
Taxa		3	8	1	10
ASPT		4.3	3.6	4	3.7

Table 13: A summary of the results obtained from the application of the SASS5 and IHAS indices to the site.

Type of Result	WV1	WV2
Biotopes sampled	Stones in current and marginal vegetation in and out of current.	Stones in current, marginal vegetation in and out of current, gravel, sand and mud...
Sensitive taxa present	None observed	None observed
Sensitive taxa absent	*Leptophlibidae, Chlorolestidae, , Aeshnidae, Perlidae, Heptageniidae, , Psephnidae, Tricorythidae, Dixidae, Hydracarina, Athericidae, Naucoridae, Atyidae; Chlorocyphidae*	*Leptophlibidae, Chlorolestidae, , Aeshnidae, Perlidae, Heptageniidae, , Psephnidae, Tricorythidae, Dixidae, Hydracarina, Athericidae, Naucoridae, Atyidae; Chlorocyphidae*
Adjusted SASS5 score	57	59
SASS5 % of reference score	15.2%	16.1%
ASPT % of reference score	58.2%	55.2%
Dickens and Graham, 2001 SASS5 classification	Class F (Critically Modified)	Class F (Critically Modified)
Dallas 2007 classification	Class E/F	Class E/F

- The SASS data at both assessment sites indicates that the aquatic macro-invertebrate communities in these sections of the Jukskei River and Modderfonteinspruit have suffered a severe loss in integrity when compared to the reference score for a pristine Highveld Aquatic Ecoregion stream.
- At present, the system can be considered as a Class F site according to both Dickens & Graham, as well as the classification of Dallas (2007). The site, therefore, falls below the DEMC for the quaternary catchment.

- Further impacts on the system could lead to further degradation of the system and, therefore, lead to further deviation from the DEMC for the catchment.
- Careful planning and mitigation will be required to limit further impacts on the system. In this regard special mention is made of the need to attenuate runoff and to prevent impacts on water quality in the system.

4.6 The Fish Community

Table 14: A summary of the results obtained from the application of the FAII index to the site.

Type of Result	WV1	WV2
Species present and number of individuals obtained	None captured	*Tilapia sparrmanii* 7 15 - 55 mm *Gambusia affinis* 1 20 mm
Health and condition	Not applicable	No impairment of fish health observed
Expected FAII score	117	117
Observed FAII score	0	16.5
Relative FAII score	0%	14.1%
FAII classification (Kleynhans, 1999)	"Class F". Critically modified.	"Class F". Critically modified.

- The FAII data at the WV1 site indicates that the fish community in this section of the Julskei River has suffered a critical loss in integrity when compared to the expected score for a stream in this catchment with the habitat characteristics of the area.
- The absence of fish in the Jukskei River and the low fish community diversity and abundance in the Modderfonteinspruit system is indicative of long term impacts on the system, with special mention of impacts on water quality, flow modification and downstream migration barriers.
- With only a low diversity and abundance of fish in the area, the fish community of the area is considered critically modified (Class F).
- Habitat and water quality in the system should be improved so that some more tolerant fish species can again become established in the system.

4.7 Wetland Mammal Assessment

GDARD identified the following wetland mammal species, *Aonyx capensis, Atilax paludinosus, Chrysopalax villosus, Dasymys incomtus, Lutra maculicollis, Itomys angoniensis (Otomys angoniensis)*, and *Otomys irroratus*, to be of concern. The habitat and food requirements of

these species are listed in the following tables as well as whether or not they these requirements were met at study site.

In addition to this site trapping using Sherman traps was undertaken. Two common small mammal species were observed, namely the Multimammate Mouse mouse (*Mastomys natalensis* or *M. coucha)* and the Swamp Musk Shrew (*Crocidura mariquensis*). The results of the Sherman trapping at the site, showed that these two species are present in high abundances, however, the species diversity at the site is considered low as no other species were captured and no other signs of small mammals were observed.

4.7.1 Atilax paludinosus

Table 15: Habitat and food requirements for *Atilax paludinosus* and the degree to which they are met on the proposed development site. This information was compiled using Apps (2000) and Cillie (2004).

Species	Habitat requirements	Habitat available on site	Food requirements	Food available on site	Overall
Atilax paludinosus [Water (Marsh) mongoose]	Dense vegetation near water; Foragers from footpaths and muddy banks	Tree encroachment close to the river could potentially provide habitat for this species.	Frogs, crabs, mice, fish, insects and bird eggs. Mainly frogs and crabs	Moderate to low	Moderate possibility of species being found in the vicinity of the study area.

4.7.2 Chrysopalax villosus

Table 16: Habitat and food requirements for *Chrysopalax villosus* and the degree to which they are met on the proposed development site. This information was compiled using Apps (2000) and Cillie (2004).

Species	Habitat requirements	Habitat available on site	Food requirements	Food available on site	Overall
Chrysopalax villosus (Rough haired golden mole)	Grassland with dry sandy soils near marshes and streams	Riparian area is moderately suitable for this species however the existing disturbances in the area will limit the probability of this species occurring in the area.	Invertebrates, especially giant earthworms and millipedes	High	Moderate possibility of species being found in the vicinity of the study area.

4.7.3 Dasymys incomtus

Table 17: Habitat and food requirements for *Dasymys incomtus* and the degree to which they are met on the proposed development site. This information was compiled using Apps (2000) and Cillie (2004).

Species	Habitat requirements	Habitat available on site	Food requirements	Food available on site	Overall
Dasymys incomtus (Water rat)	Swamps and wet areas along rivers and streams	A small wet pond area was observed on the site which may provide suitable habitat.	Stems and ripening seeds of grass; Reeds and other plants; Insects	High	Moderate possibility of being found in the vicinity of the study area.

4.7.4 Lutra maculicollis

Table 18: Habitat and food requirements for *Lutra maculicollis* and the degree to which they are met on the proposed development site. This information was compiled using Apps (2000) and Cillie (2004)

Species	Habitat requirements	Habitat available on site	Food requirements	Food available on site	Overall
Lutra maculicollis (Spotted Neck Otter)	Fresh water only, generally prefers deeper water that does not necessarily have to flow ; Must have dense vegetation and holes available	There is a small pond wetland area into which the unnamed tributary of the Jukskei River flows on the site and dense vegetation was available in areas.	Primarily fish eater. 40% fish; 40 % crab and 20% frog	Low due to impacts on the fish community of the system.	Meduim possibility of being encountered.

4.7.5 Otomys angoniensis (Otomys angoniensis)

Table 19: Habitat and food requirements for *Itomys angoniensis* and the degree to which they are met on the proposed development site. This information was compiled using Apps (2000) and Cillie (2004).

Species	Habitat requirements	Habitat available on site	Food requirements	Food available on site	Overall
Itomys angoniensis/ *Otomys angoniensis* (Angoni Vlei Rat)	Wet vleis/ swampy areas; Grassland and bushveld next to rivers; Requires dense cover for protection from prey	The wet pond area into which the unnamed tributary of the Jukskei River flows and dense vegetation and grassland close to the river could potentially provide habitat for this species.	Stems and rhizomes of grass and fine seeds; Own faeces.	High	High possibility of being encountered.

4.7.6 Otomys irroratus

Table 20: Habitat and food requirements for *Otomys irroratus* and the degree to which they are met on the proposed development site. This information was compiled using Apps (2000) and Cillie (2004)

Species	Habitat requirements	Habitat available on site	Food requirements	Food available on site	Overall
Otomys irroratus (Vlei rat)	Vleis and swampy areas; Grassland next to wet areas; Found in wetter areas than *Otomys angoniensis*; Wet soil and standing water	The wet pond area into which the unnamed tributary of the Jukskei River flows and dense vegetation and grassland close to the river could potentially provide some habitat for this species.	Stems and leaves of grasses and reeds; Forbs and seeds; Bark from pine trees;	Some food available.	Moderate probability of occurrence.

4.7.7 Aonyx capensis

Table 21: Habitat and food requirements for *Aonyx capensis* and the degree to which they are met on the proposed development site. This information was compiled using Apps (2000) and Cillie (2004).

Species	Habitat requirements	Habitat available on site	Food requirements	Food available on site	Overall
Aonyx capensis [African (Cape) clawless otter]	Fresh, unpolluted water, preferably flowing; Cover of dense vegetation; Require holes and rocks	The combination of fresh, flowing, unpolluted water was not observed at the site.	In freshwater: 50-70 % crabs; 10-20 % frogs;15% dragonfly larvae, and 3-23 % fish	Low	Site not suitable for species.

4.8 Wetland Delineation

Upon the assessment of the area the various riparian vegetation components were assessed. Dominant species were characterised as either wetland or terrestrial species. The wetland species were then further categorised as temporary, seasonal and permanent zone species. This characterisation is presented in the tables below with the terrestrial species identified on the subject property.

Permanent	Seasonal	Temporary	Terrestrial species
Arundu donax	*Eragrostis gummiflua*	*Hyparrhenia tamba*	*Hyparrhenia hirta*
Typha capensis	*Imperata cylindrica*	*Themeda triandra*	*Themeda triandra*
Cyperus sp.	*Hyparrhenia tamba*	*Eragrostis gummiflua*	

- A 32 meter buffer around the riparian zones is deemed adequate to maintain the Present Ecological State (PES) and to protect it from the effects of the proposed development, provided that the impact minimisation measures presented in the section below are adhered to.
- There is a fair diversity of terrestrial as well as wetland vegetation within the study area. It is therefore essential that the minimum riparian buffer advocated be implemented at these sites in order to allow for the conservation of riparian and wetland habitats, which are generally, considered as sensitive habitats with higher levels of biodiversity.
- Vegetation transformation was encountered close to the river systems but vegetation was still useful with the identification of the temporary zones and used as primary indicator.
- Mottling and gleying of soils were observed. This aided with identifying areas with wetland characteristics where there was uncertainty on the location of the boundary of temporary wetland zone based on the vegetation characteristics.

Wetland and riparian zone delineation

The Figure below serves to conceptually present the location of the riparian zone boundaries on the property as well as the 32 meter buffer zone. During construction and rehabilitation, the allocated buffer zones should remain as open space.

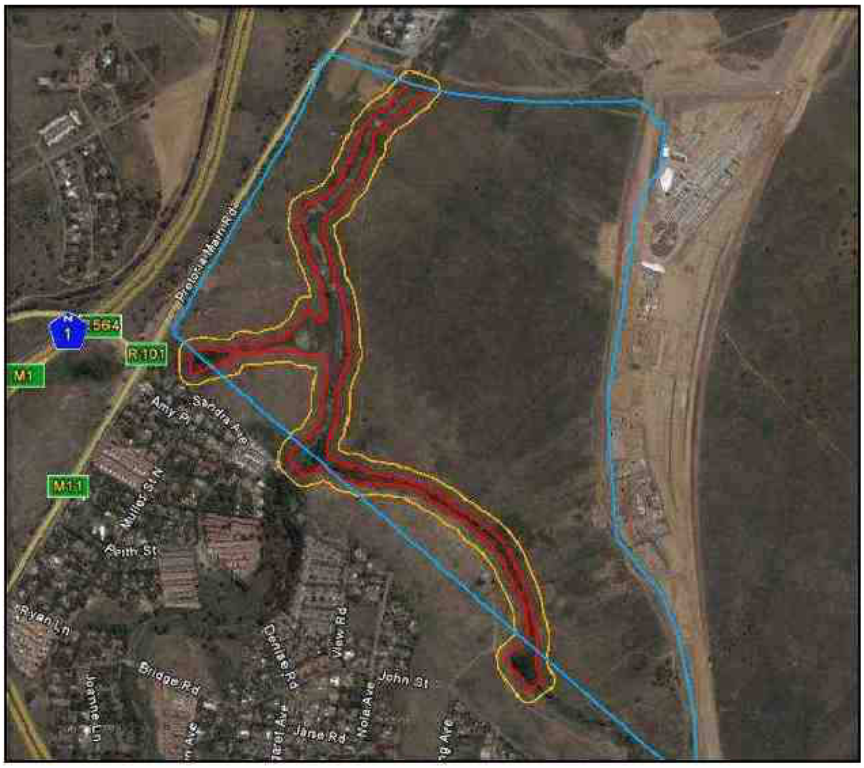

Figure 8: Riparian zone location with regards to the proposed development.

5. SYNTHESIS AND CONCLUSION

Physico-Chemical Water Quality

- General water quality at WV1 can be considered to be severely impaired,
- Limited amounts of dissolved salts are present in the system, however, eutrification is evident.
- The pH is slightly alkaline and no impact on the aquatic community due to altered pH conditions is deemed likely.
- Dissolved oxygen levels are extremely low. This will prevent many of the aquatic community members from colonising the area.
- Temperature can be regarded as normal for the time of year and time of assessment.
- The poor water quality at this site is most likely due to the introduction of urban runoff into the system further up in the catchment as well as sewage entering the system.
- General water quality at WV2 can be considered significantly impaired.
- A significant increase in the dissolved salt concentration from natural conditions is evident.
- The pH is slightly alkaline and this will impact on the diversity and abundance of the aquatic communities present.
- Some impact on dissolved oxygen levels is likely and is most likely because of the introduction of urban runoff into the system further up in the catchment. This is likely to affect more sensitive aquatic community members.
- Temperature can be regarded as normal for the time of year and time of assessment.

Riparian Vegetation Index (RVI)

The RVI score for the Modderfonteinspruit was found to be 8.88 (out of a possible 20), a value which falls within the boundary of a class E/D (Largely modified) stream. RVI score for the Jukskei River was 7.55 (out of a possible 20); class E (Extensive loss of the natural habitat). The reason for these sites receiving these low values comes mostly from the low abundance of indigenous riparian species and the impacts on the stream by erosion, with special mention of earth moving projects close to the Jukskei River. The calculation and results for the RVI are presented in Appendix 1.

Habitat Assessment

- There are several fairly large impacts on the habitat at the WV1 site.
- Instream impacts included large impacts from water quality, flow, bed and channel modifications and also solid waste disposal. Overall, the site achieved a 75.1% score for instream integrity.
- The largest riparian zone impacts were bank erosion and channel modifications, coupled with indigenous vegetation removal and exotic vegetation encroachment. Less significant impacts from flow modifications were observed.
- Overall, the site achieved a 53.2% score for riparian integrity.
- The site obtained an IHIA rating of 64.2%, which indicates moderately modified (class C conditions). The site, therefore, falls within the DEMC for the quaternary catchment.
- No further impacts on the habitat in the system should take place and actions should be taken to avoid any further degradation. In this regard special mention is made of the need to attenuate storm water runoff from the proposed development.
- From the results of the application of the IHIA to the WV2 site, it is evident that there are several fairly large impacts on the riparian habitat of the area, with bed, flow and channel and bank erosion. Lesser impacts include indigenous vegetation removal and channel modifications. Overall, the site achieved a 56.4% score for riparian integrity.
- The largest instream impacts were water quality modifications and flow, bed and channel modifications. Overall, the site achieved a 72.0% score for instream integrity.
- The site obtained an IHIA rating of 64.2%, which indicates moderately modified (class C conditions). The site, therefore, falls within the DEMC for the quaternary catchment.
- No further impacts on the habitat in the system should therefore take place and careful planning of the attenuation of storm water from the proposed development will be required.

Aquatic Macro-invertebrates

- The SASS data at both assessment sites indicates that the aquatic macro-invertebrate communities in these sections of the Jukskei River and Modderfonteinspruit have suffered a severe loss in integrity when compared to the reference score for a pristine Highveld Aquatic Ecoregion stream.

- At present, the system can be considered as a Class F site according to both Dickens & Graham, as well as the classification of Dallas (2007). The site, therefore, falls below the DEMC for the quaternary catchment.
- Further impacts on the system could lead to further degradation of the system and, therefore, lead to further deviation from the DEMC for the catchment.
- Careful planning and mitigation will be required to limit further impacts on the system. In this regard special mention is made of the need to attenuate runoff and to prevent impacts on water quality in the system.

The Fish Community

- The FAII data at the WV1 site indicates that the fish community in this section of the Julskei River has suffered a critical loss in integrity when compared to the expected score for a stream in this catchment with the habitat characteristics of the area.
- The absence of fish in the Jukskei River and the low fish community diversity and abundance in the Modderfonteinspruit system is indicative of long term impacts on the system, with special mention of impacts on water quality, flow modification and downstream migration barriers.
- With only a low diversity and abundance of fish in the area, the fish community of the area is considered critically modified (Class F).
- Habitat and water quality in the system should be improved so that some more tolerant fish species can again become established in the system.

Wetland Mammal Assessment

- Two common small mammal species were observed, namely the Multi-mammate Mouse (*Mastomys natalensis* or *M. coucha)* and the Swamp Musk Shrew (*Crocidura mariquensis*).
- The results of the Sherman trapping at the site, showed that these two species are present in high abundances, however, the species diversity at the site is considered low as no other species were captured and no other signs of small mammals were observed.

Wetland Delineation

- A 32 meter buffer around the riparian zones is deemed adequate to maintain the Present Ecological State (PES) and to protect it from the effects of the proposed

development provided that the impact minimisation measures presented in the section below are adhered to.

- There is a fair diversity of terrestrial as well as wetland vegetation within the study area. It is therefore essential that the minimum riparian buffer advocated be implemented at these sites in order to allow for the conservation of riparian and wetland habitats, which are generally, considered as sensitive habitats with higher levels of biodiversity.
- Vegetation transformation was encountered close to the river systems but vegetation was still useful with the identification of the temporary zones and used as primary indicator.
- Mottling and gleying of soils were observed. This aided with identifying areas with wetland characteristics where there was uncertainty on the location of the boundary of temporary wetland zone based on the vegetation characteristics.

6. DESIGN AND IMPACT MINIMISATION

From the above assessment, some guidelines for the proposed development design are proposed. The design should ensure that the following criteria are met to ensure the ongoing functioning of the various zones of the riparian features in the vicinity of the proposed development:

- These aquatic resources are situated in a highly urbanised area and it is likely that flows have already been severely affected due to channel and bed modifications and as well as by large amounts of urban runoff. It is considered essential that runoff from the proposed development be well attenuated to prevent additional impacts from erosion due to urban runoff in the catchment. This is necessary to ensure the ongoing viability of the aquatic communities within and downstream of the proposed development.
- Adequate stormwater management must be incorporated into the design of the proposed development in order to prevent erosion and the associated sedimentation of the riparian zones.
    - Sheet runoff from paved surfaces and access roads needs to be curtailed.
    - Runoff from paved surfaces should be slowed down by the strategic placement of berms.
    - The buffer zones should be left undisturbed to allow the climax terrestrial vegetation community to establish in these areas.

- As much vegetation growth as possible should be promoted within the proposed development area in order to protect soils and to reduce the percentage of the surface area which is paved. In this regard special mention is made of the need to use indigenous vegetation species as the first choice during landscaping.
- Any discharge of runoff into the river system must be done in such a way as to prevent erosion. In this regard special mention is made of the use of energy dissipating structures in storm water discharge. Consideration to the use of attenuation facilities must also be given.

- Crossings (if any) must ensure that the creation of turbulent flow in the system is minimised, in order to prevent downstream erosion. No support pillars should be constructed within the active channel of any of the drainage features on the subject property.
- The duration of impacts on the stream should be minimised as far as possible by ensuring that the duration of time in which flow alteration and sedimentation will take place is minimised.
- All areas affected by construction should be rehabilitated upon completion of the construction phase of the development. Areas should be reseeded with indigenous grasses as required.
- During the construction phase, no vehicles should be allowed to indiscriminately drive through any riparian areas.
- During construction no dumping of waste and no stockpiling of materials within the riparian areas as well as associated buffer zones should take place.
- No fires should be permitted near the construction area.
- If any spills occur, they should be immediately cleaned up.
- All alien vegetation in the riparian zone should be removed upon completion of construction.
- The allocated 32 meter buffer around riparian zones should be maintained as private or public open space.
- It must be insured that connectivity of the river upstream and downstream of the proposed development are maintained.

The points below serve to summarise the measures deemed necessary in order to ensure protection of the riparian and aquatic resources and to ensure environmental protection during the operational phase of the proposed development.

- Any areas where bank failure is observed, due to the effects of any crossings, should be immediately repaired by reducing the gradient of the banks to a 1:3 slope.

- Bank vegetation cover should be monitored to ensure that sufficient vegetation is present to bind the bankside soils and prevent further bankside erosion.
- Alien vegetation control along the wetland and riparian features needs to be controlled for the life of the proposed development.

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Appendix 1: RVI score sheets January 2010

RIPARIAN VEGETATION INDEX (RVI)

A. Site details

River:	Modderfontein	Date:	26/01/2010
Site No:	1	Assessors:	N vd Haar
Site Name:	Waterfall Valley		
Location (GPS):	S26°02'40.16" E28°06'52.95"	Elevation:	1606mamsl

B. Riparian vegetation index details

RVI score calculation

The RVI formula is:

RVI = [(EVC) + (SI x PCIRS) + (RIRS)]

Where:

EVC = Extent of vegetation cover

SI = Structural intactness

PCIRS = Percentage cover of indigenous riparian species

RIRS = Recruitment of indigenous riparian species

Riparian Vegetation Index Details:

			RVI Score	8.88
EVC Score	6		PCIRS Score	-0.2
SI Score	0.6		RIRS Score	3

C. RVI Score, assessment class and its description

RVI Score	Assessment Class	Description
19 to 20	A	Unmodified conditions, natural state
17 to 18	B	Largely natural with few modifications
13 to 16	C	Moderately modified
9 to 12	D	Largely modified
5 to 8	E	Extensive loss of the natural habitat
0 to 4	F	Critical level of modifications, almost a complete loss of natural habitat

D. Riparian ecosystem state variables

Channel type	Single
Width of potential riparian zone	LHB = ca. 5m; RHB = ca. 2m
Substrate	10% soil, 45% rocky, 15% sand, 25%bedrock,5%silt
Disturbances	Erosion/ Sedimentation
	Vegetation invasive (exotic)
	Construction of bridges
	Mowing of riparian zone

Surrounding land use	Residential development, roads and park.
Dominant cover	Approximately: grass 50%; trees/shrubs 30%; reeds 20%
Indigenous species richness	Low Diversity
Exotic species richness	Low diversity; High abundance
Evidence of riparian ecosystem functioning:	
Channel bank stability	Low to medium; signs of extensive erosion and collapse.
Flood attenuation potential	Low, limited riparian zone has low potential of flood attenuation.
Filtering potential (water quality)	Low to Medium; Large number of reeds.
Habitat provision	Low availability of habitat: High levels of exotic invasion, manicuring and mowing of riparian zone means that habitat availability is greatly impacted upon.

RVI SCORE CALCULATIONS

The RVI formula is:

RVI = [(EVC) + (SI x PCIRS) + (RIRS)]

Where: EVC = Extent of vegetation cover
SI = Structural intactness
PCIRS = Percentage cover of indigenous riparian species
RIRS = Recruitment of indigenous riparian species

The final score is out of 20 (comparable to the six Ecological Reserve Assessment Classes)

EVC

EVC: determined by calculating the mean score of the EVC1 and EVC2, by two alternative methods:

EVC1 - Combined vegetation cover score out of 10 for the LHB, RHB & islands (if present)

Percentage vegetation cover (all vegetation)

Percentage score	0%	1-5%	6-25%	26-50%	51-75%	76-100%	
EVC score	0	2	4	6	8	10	8

EVC2 - Total site disturbance score (out of 10) Natural vs disturbed

% score			Disturbed	Natural			
EVC score	0	2	4	6	8	10	4

EVC Score (out of 10) = [(EVC1 + EVC2)/2]	6

SI

SI is determined with reference to the following scoring table of vegetation distribution for *Present State* VS *Perceived Reference State*

Perceived reference state vs present state

	Continuous	Clumped	Scattered	Sparse
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

Trees	2
Shrubs	2
Reeds	2
Sedges	2
Grasses	3
Bare ground	0

SI Score (out of 1) = [((SI1 + SI2 + SI3 + SI4 + SI5 + SI6) /6) * 0.33]	0.60

PCIRS

Percentage cover of indigenous riparian species (PCIRS): Scoring system for the cover of exotic species, terrestrial species & reeds

Cover score	0	VL	L	M	H	VH
PCIRS sub-score	0	1	2	3	4	5

If no indigenous riparian spp are present at the site, the PCIRS (min) = 0

Exotic species	3
Terrestrial species	3
Reeds	4

PCIRS score (out of 5) = [(EVC/2) - ((exotics x 0.7) + (terrestrial x 0.1) + (reeds x 0.2))] -0.2

RIRS

Recruitment of indigenous riparian species (RIRS), the recruitment of positive significance and importance at a site is that of indigenous riparian species, particularly the dominant species present (by biomass)

Extent of recruitment	0	VL	L	M	H	VH
RIRS score	0	1	2	3	4	5

RIRS VALUE 3

RIPARIAN VEGETATION INDEX SCORE	8.88	**CLASS**	D/E

RIPARIAN VEGETATION INDEX (RVI)

A. Site details

River:	Jukskei River	Date:	26/01/2010
Site No:	2	Assessors:	N vd Haar
Site Name:	Waterfall Valley		
Location (GPS):	S26°02'40.16" E28°06'52.95"	Elevation:	1472

B. Riparian vegetation index details

RVI score calculation

The RVI formula is:

RVI = [(EVC) + (SI x PCIRS) + (RIRS)]

Where:

EVC = Extent of vegetation cover

SI = Structural intactness

PCIRS = Percentage cover of indigenous riparian species

RIRS = Recruitment of indigenous riparian species

Riparian Vegetation Index Details:

			RVI Score	7.55
EVC Score	5		PCIRS Score	1
SI Score	0.55		RIRS Score	2

C. RVI Score, assessment class and its description

RVI Score	Assessment Class	Description
19 to 20	A	Unmodified conditions, natural state
17 to 18	B	Largely natural with few modifications
13 to 16	C	Moderately modified
9 to 12	D	Largely modified
5 to 8	E	Extensive loss of the natural habitat
0 to 4	F	Critical level of modifications, almost a complete loss of natural habitat

D. Riparian ecosystem state variables

Channel type	Single
Width of potential riparian zone	LHB = ca. 10m; RHB = ca. 10m
Substrate	15% soil, 5% rocky, 70% sand, 10% silt

Disturbances	Erosion/ Sedimentation
	Vegetation invasive (exotic)
	Earth moving activities
Surrounding land use	Residential development, roads and veld.
Dominant cover	Approximately: grass 50%; trees/shrubs 30%; reeds 20%
Indigenous species richness	Low-Medium Diversity
Exotic species richness	Low diversity; medium-high abundance
Evidence of riparian ecosystem functioning:	
Channel bank stability	Low to Medium; extensive erosion and bank collapse in some sections.
Flood attenuation potential	Medium; the presence of reeds and larger riparian banks would help attenuate flooding
Filtering potential (water quality)	Medium; reed beds have a filtering potential
Habitat provision	Low availability of habitat: High levels of exotic invasion, manicuring and earth moving activity within the riparian zone means that habitat availability is greatly impacted upon.

RVI SCORE CALCULATIONS

The RVI formula is:

RVI = [(EVC) + (SI x PCIRS) + (RIRS)]

Where:
EVC = Extent of vegetation cover
SI = Structural intactness
PCIRS = Percentage cover of indigenous riparian species
RIRS = Recruitment of indigenous riparian species

The final score is out of 20 (comparable to the six Ecological Reserve Assessment Classes)

EVC

EVC: determined by calculating the mean score of the EVC1 and EVC2, by two alternative methods:

EVC1 - Combined vegetation cover score out of 10 for the LHB, RHB & islands (if present)

Percentage vegetation cover (all vegetation)

Percentage score	0%	1-5%	6-25%	26-50%	51-75%	76-100%
EVC score	0	2	4	6	8	10

8

EVC2 - Total site disturbance score (out of 10) Natural vs disturbed

% score			Disturbed	Natural		
EVC score	0	2	4	6	8	10

2

EVC Score (out of 10) = [(EVC1 + EVC2)/2]	

5

SI

SI is determined with reference to the following scoring table of vegetation distribution for *Present State* VS *Perceived Reference State*

Perceived reference state vs present state

	Continuous	Clumped	Scattered	Sparse
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

Trees	2
Shrubs	2
Reeds	1
Sedges	2
Grasses	3
Bare ground	0

SI Score (out of 1) = [((SI1 + SI2 + SI3 + SI4 + SI5 + SI6) /6) * 0.33]	

0.55

PCIRS

Percentage cover of indigenous riparian species (PCIRS): Scoring system for the cover of exotic species, terrestrial species & reeds

Cover score	0	VL	L	M	H	VH
PCIRS sub-score	0	1	2	3	4	5

If no indigenous riparian spp are present at the site, the PCIRS (min) = 0

Exotic species	4
Terrestrial species	2
Reeds	3

PCIRS score (out of 5) = [(EVC/2) - ((exotics x 0.7) + (terrestrial x 0.1) + (reeds x 0.2))] 1

RIRS

Recruitment of indigenous riparian species (RIRS), the recruitment of positive significance and importance at a site is that of indigenous riparian species, particularly the dominant species present (by biomass)

Extent of recruitment	0	VL	L	M	H	VH
RIRS score	0	1	2	3	4	5

RIRS VALUE			2
RIPARIAN VEGETATION INDEX SCORE	7.55	CLASS	E

Appendix 2: IHAS score sheets January 2010

INVERTEBRATE HABITA ASSESSMENT SYSTEM (IHAS)

River Name: Jukskei
Site Name: WV1
Date: January 2010

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)	0					
Total length of white water rapids (ie: bubbling water) (in metres)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in metres)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent acutally kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
SIC Score (max 20):				**15**		
VEGETATION	0	1	2	3	4	5
	0					
Length of fringing vegetation sampled (river banks) (PROTOCOL - in metres)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square metres)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	still		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none		1-25	26-50	51-75	>75
Vegetation Score (max 15):				**14**		
OTHER HABITAT/GENERAL	0	1	2	3	4	5
	0			3		5
Stones out of current (SOOC) sampled: (PROTOCOL - in square metres)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
Other Habitat Score (max 20):				**4**		
HABITAT TOTAL (MAX 55):				**33**		

STREAM CONDITION	0	1	2	3	4	5
PHYSICAL	0	1	8	8	4	
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in metres)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in metres)	>1	1	>½-1	½	<½-¼	<¼
Approximate velocity of stream: ('slow' = <1m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	fl/dr	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('eroen' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-75	75-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-75	75-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
STREAM CONDITIONS TOTAL (MAX 45):				**31**		
TOTAL IHAS SCORE (%):				**64**		

INVERTEBRATE HABITA ASSESSMENT SYSTEM (IHAS)

River Name: Modderfontein
Site Name: WV2
Date: January 2010

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)	0					
Total length of white water rapids (ie: bubbling water) (in metres)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in metres)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent acutally kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
SIC Score (max 20):				**13**		
VEGETATION	0	1	2	3	4	5
	0					
Length of fringing vegetation sampled (river banks) (PROTOCOL - in metres)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square metres)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	still		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none		1-25	26-50	51-75	>75
Vegetation Score (max 15):				**12**		
OTHER HABITAT/GENERAL	0	1	2	3	4	5
	0			3		5
Stones out of current (SOOC) sampled: (PROTOCOL - in square metres)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
Other Habitat Score (max 20):				**8**		
HABITAT TOTAL (MAX 55):				**33**		

STREAM CONDITION	0	1	2	3	4	5
PHYSICAL	0	1	8	8	4	
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in metres)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in metres)	>1	1	>½-1	½	<½>¼	<¼
Approximate velocity of stream: ('slow' = <1m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	fl/dr	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('eroen' = erosion/shear bank; 'farm' = farmland/settlement)***	eroen	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-75	75-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-75	75-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
STREAM CONDITIONS TOTAL (MAX 45):				**38**		
TOTAL IHAS SCORE (%):				**71**		

Appendix 3: SASS5 score sheets January 2010

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: January 2010	**TAXON**		S	VG	GSM	TOT	**TAXON**		S	VG	GSM	TOT	**TAXON**		S	VG	GSM	TOT
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10				
E:	**TURBELLARIA**	3					Corixidae*	3					Blepharoceridae	15				
SITE CODE:WV1	**ANNELIDA:**						Gerridae*	5					Ceratopogonidae	5	B	A		B
RIVER: Jukskei	Oligochaeta	1	B	A		B	Hydrometridae*	6					Chironomidae	2	B	B		C
SITE DESCRIPTION: Upper	Leeches	3	A	1		A	Naucoridae*	7					Culicidae*	1				
WEATHER CONDITION: cool clear	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP:	Amphipoda	13					Notonectidae*	3					Empididae	6				
Ph: 7.59	Potamonautidae*	3					Pleidae*	4					Ephydridae	3				
DO: 9.2mg/l	Atyidae	8					Veliidae/M...veliidae*	5					Muscidae	1				
Cond: 45.0mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5	B	B		C
SIC: x TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC: 0	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: x DOM SP:	Baetidae 1 sp	4		B		B	Hydropsychidae 1 sp	4					Ancylidae	6				
M VEG OOC: x DOM SP:	Baetidae 2 sp	6	C			C	Hydropsychidae 2 sp	6	A	A		B	Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12					Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6					Philopotamidae	10					Lymnaeidae*	3				
MUD: 3	Ephemeridae	15					Polycentropodidae	12					Physidae*	3		B		B
HAND PICKING/VISUAL OBS: Yes	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW: Medium	Leptophlebiidae	9					**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY: Low	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		28	29	0	35
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6					**NO OF TAXA:**		7	8	0	9
	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		4	3.6	0	3.9
	Chlorolestidae	8					Pisulidae	10					**IHAS: 64%**					
	Coenagrionidae	4					Sericostomatidae SWC	13					**OTHER BIOTA:**					
	Lestidae	8					**COLEOPTERA:**						Litter; Foam; Oudour					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS:**					
	Protoneuridae	8					Elmidae/Dryopidae*	8					* = airbreathers					
	Zygoptera juvs.	6					Gyrinidae*	5					SWC = South Western Cape					
	Aeshnidae	8					Halipidae*	5					T = Tropical					
	Cordulidae	8					Helodidae	12					ST = Sub-tropical					
OTHER OBSERVATIONS:	Gomphidae	6					Hydraenidae*	8					S = Stone & rock					
	Libellulidae	4					Hydrophilidae*	5					VG = all vegetation					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud					
	Pyralidae	12					Psephenidae	10					1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: January 2010	**TAXON**		S	VG	GSM	TOT	**TAXON**		S	VG	GSM	TOT	**TAXON**		S	VG	GSM	TOT
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:	**COELENTERATA**	1					Belostomatidae*	3		A		A	Athericidae	10				
E:	**TURBELLARIA**	3					Corixidae*	3		A		A	Blepharoceridae	15				
SITE CODE: WV2	**ANNELIDA:**						Gerridae*	5					Ceratopogonidae	5				
RIVER: Modderfontein	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2		B		B
SITE DESCRIPTION: Representative	Leeches	3					Naucoridae*	7					Culicidae*	1		A		A
WEATHER CONDITION: Cold, frosty and clear	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP:	Amphipoda	13					Notonectidae*	3					Empididae	6				
Ph: 7.91	Potamonautidae*	3					Pleidae*	4					Ephydridae	3				
DO: 5.1 mg/l	Atyidae	8					Veliidae/M...veliidae*	5					Muscidae	1				
Cond: 101.8mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5	A	B		B
SIC: x TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC: 0	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: x DOM SP:	Baetidae 1 sp	4	A		A	B	Hydropsychidae 1 sp	4	A			A	Ancylidae	6				
M VEG OOC: x DOM SP:	Baetidae 2 sp	6		B		B	Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL: x	Baetidae >2 sp	12					Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND: x	Caenidae	6					Philopotamidae	10					Lymnaeidae*	3				
MUD: x	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS: Yes	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW: Low	Leptophlebiidae	9					**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY: Low	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		13	29	4	37
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6					**NO OF TAXA:**		3	8	1	10
	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		4.3	3.6	4	3.7
	Chlorolestidae	8					Pisulidae	10					**IHAS:** 71%					
	Coenagrionidae	4		A		A	Sericostomatidae SWC	13					**OTHER BIOTA:**					
	Lestidae	8					**COLEOPTERA:**						1 G. afinis (20mm)					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					7 T. Spar. (15-55mm)					
	Protoneuridae	8					Elmidae/Dryopidae*	8					**COMMENTS:**					
	Zygoptera juvs.	6					Gyrinidae*	5		1		A	* = airbreathers					
	Aeshnidae	8					Halipidae*	5					SWC = South Western Cape					
	Cordulidae	8					Helodidae	12					T = Tropical					
OTHER OBSERVATIONS:	Gomphidae	6					Hydraenidae*	8					ST = Sub-tropical					
	Libellulidae	4					Hydrophilidae*	5					S = Stone & rock					
	LEPIDOPTERA:						Limnichidae	10					VG = all vegetation					
	Pyralidae	12					Psephenidae	10					GSM = gravel, sand & mud					
													1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Appendix 4: IHIA score sheet January 2010

In stream Habitat Integrity

Weights	14	13	13	13	14	10	9	8	6		
REACH	Water abstraction	Flow modification	Bed modification	Channel modification	Water quality	Inundation	Exotic macrobytes	Exotic fauna	Solid waste disposal	Total Score (%)	Classification
WV1	0	18	16	16	16	0	0	0	12	75.1	C Moderately modified
WV2	0	18	19	16	18	0	0	0	9	72.0	C Moderately modified

None	Small	Moderate	Large	Serious	Critical

Riparian Zone Habitat Integrity

Weights	13	12	14	12	13	11	12	13		
REACH	Vegetation removal	Alien encroachment	Bank erosion	Water abstraction	Flow modification	Channel modification	Water quality	Inundation	Total Score (%)	Classification
WV1	21	22	19	0	18	16	8	0	53.2	D Largely modified
WV2	22	22	19	0	18	19	6	0	56.4	D Largely modified

None	small	Moderate	Large	Serious	Critical

REACH	*INSTREAM HABITAT*	*RIPARIAN ZONE*	*IHI SCORE*	*CLASS*
WV1	75.1	53.2	64.2	C Moderately modified
WV2	72.0	56.4	64.2	C Moderately modified

ANNEXURE D5:
HERITAGE IMPACT ASSESSMENT

CULTMATRIX...

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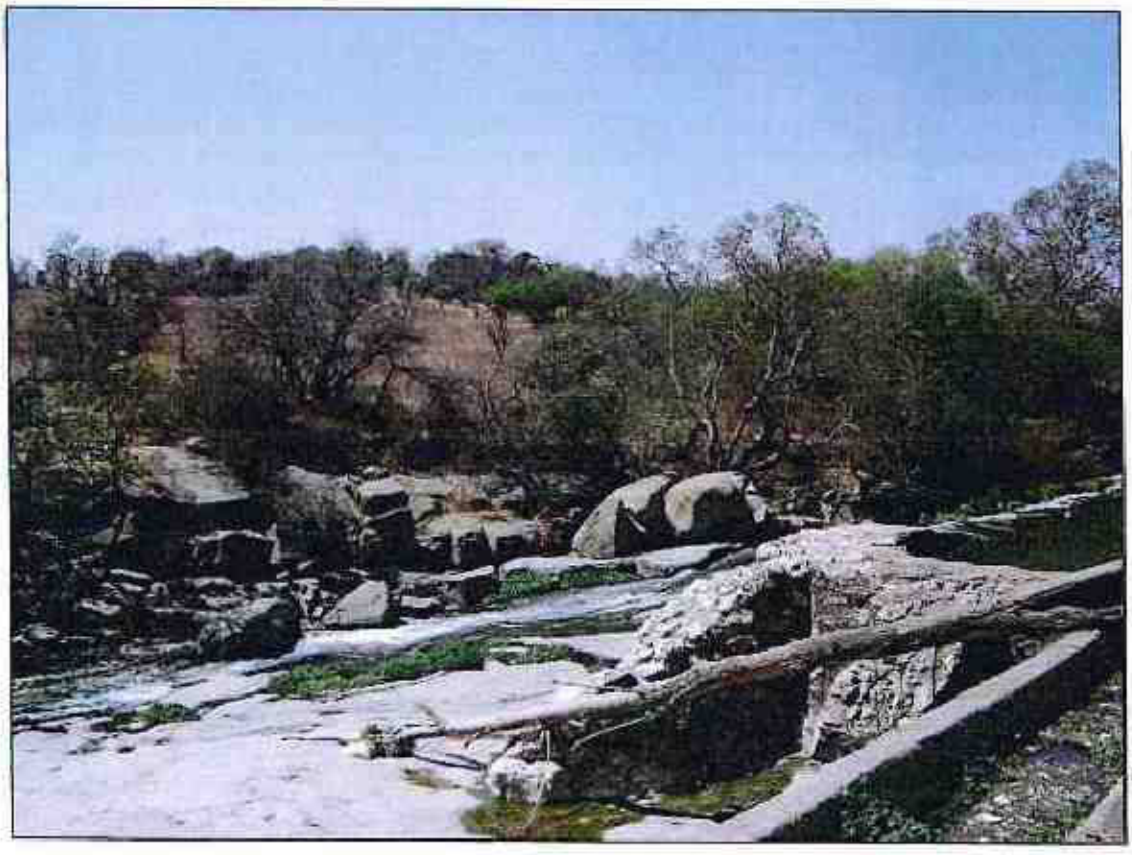
LEVEL 2 (HERITAGE SCOPING) REVISED FINAL REPORT: PROPOSED NORTHERN GOLF COURSES PROJECT (MIA'S FARM), JOHANNESBURG



SUBMITTED TO:
Betty Mdala
Strategic Environmental Focus
PO Box 74785
LYNNWOOD RIDGE
0040

DATE OF SUBMISSION:
19 June 2006

TABLE OF CONTENTS

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REVISED FINAL LEVEL 2 (HERITAGE SCOPING) REPORT: PROPOSED NORTHERN GOLF COURSES PROJECT (MIA'S FARM), JOHANNESBURG

SUBMITTED TO: Betty Mdala, Strategic Environmental Focus, Pretoria
DATE OF SUBMISSION: 19 June 2006

EXECUTIVE SUMMARY

This report fulfils the requirements for the Level 2 (scoping) phase of a Heritage Impact Assessment (HIA) as provided for in the National Heritage Resources Act (Act 25 of 1999). In this case, a

- Heritage scoping study was conducted as part of the broader Environmental Scoping Report.

The aim of the scoping investigation was to analyse heritage issues and how to manage them within the context of the proposed development. The objectives were to assess heritage significance (involving site inspections and basic desktop and archival research), to identify the need for further detailed inputs by heritage specialists, to review the general compatibility of the development proposals with heritage policy and to assess the acceptability of the proposed development from a heritage perspective. The result of this investigation is a heritage scoping report.

The previous scoping report submitted by Cultmatrix called for the preservation of all buildings on the farmstead. Through meetings with the developers and successive interaction it was agreed to modify these recommendations to provide for the preservation of the most significant buildings, the demolition of the remaining buildings and adaptations to the layout of the development affecting the farmstead to provide for the preservation of significant landscape patterns.

Based on what was found and its evaluation, it is recommended that the proposed development can continue in the area, on condition of acceptance of the following recommendations:

- Acknowledging inputs through forthcoming public participation process (also for identifying any intangible heritage values);
- Identifying and documenting intangible heritage values;
- Documentation of heritage sites that merit conservation and incorporation into the design and layout of the proposed development (plans, photos, site plans, additional background research);
- Documentation of heritage sites that can be demolished;
- The above plus the scoping report to be submitted as a full HIA report to SAHRA for authorisation purposes;
- Relocation of the cemetery;
- Compilation of Conservation Management Plan to enable rehabilitation, adaptation and new used of conserved heritage resources.

Heritage sites that merit conservation and incorporation into the layout and design of the proposed development are the following (refer to Figure 8):

- The following buildings of the old Waterval farmstead, which has high heritage significance due to its association with the Mia family and the Waterval Islamic Institute: original cottage (building 1a), reservoir tower (1d), girls' compound (6a), original cowshed (4a) and two store buildings (5a and 5di);
- A link between the old Waterval farmstead and the Jukskei River as a green zone;
- Significant elements of the historic irrigation system (furrows, dams, weirs), which has created artificial ecosystems that are habitat to various animal and plant species;
- Old roads and tree lanes, which give structure to the landscape and are visible landmarks;
- The rapids in the Jukskei River that gave the farm its name.

Heritage sites that can possibly not be incorporated into the layout of the proposed development and hence must be relocated are:

- A large cemetery near the north-western corner of the development area

Heritage sites that have low conservation value and can be removed after documentation where appropriate are:

- Remaining buildings on the farmstead;
- Ruins of cottages (the area east of the N 1);
- All other ruins and foundations;
- The old sewage treatment plant.

R C DE JONG
Principal Member: Cultmatrix cc

PART 1: REPORT ON PROJECT EXECUTION

The structure of this report is based on:

- SOUTH AFRICAN HERITAGE RESOURCES AGENCY, Heritage Impact Assessment: Notification to SAHRA of intent to develop (form)
- DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND DEVELOPMENT PLANNING, PROVINCIAL GOVERNMENT OF THE WESTERN CAPE, 2005, Guideline for involving heritage specialists in EIA processes (document)
- DEPARTMENT OF ENVIRONMENT AFFAIRS AND TOURISM, Integrated Environmental Management Guidelines
- Best-practice HIA reports submitted by Cultmatrix and other heritage consultants

1.1 Background

1.1.1 General

The broader study entails the required environmental scoping and impact assessment investigations for the development of the Northern Golf Courses Project, located on portions of the historic farm Waterval 5 IR (also known as *Mia's Farm*, named after the Mia family who are its co-owners and also users) in the Midrand area. Annexure 2 contains maps indicating the location of the proposed development.

This is an area with a long history of human use and occupation, initiated by Stone and Iron Age communities and culminating in permanent colonial settlement in the 1850s. It includes a range of heritage resources as defined in the *National Heritage Resources Act* (Act 25 of 1999):

- Places, buildings and structures and equipment of cultural significance;
- Places to which oral traditions are attached or that are associated with living heritage (ceremonies, festivals, economic use etc);
- Historical settlements and townscapes;
- Landscapes and natural features of cultural significance;
- Geological sites of scientific or cultural importance;
- Graves and burial grounds;
- Sites related to the history of labour.

This project entails the development of a golf estate with two private golf courses (on land west of the N 1) and a public golf course (on land east of the N 1).

Another part of the development of Mia's farm is commercial and retail facilities, which is apparently dealt with through a separate EIA process.

The proposed Gautrain will run through the Mia's farmland east of the N 1, and the route for this project has already been through the EIA process.

Strategic Environmental Focus (SEF) appointed Cultmatrix cc as an independent heritage consultant to conduct a strategic assessment (heritage scoping) of places, buildings, objects and structures of cultural significance found within the boundaries of the area that is to be impacted upon by the development.

1.1.2 Terms of reference and approach

The investigation consisted of conducting a Level 2 investigation of the site in accordance with the requirements of Section 38(3) of the National Heritage Resources Act (Act 25 of 1999).

The aim of the investigation is to identify, verify and analyse heritage issues and to recommend how to manage them within the context of the proposed development.

The objectives of the investigation were:

- Identifying heritage places, objects, buildings, structures etc
- Analysing these;
- Assessing broad cultural significance of identified sites, places, buildings, structures, objects etc involving site
- Surveying and mapping of significance/sensitivity issues and opportunities/constraints issues;
- Reviewing of the general compatibility of the proposed development with heritage policy planning frameworks;
- Undertaking a preliminary assessment of the acceptability of the proposed development from a heritage perspective;
- Identifying the need for alternatives if necessary;
- Recommending initial management measures to conserve significant heritage elements.

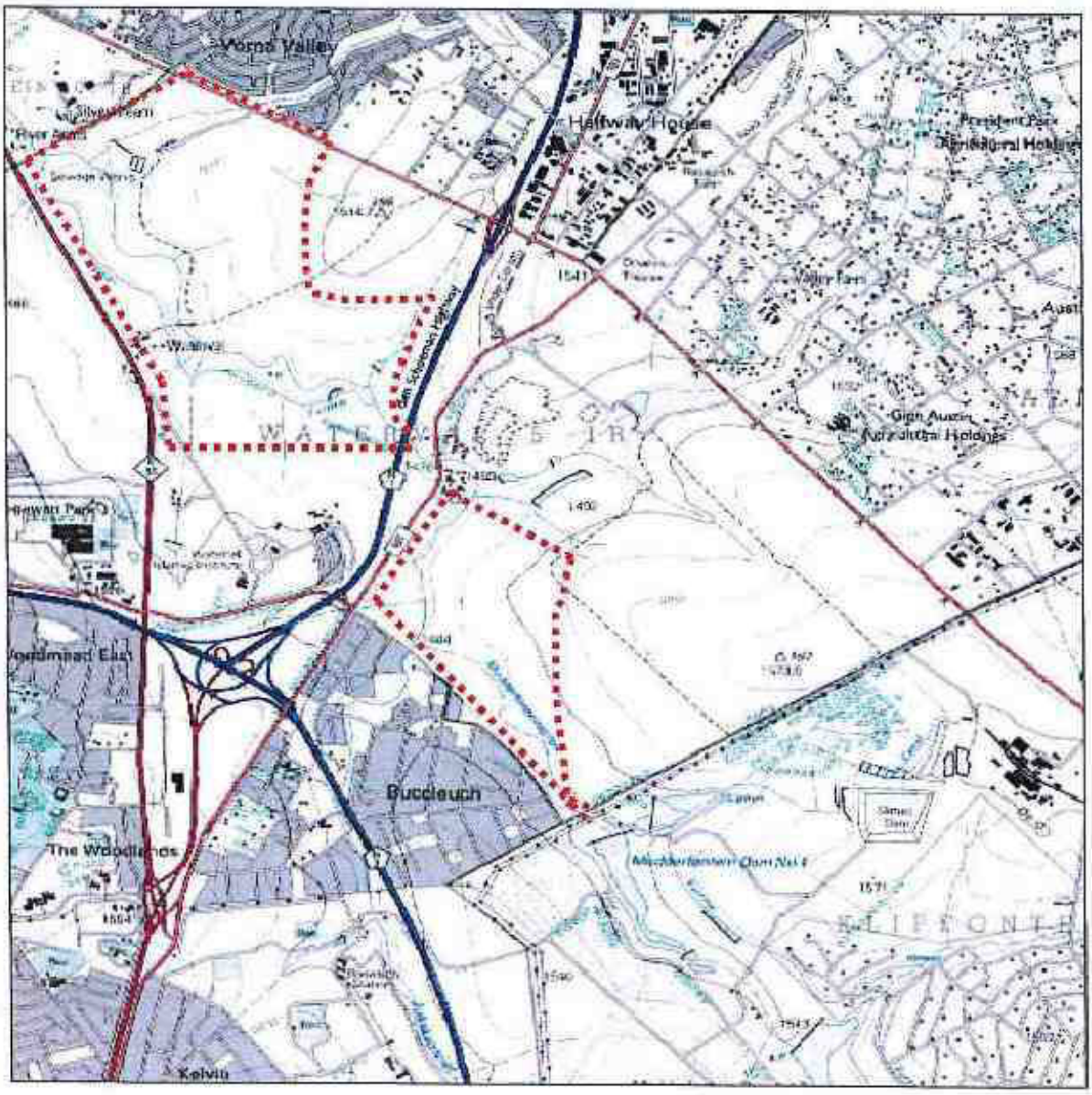


FIGURE 1: Portion of 2628 AA 1:50 000 map (Johannesburg) indicating boundaries (dotted lines) of proposed Northern Golf Courses development site

A heritage scoping investigation is comparable to a strategic environmental assessment (SEA) in respect of the following:

- It is pro-active and informs the Northern Golf Courses development;
- It assesses the effect of existing heritage elements on development opportunities and constraints;
- It relates to broad areas;
- It enables the development of a framework against which positive and negative impacts on heritage elements can be measured;
- It focuses on maintaining a chosen level of conserving the heritage qualities of the area;
- It has a wide perspective and includes a low level of detail;
- It forms a basis for certain specialist investigations such as architecture and archaeology in the case of the Northern Golf Courses Project.

EIA focuses on the positive and negative impacts of a specific development project once it has been formulated. The role of SEA, however, is to allow for the decision maker to proactively determine the most suitable development type for a particular area, **before** development proposals are formulated.

1.1.3 Definitions and assumptions

The following aspects have a direct bearing on the investigation and the resulting report:

X *Cultural (heritage) resources* are all non-physical and physical human-made occurrences, as well as natural occurrences that are associated with human activity. These include all sites, structures and artefacts of importance, either individually or in groups, in the history, architecture and archaeology of human (cultural) development.

X The *significance* of the sites and artefacts is determined by means of their historical, social, aesthetic, technological and scientific value in relation to their uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

X Although the focus of the scoping investigation was on the Northern Golf Courses development sites, Cultmatrix cc also looked at the adjacent areas. Experience with physical developments has shown that there are normally "spill-over" effects on adjacent areas often with negative impacts, which also need to be assessed.

1.1.4 Limitations

The investigation has been influenced by the following factors related to time scales of the overall EIA:

- Availability and reliability of baseline information about the affected area;
- Unpredictability of buried archaeological/palaeontological remains (absence of evidence does not mean evidence of absence);
- Difficulty in establishing nature and degree of significance of intangible heritage values, which will only be accessed through the public participation phases;
- Degree of contentiousness of the project from a heritage perspective and the need for targeted consultation as part of the broader EIA process.

1.2 Legal context

This study constitutes a Level 2 heritage scoping report as part of the environmental impact assessment required by SAHRA (and GDACE) for authorising the development of the Northern Golf Courses on Mia's Farm. In terms of Section 38 (1) of the National Heritage Resources Act (NHRA) (Act 25 of 1999), a heritage impact assessment is required by the responsible heritage resources agency, which, in this case, is the SAHRA provincial office in Johannesburg.

The purpose of this report is to alert the developer/contractor, SEF and interested and affected parties at the earliest possible stage about existing and potential heritage resources that may be affected by

the proposed development, and to recommend mitigatory measures aimed at reducing any potentially negative impacts on these heritage resources.

The heritage scoping report can form the basis of a full HIA investigation. This scoping report should be made available for public comments. A final report, based on the scoping report and the results of the public participation process, must be submitted to SAHRA's Gauteng office for consideration and authorisation in terms of Section 38(10) of the NHRA.

1.3 Development criteria in terms of Section 38(1)

1.3	Development criteria in terms of Section 38(1)	Yes/No details
1.3.1	Construction of road, wall, power line, pipeline, canal or other linear form of development or barrier exceeding 300m in length	Possible
1.3.2	Construction of bridge or similar structure exceeding 50m in length	No
1.3.3	Development exceeding 5000 sq m	Yes
1.3.4	Development involving three or more existing erven or subdivisions	No information
1.3.5	Development involving three or more erven or divisions that have been consolidated within past five years	No information
1.3.6	Rezoning of site exceeding 10 000 sq m	Yes
1.3.7	Any other development category, public open space, squares, parks, recreation grounds	Yes
1.3.8	Costs of which will exceed a sum set in terms of regulations set by SAHRA and the PHRA	No

1.4 Property ownership

1.4	Property owners	
1.4.1	Names	Witwatersrand Estates Ltd
1.4.2	Name and contact address	
1.4.3	Telephone number	
1.4.4	Fax number	
1.4.5	E-mail	

1.5 Development Project Coordinator

1.5	Project Coordinator	
1.5.1	Name and contact address	Mark Corbett, Century Property Developments, Box 70406, Bryanston 2021
1.5.2	Telephone number	(011) 464-2962
1.5.3	Fax	(011) 464-1316
1.5.4	E-mail	mark@century-group.co.za

1.6 Heritage impact assessment specialists and methods of investigation

1.6.1 Specialists

	Specialist 1	
1	Name and contact address	Dr RC de Jong (Principal Member: Cultmatrix cc), PO Box 12013, Queenswood 0121, Pretoria
2	Qualifications and field of expertise	PhD (Cultural History) UP (1990), Post-Graduate Museology Diploma UP (1979), general heritage management specialist with experience in museums and heritage since 1983
3	Relevant experience in study area	Started a similar investigation of the site for an earlier EIA managed by Felehetsa; did a heritage survey of Midrand in the mid-1990s
4	Telephone number	(082) 577-4741
5	Fax number	(0866) 127383
6	E-mail	cultmat@iafrica.com

	Specialist 2	
1	Name and contact address	Prof Karel Bakker
2	Qualifications and field of expertise	PhD (Architecture)(UP). Specialist in architectural heritage management and conservation.
3	Relevant experience in study area	HIAs with regard to various projects in Johannesburg area, including mine sites
4	Telephone number	(083) 564-0381
5	Fax number	(012) 330-1021
6	E-mail	kabakker@telkomsa.net

	Specialist 3	
1	Name and contact address	Dr JA van Schalkwyk, PO Box 26389, Monument Park 0105
2	Qualifications and field of expertise	D Litt et Phil (UNISA), Post-Graduate Museology Diploma UP, general heritage management specialist with experience in museums and heritage, anthropologist and archaeologist
3	Relevant experience in study area	Archaeological investigation of entire site for Midrand municipality in mid-1990s
4	Telephone number	(012) 347-7270
5	Fax number	
6	E-mail	jvschalkwyk@mweb.co.za

1.6.2 Method of investigation

Preliminary investigation (desktop study)

Survey of the literature

A survey of the relevant literature and archival records was conducted with the aim of reviewing the previous research done and determining the heritage potential of the area.

Other sources

- Topographical maps
- Aerial photographs (current and 1938)
- Historic maps
- Various Internet sources

Field surveys

The field surveys were aimed at locating possible sites, objects and structures that were identified through the desktop study and to find new ones. Members and associates of Cultmatrix by means of maps and aerial photos and during site visits identified the area that had to be investigated. The area was investigated on foot and by vehicle. GPS coordinates were obtained for identified sites.

Documentation

All sites, objects and structures that are identified are documented according to the general minimum standards accepted by the archaeological profession. Coordinates of individual localities are determined by means of the *Global Positioning System* (GPS)[1] and plotted on a map. This information is added to the description in order to facilitate the identification of each locality.

Report

[1] According to the manufacturer a certain deviation may be expected for each reading. Care was, however, taken to obtain as accurate a reading as possible, and then to correlate it with reference to the physical environment before plotting it on the map.

The findings and recommendations of the heritage scoping study are contained in this report.

1.7 Property details

1.7	Property details	
1.7.1	Name and location of property	Mia's Farm, Midrand
1.7.2	Erf or farm numbers	Waterval 5 IR
1.7.3	Magisterial district	Johannesburg
1.7.4	Local authority	City of Johannesburg
1.7.5	Current use	Agricultural
1.7.6	Current zoning	
1.7.7	Land use of surrounding properties	Mixed residential and commercial
1.7.8	Extent of property	646 ha

1.8 Development description

1.8	Development description	
1.8.1	Nature of proposed development	To be guided by results of scoping
1.8.2	Siting, orientation, height and footprint of new structures	To be guided by results of scoping
1.8.3	Location and treatment of access roads to site, internal roads, parking	To be guided by results of scoping
1.8.4	Intended extent of cut/fill on steep slopes	To be guided by results of scoping
1.8.5	Intended demolition/alteration of existing structures	To be guided by results of scoping
1.8.6	Intended removal/retention of existing vegetation	To be guided by results of scoping
1.8.7	Type and height of new signage	To be guided by results of scoping
1.8.9	Nature and height of boundary treatments	To be guided by results of scoping
1.8.10	Location of construction facilities	To be guided by results of scoping
1.8.11	Traffic within, to and from site	To be guided by results of scoping
1.8.12	Architectural treatment and use of materials	To be guided by results of scoping
1.8.13	Extent of proposed demolitions and new additions to existing structures	To be guided by results of scoping
1.8.14	Phasing of project and nature and extent of future expansion	To be guided by results of scoping
1.8.15	Project alternatives (proposed)	To be guided by results of scoping
1.8.16	History of application	To be guided by results of scoping

1.9 Legal requirements

1.9	Legal requirements	
1.9.1	Is planning permission required for any departures or consent use in terms of zoning schemes? Has an application been submitted to the planning authority and has any comments or approval from the planning authority been obtained?	
1.9.2	Is planning authority permission required for any subdivision or	

1.9	Legal requirements	
	consolidation? Has an application been submitted to the planning authority and has any comment or approval from the planning authority been obtained?	
1.9.3	Is the proposed development subject to EIA regulations and has an application been submitted to the provincial environmental agency?	Yes
1.9.4	Has any assessment of the impact of the proposed development on any heritage resources been undertaken in terms of EIA or planning processes?	Under way
1.9.5	Title deed restrictions	
1.9.6	Is affected area situated within or adjacent to a conservation area, special area, scenic route or any other area that has special environmental or heritage protection?	Yes: open green space with recreational and agricultural potential and biophysical significance
1.9.7	Does affected area have any special conservation status?	Possible the Jukskei River zone
1.9.8	Are there any other restrictions on the property	
1.9.9	Does the proposed development conform to local planning policies?	Yes
1.9.10	What interested and affected parties have been consulted?	Part of EIA process
1.9.11	Is approval from any authority required?	Yes
1.9.12	Has permission for similar development been refused by any authority in the past?	No

1.10 Acknowledgements

Cultmatrix cc is grateful for the permission granted by Messrs Ibrahim Mia and Abdulrahman Mia to access the development area.

Cultmatrix also express their gratitude towards Mr P Bowerman and Ms D Sutherland of the Surveys and Mapping Directorate, Department of Land Affairs, Cape Town, for sourcing, scanning and mailing the 1938 aerial photographs of the development area.

PART 2: HERITAGE ASPECTS OF THE AFFECTED AREA

2.1 Cultural significance, issues and environmental concerns of site and context

2.1	Cultural significance, issues, concerns	
2.1.1	Environmental and heritage context	See 2.2 below
2.1.2	Cultural significance of adjoining properties relating to property	Not known
2.1.3	Archaeological remains	Possible
2.1.4	Palaeontological remains	No
2.1.5	Structures older than 60 years	Yes (old Waterval farmstead and water furrows)
2.1.6	Graves or burial sites	Yes
2.1.7	Formally protected heritage sites (Grade 1, 2, 3)	No
2.1.8	Is affected area part of proclaimed special area, conservation area, heritage area, protected area	No but adjoins Modderfontein Conservation Area
2.1.9	Places or objects of cultural significance, listed heritage resources	Old Waterval farmstead, water furrow, cemetery, weirs in Jukskei River, rapids in river
2.1.10	Places with oral traditions	Yes (rapids)
2.1.11	Part of historical settlement or townscape	No
2.1.12	Part of landscape of cultural significance	Yes
2.1.13	Geological sites of cultural importance	No
2.1.14	Places or objects related to history of slavery	No
2.1.15	History of property	See 2.2
2.1.16	Association with important person, event, groups, activities, public memory	Mia family and Waterval Islamic Institute
2.1.17	Sea frontage or water source	Yes (Jukskei River)
2.1.18	Rocky outcrops	Yes
2.1.19	Rock shelters	No
2.1.20	Part of coastal dune system	No
2.1.21	Geological features	No
2.1.22	Located on land reclaimed from sea	No
2.1.23	Situated adjacent to or within scenic route	No
2.1.24	Previously cultivated	Partially

2.2 General history of the affected environment

2.2.1 Stone Age occupation

The cultural heritage in Midrand has been shaped by almost continuous human occupation and use of the natural landscape and resources over the past 500 000 years, beginning with human occupation during the Early Stone Age and stretching through Iron Age settlement to colonial settlement in the 1840s. Whereas previously human use of the area was primarily directed towards the production of food and fibre through agriculture, mining and industrial development since the 1880s have changed the landscape, with the result that the cultural heritage of Midrand is now dominated by manifestations and interventions in terms of mining, industry, commerce and urban settlement. Relatively little has remained of the traces of earlier human settlements, except along less disturbed riverine areas (where there often are signs of Stone Age occupation) and on some hilltops, where the ruins of Iron Age settlements have escaped urban development.

Very little is known about the earliest human occupation of Midrand. However, there is little doubt that the first humans in Midrand may have been *Homo erectus* who roamed the area during the Acheulian period of the Early Stone Age, 500 000 years ago. The ancestor of *Homo erectus*, *Australopithecus*, considered to be the earliest ancestor of humans, lived in the Sterkfontein Valley around Krugersdorp (today the Cradle of Humankind – a World Heritage Site) several million years ago.

During the Middle Stone Age, 200 000 years ago, modern man or *Homo sapiens* had emerged, manufacturing a wider range of tools with technologies more advanced than those from earlier periods. This enabled skilled hunter- gatherer bands to adapt to different environments. From this time onwards, rock shelters and caves were used for occupation and reoccupation over very long periods of time.

The Late Stone Age, considered to have started some 30 000 years ago, is associated with the predecessors of the San and Khoi Khoi. San hunter-gatherer bands with their small (microlithic) stone tools lived in Midrand.

Evidence of Stone Age habitation in the Midrand area can be found at a number of sites.

- Situated between the Waterfall Quarry and the N 1 is a rock shelter, which is considered to be one of the oldest Stone Age shelters according to professor-emeritus Revil Mason. Information about this site is contained in a SEF Scoping Report in connection with the rezoning from agricultural to commercial uses of this portion (July 2001). The stone artefacts at this site, probably dating back to the Middle Stone Age, have been excavated.

- An archaeological investigation (1997) (by Revil Mason) connection with the development of *The Boulders*, a shopping mall at Halfway House (north of Waterval) yielded evidence of Middle and Late Stone Age occupation.

- Further downstream is the Glenferness archaeological site next to the Jukskei River.

Because colonial farmers, settlers and miners have continuously and intensively used the development area for the past 150 years, no signs of Stone Age occupation in the form of surface deposits and finds of artefacts have been found at Waterval.

2.2.2 Iron Age occupation

The excavations at The Boulders indicate that between 350 AD and 600 AD early Tswana communities lived in the Midrand area, building semi-permanent settlements of stone, wood and clay, growing crops, farming with livestock and manufacturing pots and iron implements. They moved out after 600 AD and returned about 1200 AD.

Between 1100 AD and 1200 AD San communities inhabited the area. Tswana communities returned in about 1500 AD and stayed in the area until their displacement by the Matabele kingdom during the 1820s and early 1830s and by colonial settlers since the 1840s.

Because colonial farmers, settlers and miners have continuously and intensively used the development area for the past 150 years, no signs of Iron Age occupation in the form of surface deposits and finds of artefacts have been found at Waterval.

2.2.3 Colonial settlement

The first white colonists who settled in the Midrand area came for very much the same reasons as the Iron Age groups: water and grazing for cattle, water for crop-farming, trees, thatching grass, clay for making bricks and pots, mild climate, wildlife and the presence of the hills as shelter and protection.

In the 1820s the first white people appeared on the scene, hunters, traders, missionaries and other travellers. Permanent occupation by whites began in the early 1840s, when Voortrekker farmers established the farms that today form Johannesburg and Midrand. These farms were subdivided many times over in more recent years and more farmsteads were established. Gradually the entire area was divided into farms. However, it was only since the 1880s that these farms were formally surveyed and

mapped, and when not only their names (such as Waterval), but also the names of rivers and other features became permanent fixtures on maps.

2.2.4 The farm Waterval 5 IR

The original farm Waterval No 34 (now 5 IR) was probably established in the 1850s when many other colonial farms were created following the permanent settlement of the Voortrekkers in the Midrand area. It is alleged that Paul Kruger (later State President of the Transvaal Boer republic) was one of its first owners, but this must be verified by research. Even by the standards of those days it was a large farm, comprising about 4000 morgen (about 3400 ha). It was named after some rapids (referred to as a waterfall) in the Jukskei River, which are situated immediately west of the N 1.

The Jukskei River is a tributary of the Hennops River. It is named after the Afrikaans word *Jukskei*, meaning *yoke-pin*. The name is said to have been given on 8 October 1853 by a prospector, Pieter Jacob Marais, who discovered traces of gold on the river bank and a yoke-pin lying at this spot.

Peter MacDonald properly surveyed the farm in May 1888 for its then owner, Miss E Pyrmont. Surveyor-General Johann Rissik approved the diagram in June 1888, which was then signed off by President Paul Kruger in January 1889.

Two Englishmen, James K and John A Gibson, bought large portions of the farm where they bred cattle and established commercial plantations. The Gibson's were owning and managing a stage-coach service between Johannesburg and Pretoria and established a hotel as a "pit-stop" on their farm, soon known as *Halfway House*. This area was proclaimed as the *Waterfall Park Estate Township* in 1889 and the first land was sold in 1890. It was the nucleus of today's Halfway House, north of the development sites.

Descendants of the Gibsons sold their portions of the farm to the Witwatersrand Estates Ltd in June 1934. Indian families, including the Mia family, held the controlling interest in this company. The company leased the farm to SI Mia. He was concerned about the education of Indian children who, either through poverty or because their parents resided in isolated parts of South Africa, could not enjoy proper education. He started a school and hostel in Market Street, Johannesburg, where Indian street children and orphans were also admitted. This school grew so fast that a new site had to be found. Subsequently, in 1937 permission was granted by the authorities to establish a school for Indian children on the farm Waterval. Construction of this facility, known as the *Waterval Islamic Institute*, started in 1939 and the school opened in 1940. The Institute comprised a madrasah, boarding school and mosque. It was the first establishment of its kind in the former Transvaal Province. It is likely that some of the existing farm buildings were altered during this period and that some new buildings were erected as well.

The establishment of Mia's farm led to the revival of the *Jamiatul Ulama Transvaal*, originally created in 1923 as an organisation to which Indian religious leaders belong in the former Transvaal Province.

Staff quarters were provided at the Waterval farmstead, which still exists. African farm workers were housed in a separate compound on the farm, which included a school. No traces of this compound were found. According to the 1938 aerial photo, other parts of the farm were occupied by what appears to be African tenant farmers, who left behind a number of ruins of mud-brick houses (found east of the N 1).

The main purpose of farming on Waterval was (and still is) to provide meat and dairy products to the Islamic Institute and also funds from the sale of these products. For this purpose an irrigation system was constructed, comprising water furrows, dams and weirs, providing water for pastures and crops. Various buildings for this purpose were added to the existing buildings at the farmstead.

The township of Buccleugh, also on the farm Waterval, was established by FC Gibson and named after the residence of his father, John A Gibson, at Kenilworth in the Western Cape. It was proclaimed in August 1938.

2.3 General description of the affected environment

From a heritage perspective, the proposed development sites are some of the few remaining original farmlands between Pretoria and Johannesburg and thus have visual (physical) and intangible (place names, events, activities, legends etc) significance. Basically the development sites consist of sloping plains of Highveld grass with scattered clumps of trees (mainly exotic), granite outcrops and the scenic Jukskei River valley as main features. It is traversed by a variety of arterial roads such as the N 1. The main heritage elements comprise the irrigation system associated with the Jukskei River, the Waterval farmstead, an old sewage treatment plant near the northern boundary, an extensive cemetery close to this plant and a small number of ruins of mud-brick houses.

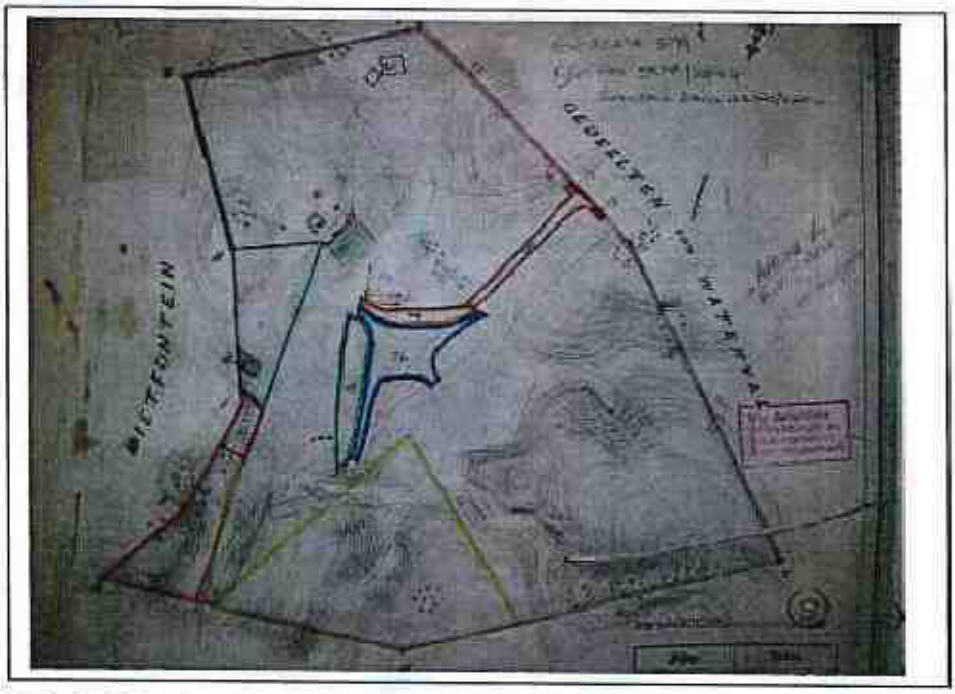


FIGURE 2: Original farm map, Department of Land Affairs, Pretoria

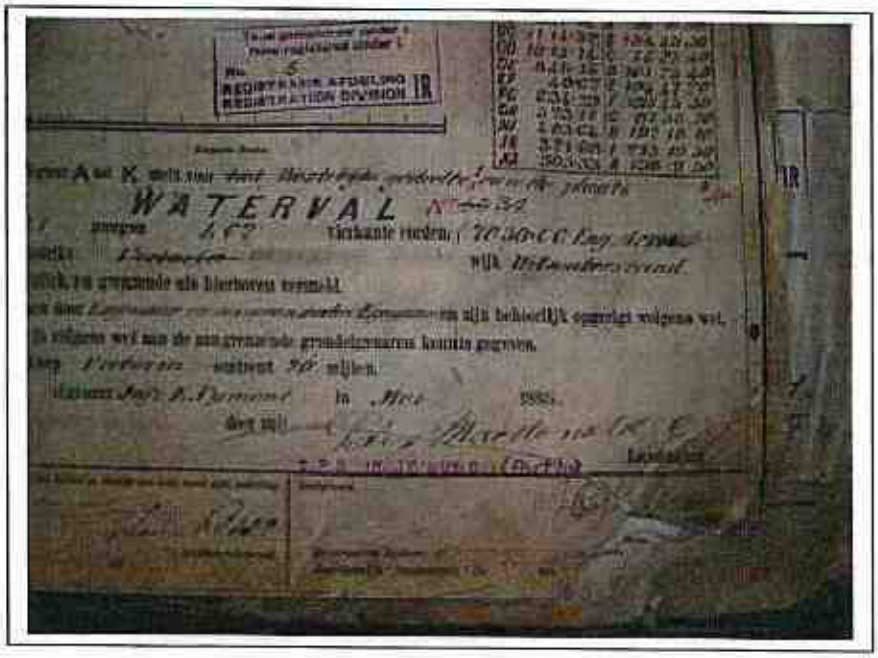


FIGURE 3: President Paul Kruger's signature (below right) on farm map

PART 3: FINDINGS AND RECOMMENDATIONS

3.1 Identification and mapping of heritage resources

See Annexure 1.

3.2 Assessment of significance of heritage resources

3.2.1 Significance assessment of the site in its totality

The below statement of significance reflects the heritage significance of the site in its totality.

KEY CRITERIUM	ELEMENTS	EVIDENCE	Rating
Importance in the community, or pattern of South Africa's history	Support for Waterval Islamic Institute, providing the first Muslim boarding school and madrassa with subsidised tuition in the north of the country	Farming facilities, farmstead, cemetery	Medium
Possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage	None	None	Low
Potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage	Entire site	Possible oral information sources (former employees)	Medium
Importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects	Entire site	Farmstead and irrigation system as good examples of farming techniques and facilities	Medium
Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group	Entire site	Green open farmland in dense urban areas	High
Importance in demonstrating a high degree of creative or technical achievement at a particular period	None	None	Low
Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons	Entire site	Associated with Mia family	High

KEY CRITERIUM	ELEMENTS	EVIDENCE	Rating
Strong or special association with the life and work of a person, group or organisation of importance in the history of South Africa	Entire site	Waterval Islamic Institute	High
Site of significance relating to the history of slavery/labour in South Africa	Ruins of houses, cemetery	Impression of living conditions	Low
Economic significance	Entire site	Some buildings and open areas can be rehabilitated for new uses	High

3.2.2 Significance assessment of individual heritage-related features

See Annexure 1.

3.3 Impact assessment

A table summarised anticipated impacts on heritage resources is provided in Annexure 3.

3.4 Social and economic benefits

It is anticipated that the social and economic benefits associated with the proposed development could outweigh the benefits in conserving certain heritage elements.

3.5 Consultation with affected communities

This process is part of the EIA as a whole and could also be part of the HIA process. It is anticipated that this could generate new heritage-related information.

3.6 Key mitigation and enhancement measures

The most important in this context are the following:

- Documentation of highly significant heritage sites before any future changes related to rehabilitation and new uses, namely the Waterval farmstead, furrow system, tree lanes, dams and weirs;
- Documentation (where necessary) of heritage sites of low significance that can be demolished, namely the sewage treatment plant and ruins of farm labourers' cottages;
- Relocation of the cemetery as prescribed by the Regulations (2000) in terms of the National Heritage Resources Act;
- Changes to the layout of the development affecting the Waterval farmstead to provide for the preservation of significant buildings and landscape elements (already agreed to by the developers).

3.7 Mitigation of adverse effects during and after construction

The following project actions may impact negatively on archaeological sites and other sites of cultural importance. The actions are most likely to occur during the construction phase of the proposed project.

- Road making, construction activities and development of services may expose as yet unknown heritage resources;
- Occupation of the area would bring in curious visitors, who might destroy or remove objects from the identified sites;

- Removal of historic fabric during demolition.

We recommend that:

- Construction work is monitored by specialist archaeologists, cultural historians or conservation architects for the uncovering of any archaeological and historical sites, structures and objects through excavation and demolition activities;
- This recommendation must be included in construction tender documents.
- Identified sites should be properly documented and protected.

3.8 Key uncertainties and risks that may influence accuracy and confidence of scoping investigation

It is possible that new information, which could change the recommendations, will be generated through the following research activities:

- Public participation inputs
- Archaeological and historical sites and objects that are hidden or are buried

3.9 Final recommendations

The aim of the investigation was to identify, verify and analyse heritage issues and to recommend how to manage them within the context of the proposed development.

Based on what was found and its evaluation, it is recommended that the proposed development can continue in the area, on condition of acceptance of the following recommendations:

- That the proposed heritage conservation actions/interventions, as set out in 3.6, 3.7, the below summary and Annexure 1 of this report, are applied for each identified site;
- That a Conservation Management Plan (CMP) (to be authorised by SAHRA) should be compiled in order to provide for the rehabilitation, adaptation and new uses of conserved heritage resources. See Annexure 4 for a framework of such a CMP.

Summary of proposed conservation and mitigation measures (site numbers refer to detailed descriptions in Annexure 1):

SITE	DESCRIPTION	SIGNIFICANCE	MANAGEMENT ACTION
1	Waterval farmstead	High	Preserve significant buildings and incorporate in layout for rehabilitation purposes (new uses)
2	Sewage treatment plant	Low	No compelling conservation reasons
3	Cemetery	High	Relocate
4	Water furrow	Medium to high	Incorporate into layout
5	Dams and weirs in river	Medium	Incorporate in layout if ecologically acceptable
6	Rapids (Waterval)	High	Conserve
7	Tree lane	Medium	Conserve memory in layout
8	Ruins	Low	Document and demolish where appropriate

PART 4: INFORMATION SOURCES USED IN THIS REPORT

4.1 Archival sources

DEPOT SAB
SOURCE ARG
TYPE LEER
VOLUME_NO 144
SYSTEM 01
REFERENCE GEN12/4
PART 1
DESCRIPTION FARM WATERVAL NO 34, JOHANNESBURG OWNED BY THE WITWATERSRAND ESTATES
LTD AND LEASED TO AM **MIA** AND THE **ISLAMIC** INSTITUDE - OBJECTIONS
RAISED RE ASIATIC OCCUPATION AND TRADING.
STARTING 19430000
ENDING 19490000

DEPOT SAB
SOURCE BNS
TYPE LEER
VOLUME_NO 1/1/19
SYSTEM 01
REFERENCE 71/22
PART 1
DESCRIPTION TRANSVAAL ORDINANCE. **WATERVAL 34** PROPOSED TOWNPLANNING ORDINANCE FOR.
STARTING 1934
ENDING 1937

DEPOT SAB
SOURCE URU
TYPE LEER
VOLUME_NO 1883
SYSTEM 01
REFERENCE 1800
PART 1
DESCRIPTION RESERVATION OF PORTIONS NOS 42 AND 43 OF FARM **WATERVAL NO 34,** JOHANNESBURG, FOR EDUCATIONAL PURPOSES.
STARTING 1940
ENDING 1940

DEPOT SAB
SR/SN 000/00
SOURCE GEM
TYPE LEER
VOLUME_NO 268
SYSTEM 01
REFERENCE G20/2/199
PART 1
DESCRIPTION WITWATERSRAND ESTATES LIMITED JOHANNESBURG. REMAINING EXTENT OF THE
WESTERN PORTION OF **WATERVAL** NO **34** JOHANNESBURG.
STARTING 1952
ENDING 1952
REMARKS OU NO BNSGA2/1/199.

DEPOT SAB
SOURCE ARG
TYPE LEER
VOLUME_NO 139
SYSTEM 01
REFERENCE PROC1/5
PART 1
DESCRIPTION APPLICATION FOR A PROCLAMATION IN TERMS OF SECTION 6(4)(A) OF ACT NO 28 OF 1946 IN RESPECT OF THE REMAINDER OF THE FARM **WATERVAL** NO **34** (IN EXTENT 3744 - 2769 MORGEN) DISTRICT JOHANNESBURG PROCLAMATIONS: NO 321, 1949 AND NO 75 OF 1951.

STARTING 19490000
ENDING 19520000

DEPOT SAB
SOURCE ARG
TYPE LEER
VOLUME_NO 144
SYSTEM 01
REFERENCE GEN12/4
PART 1
DESCRIPTION FARM **WATERVAL** NO **34**, JOHANNESBURG OWNED BY THE WITWATERSRAND ESTATES
LTD AND LEASED TO AM MIA AND THE ISLAMIC INSTITUDE - OBJECTIONS
RAISED RE ASIATIC OCCUPATION AND TRADING.
STARTING 19430000
ENDING 19490000

DEPOT SAB
SOURCE CDB
TYPE LEER
VOLUME_NO 3/771
SYSTEM 01
REFERENCE TAD9/25/19
PART 1
DESCRIPTION DEPARTEMENT PLAASLIKE BESTUUR. ONDERVERDELING VAN PLAASGROND.
JOHANNESBURG. **WATERVAL 34** - 5IR.
STARTING 19400000
ENDING 19630000

DEPOT SAB
SOURCE CDB
TYPE LEER
VOLUME_NO 3/1003
SYSTEM 01
REFERENCE TAD13/1/104
PART 1
DESCRIPTION PLAASLIKE BESTUUR. LANDBOUHOEWES. BUCCLEUCH. PLAAS **WATERVAL 34**.
DISTRIK JOHANNESBURG.
STARTING 19190000
ENDING 19370000

DEPOT SAB
SOURCE CDB
TYPE LEER
VOLUME_NO 3/1177
SYSTEM 01
REFERENCE TAD14
PART 1
DESCRIPTION PLAASLIKE BESTUUR. STEDELIKE NEDERSETTINGS. PLAAS **WATERVAL 34**.
STARTING 19340000
ENDING 19340000

DEPOT SAB
SOURCE VWN
TYPE LEER
VOLUME_NO 2205
SYSTEM 01
REFERENCE SWC9/191/1
PART 1
DESCRIPTION WATERVAL **ISLAMIC INSTITUTE**. PER CAPUT GRANTS.
STARTING 1955
ENDING 1959

DEPOT SAB
SOURCE HEN
TYPE LEER
VOLUME_NO 2307
SYSTEM 01

REFERENCE 437/1/12/541
PART 1
DESCRIPTION COMPANIES ACT REGISTRATION OF COMPANIES UNDER SECTION 21. WATERVAL **ISLAMIC INSTITUTE.**
STARTING 1960
ENDING 1960

DEPOT SAB
SOURCE BEP
TYPE LEER
VOLUME_NO 157
SYSTEM 01
REFERENCE G7/139/12
PART 1
DESCRIPTION JOHANNESBURG WATERVAL **ISLAMIC INSTITUTE.**
STARTING 19540000
ENDING 19620000

DEPOT TBK
SOURCE KUS
TYPE LEER
VOLUME_NO 2799
SYSTEM 02
REFERENCE 8/7/6/C148
PART 1
DESCRIPTION PRIVATE KINDERHUISE EN VERSORGINGSOORDE: VERSLAE EN STATUTERE OPGAWES: WATERVAL **ISLAMIC INSTITUTE,** JOHANNESBURG.
STARTING 1961
ENDING 1965

DEPOT SAB
SOURCE CDB
TYPE LEER
VOLUME_NO 5733
SYSTEM 01
REFERENCE PB4/2/2/5353
PART 1
DESCRIPTION PLAASLIKE BESTUUR. GEMEENSKAPSVORMING. DORPE. HALFWAY HOUSE UITBREIDING 7. PLAAS **WATERVAL 5IR.** DISTRIK JOHANNESBURG.
STARTING 19740000
ENDING 19770000

DEPOT SAB
SOURCE CDB
TYPE LEER
VOLUME_NO 7225
SYSTEM 01
REFERENCE PB4/2/2/6719
PART 2
DESCRIPTION PLAASLIKE BESTUUR. GEMEENSKAPSVORMING. DORPE. VORNA VALLEY UITBREIDING 11. FARM **WATERVAL 5IR.** MIDRAND.
STARTING 19830000
ENDING 19880000

DEPOT SAB
SOURCE CDB
TYPE LEER
VOLUME_NO 7305
SYSTEM 01
REFERENCE PB4/3/2/2/22
PART 1
DESCRIPTION GEMEENSKAPSVORMING. ONWETTIGE DORPE. GEDEELTE 47 (GEDEELTE VAN GEDEELTE 12). **WATERVAL 5IR.** JOHANNESBURG.
STARTING 19740000
ENDING 19820000

DEPOT SAB
SOURCE RLA
TYPE LEER
VOLUME_NO 53
SYSTEM 01
REFERENCE 20/2/2/4/34
PART 1
DESCRIPTION FISIESE BEPLANNING. GIDSBEPLANNING. GROTER PRETORIA. WYSIGING VAN GIDSPLAN. 'N GEDEELTE VAN DIE PLAAS **WATERVAL 5IR.**
STARTING 19850000
ENDING 19900000

DEPOT SAB
SOURCE CDB
TYPE LEER
VOLUME_NO 16138
SYSTEM 01
REFERENCE PB13/2/S6/1
PART 1
DESCRIPTION DEPARTEMENT PLAASLIKE BESTUUR. BEHEER OOR PLAASLIKE OWERHEDE. GROEPSGEBIEDPERMITTE. SANDTON. GEDEELTE 40 (GEDEELTE VAN GEDEELTE 20). **WATERVAL 5IR.** K MIA.
STARTING 19850000
ENDING 19870000

4.2 Literature

Amazing find at boulders. *Midrand Reporter*, 10 July 1997.

GIFFORD, G, Cave home of early Tswana on banks of Jukskei River will change way history is taught. *The Star*, 20 Jan 1997.

Halfway House. *Be my guest*, August 1988.

MACDONALD, ZAHRAA, undated, *Constructing a conservative identity: The Tablīgh Jamā'a in Johannesburg* (posted on the Internet).

Standard Encyclopedia of Southern Africa, Vol 2., 1972. Cape Town: Nasou.

Jamiatul Ulama. 2005. *A Brief Chronology of 350 Years of Muslim Presence in South Africa*. Ar Rasheed, Vol 8, No. 1, page 6, 8 April 2005.

4.3 Maps

Department of Land Affairs, Pretoria: Historic maps of farm Waterval 5 IR (in Plan Room)
1:50 000 map 2628 AA Johannesburg

4.4 Aerial photographs

1938
2005

4.5 Unpublished reports

STRATEGIC ENVIRONMENTAL FOCUS, 2001, *Rezoning from agricultural to commercial on a portion of the farm Waterval 5 IR, Midrand, Gauteng.* Submitted to Property Management Development.

NATIONAL CULTURAL HISTORY MUSEUM, 1996, *Survey of heritage resources in Midrand area.*

PART 5: TERMINOLOGY USED IN THIS REPORT

Cultural significance (Burra Charter)

Aesthetic, historic, scientific, social or spiritual importance, meaning or noteworthiness for past, present or future generations

Cultural significance is embodied in the place itself (intrinsic significance), its fabric, setting, use, associations, meanings, records, related places and related objects

Heritage resources/features (NHRA)

Any place or object of cultural significance, including:
(a) places, buildings, structures and equipment of cultural significance;
(b) places to which oral traditions are attached or which are associated with living heritage;
(c) historical settlements and townscapes;
(d) landscapes and natural features of cultural significance;
(e) geological sites of scientific or cultural importance;
(f) archaeological and palaeontological sites;
(g) graves and burial grounds, including—
(i) ancestral graves;
(ii) royal graves and graves of traditional leaders;
(iii) graves of victims of conflict;
(iv) graves of individuals designated by the Minister by notice in the *Gazette*;
(v) historical graves and cemeteries; and
(vi) other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
(h) sites of significance relating to the history of slavery in South Africa;
(i) movable objects, including—

(i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
(ii) objects to which oral traditions are attached or which are associated with living heritage;
(iii) ethnographic art and objects;
(iv) military objects;
(v) objects of decorative or fine art;
(vi) objects of scientific or technological interest; and
(vii) books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

Heritage significance (NHRA)

(a) its importance in the community, or pattern of South Africa's history;
(b) its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
(c) its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
(d) its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
(e) its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
(f) its importance in demonstrating a high degree of creative or technical achievement at a particular period;
(g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
(h) its strong or special association with the life or work of a person, group or

organisation of importance in the history of South Africa; and
(i) sites of significance relating to the history of slavery in South Africa.

Historic period
Since the arrival of the white settlers - c. AD 1840 in this part of the country

Impact

A description of the effect of an aspect of the development on a specified component of the biophysical, social or economic environment within a defined time and space

Impact assessment

Issues that cannot be resolved during screening (Level 1) and scoping (Level 2) and thus require further investigation

Iron Age

Early Iron Age (EIA)	AD 200 - AD 1000
Late Iron Age (LIA)	AD 1000 - AD 1830

Issue

A question that asks what the impact of the proposed development will be on some element of the environment

Maintenance

Keeping something in good health or repair.

Management actions

Actions that enhance benefits associated with a proposed development or avoid, mitigate, restore, rehabilitate or compensate for the negative impacts

Preservation

Conservation activities that consolidate and maintain the existing form, material and integrity of a cultural resource

PHRA – Provincial Heritage Resources Agency

Reconstruction

Re-erecting a structure on its original site using original components.

Rehabilitation

Re-using an original building or structure for its historic purpose or placing it in a new use that requires minimal change to the building or structure characteristics and its site and environment.

Restoration

Returning the existing fabric of a place to a known earlier state by removing additions or by reassembling existing components.

SAHRA - South African Heritage Resources Agency

Stone Age

Early Stone Age (ESA)	2 000 000 - 150 000 Before Present
Middle Stone Age (MSA)	150 000 - 30 000 BP

Late Stone Age (LSA)	30 000 - until c. AD 200

Value

Worth, conservation utility, desirability to conserve etc in terms of physical condition, level of significance (importance), economy (feasibility), possible new uses and associations/comparisons with similar features elsewhere

ANNEXURE 1: DESCRIPTION AND ASSESSMENT OF INDIVIDUAL HERITAGE RESOURCES

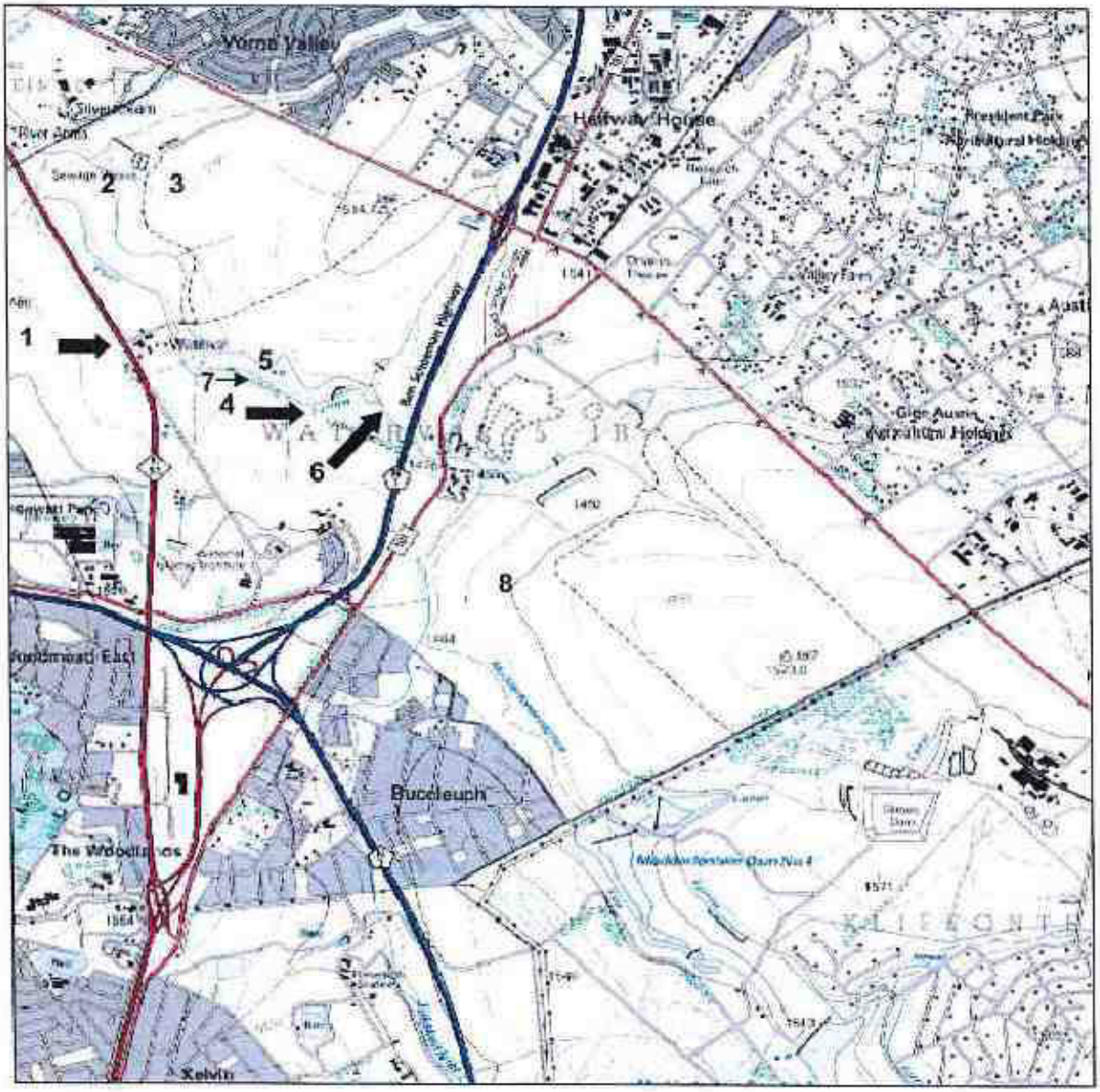


FIGURE 4: Portion of 1:50 000 map 2628 AA Johannesburg indicating location of individual heritage resources discussed below

ITEM NO 1: Old Waterval farmstead	
Location	See map
GPS coordinates	See map for location of farmstead. The co-ordinates of the proposed minimum heritage conservation area (excluding the proposed larger conservation area up to the river), basically comprising the farmstead, are as follows: S 26°01'26.38", E 28°05'20.77" S 26°01'36.83", E 28°05'26.94" S 26°01'22.34", E 28°05'31.03" S 26°01'31.36", E 285'37.48"
Original name	Unknown
Other reference	None
Existing documentation	None

Description and discussion: The farm complex in 1938-1939

From the 1938-1939 aerial photograph (Figure 4, below) one can discern that the complex during the 1930's already consists of a series of small buildings, structures, enclosures, small roads and tracks, trees, agricultural lands and pasturage adjacent and west of the Jukskei River. A plan of the core of the farm complex has been prepared from the 1938-1939 aerial photograph (Figure 1, below), and the numbering system on the plan is used in the following description. The functions of the buildings described below are surmised from their present condition and form.

The farm complex has a simple ordering system of buildings adjacent to small orthogonal farm roads, the whole tucked in a corner formed by the old main road, being a dirt road, and a smaller road, also dirt and perpendicular to the main road, providing access to the diary and lands.

To the north-west there is a farm house (number 1a) with what appears to be cowsheds (number 1b) with a cattle enclosure (number 1c) to its east, the ensemble bordered by a small farm road to their east and south. A building of unknown function (number 2d) but probably an older pump room, lies on the south side of the small farm road.

South of this ensemble, and alongside the larger east-west road in the farm complex perpendicular to the main road, is another ensemble of several buildings or groups of buildings: The first is a farm house (number 2a) facing the main road to its west, having a formally laid out garden section (number 2b) to its south-west and an enclosure of unknown function (number 2c) to its north-west. The second building is another farm house (number 3a) to the east of the first house and also facing the main road. Thirdly, from this house, alongside the centrally located north-south farm road west of the diary, is a row of small buildings (number 3b) that have most probably been farm workers' housing. The fourth building (number 4a) is a milking shed at the south-eastern extremity of the farm complex, and along a small north-south farm road there is a fifth building (number 5a) of unknown function, but surmised to have been the equipment store, with two cattle enclosures (number 5b and 5c) to the east of it.

South of the main group of buildings described above, there is a large rectangular open surface which is the floor of a new building being constructed – from our knowledge of the farm today it is known that this is a housing and office/workshop complex. Slightly to the east of this adjacent the farm road there is a small structure (number 7a) of unknown function.

Buildings that are still extant from this era (marked blue and red on the plan) are numbers 1a, 1b [Subsumed in a newer structure], 1d [possibly subsumed in the 1940s pumphouse], 2a, 3a, 4a and 5a. Building 6a was in its construction phase during 1937. Buildings currently not extant are marked up in green on the plan

Dating

The farm at this point in time seems to consist of buildings from 2 distinct phases, ie the original farmstead (marked blue), and subsequent buildings marked red).

From the first assessment it is surmised that the milking shed (number 4a) was the original wagon house and store building of the farm, dating from the late 19th C, and that the house to its west (number 3a) could contain the core structure of the original farm house.

The other buildings included in the above description probably all date from the 1935 building period to co-incide with the revival of the Jamiatul Ulama Transvaal [started 1923] in 1935 when a larger "Mia's Farm" [not the original farmstead] was established.

ITEM NO 1: Old Waterval farmstead

Description and discussion: The farm complex post-1939

From the clue of the start of construction of building number 6a in 1939, it is surmised that a large group of new buildings were designed and constructed for the farm complex – a so called 2nd wave due to the increased needs of the Jamiatul Ulama. From an inspection of the architectural style and style markers of the buildings, it appears as if one architect was involved with a group of 3 buildings (marked yellow on the plan), and that another group of buildings are of a more utilitarian, industrial nature (marked orange on the plan). A map of this phase is included as Figure 2 (below).

The first group of buildings show Art Deco and neo-classical influences, and are reminiscent of work done in Italy in the 1930/40's. The first building in this group is the already mentioned housing and office/workshop complex (number 6a). The combined function and design is of high architectural and socio-cultural value – a newer addition of a workshop on the flat concrete roof of the south part of the complex displays future evolution and functional needs of the farm, but mars this quality and original intent. A flour mill and workshop structure (number 5f) and office (number 5g) with details similar to the building 6a were added to the north-east extremity of the complex.

The second group of buildings of a more utilitarian design nature includes what is deemed to be a large rectangular plastered brick workshop north of house number 3a, and a large face brick workshop north of the first-mentioned workshop. The other buildings of this group includes a stone masonry enclosure and stores (number 5e) just east of the wagon house turned milk-shed, as well as face brick stores (number 5di and 5dii) north and south of the equipment store.

Later additions and alterations still classified as heritage resources

Later additions include a water canal (dated 1950 on a paving block) diagonally across the site from the milk shed to the housing complex, with an accompanying double lane of palm trees which are now quite mature. A large stone walled cattle enclosure was added to the east of the stores number 5dii, within which the older enclosure 5c was subsumed.

More recent additions not classified as heritage resources under the 60 year clause

More recent additions include a large L-shaped roof structure which is used in the milking process, situated north of building 5e, and south of the large cattle enclosure 5c - The structure is well designed and compliments the ensemble of functional farm buildings.

A store building in an Islamic vernacular style (a manner of building revived by architects of north Africa, in particular Egypt, Morocco and Tunisia) in the 1960s, was built just east of the milking shed. There is one other smaller structure in this style some ways south of the whole complex.

A large industrial building was built just west of the flour mill (building number 5f)

Setting

The core of the Mia farm complex is currently situated on a gently sloping piece of Highveld land, east to and adjoining a dirt road running in a north-south direction and west of the Jukskei river, which here also runs in a north-south direction. The main gate is just south of a slight kink in the road. The dirt road, historically a main road, is situated just east of the current R55 tarred provincial road between Woodmead and Kyalami.

Current heritage conservation status

Because of the condition and quality of the buildings, the current heritage conservation status is medium to low. However, the intangible heritage significance (association with Mia family and the Institute) is medium to high.

The initial significance assessment indicates that this farm complex

- Has a large number of heritage resources which provide a unique insight of the origins and evolution of a very important family in the history of South Africa, from the time of the old Transvaal Republic to the present Democracy,
- Components of it must be conserved and/or rehabilitated for re-use within a future town-planning development proposal.
- The heritage value and significance must be derived of the totality of buildings, structures, boundaries, roads and vegetation, rather than for individual buildings or elements.

Cultural significance

No	Criteria	Applicability	Rating
a	Importance in the community or pattern of history	Associated with Waterval Islamic Institute	High
b	Possession of uncommon, rare or endangered aspects of natural or cultural	None	Medium

ITEM NO 1: Old Waterval farmstead			
	heritage		
c	Potential to yield information to understand the natural or cultural heritage	Oral history elements	Medium
d	Importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects	None	Low
e	Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group	None	Low
f	Importance in demonstrating a high degree of creative or technical achievement at a particular period	None	Low
g	Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons	Waterval Islamic Institute	High
h	Strong or special association with the life and work or a person, group or organisation of importance in history	Mia family	High
i	History of slavery/labour	None	Low
j	Economic importance	Can be rehabilitated for other uses	Medium
Impact assessment			
The farmstead could be impacted upon negatively by the proposed development because of its extent and the perception that its heritage conservation status and cultural significance is low.			
Summarised conservation indicators			
Age of property and protection status			
Some of the buildings are older than 60 years and protected through the NHRA			
Compelling/No reasons for conservation			
Due to the heritage conservation status and cultural significance, there are compelling reasons to conserve the farmstead.			
Conditions for further conservation/demolition			
All buildings should be recorded before demolition and re-use. A Conservation Management Plan is necessary for enabling rehabilitation, adaptation and new uses of the site.			
Legal requirements			
Some buildings are protected by the NHRA since they are older than 60 years. Any authorisations for demolitions and other changes must be done by SAHRA in terms of Section 38(10) of the NHRA.			
Summary of conservation management actions			
Those extant resources that are deemed important for conservation, including the boundaries of the proposed heritage conservation area and the spaces between the buildings, are indicated on Figure 3 (map) in purple.			
Summary of impact significance			
With mitigation	Medium negative (implying recording and conservation of most important elements)		
Without mitigation	High negative (implying demolition without recording)		

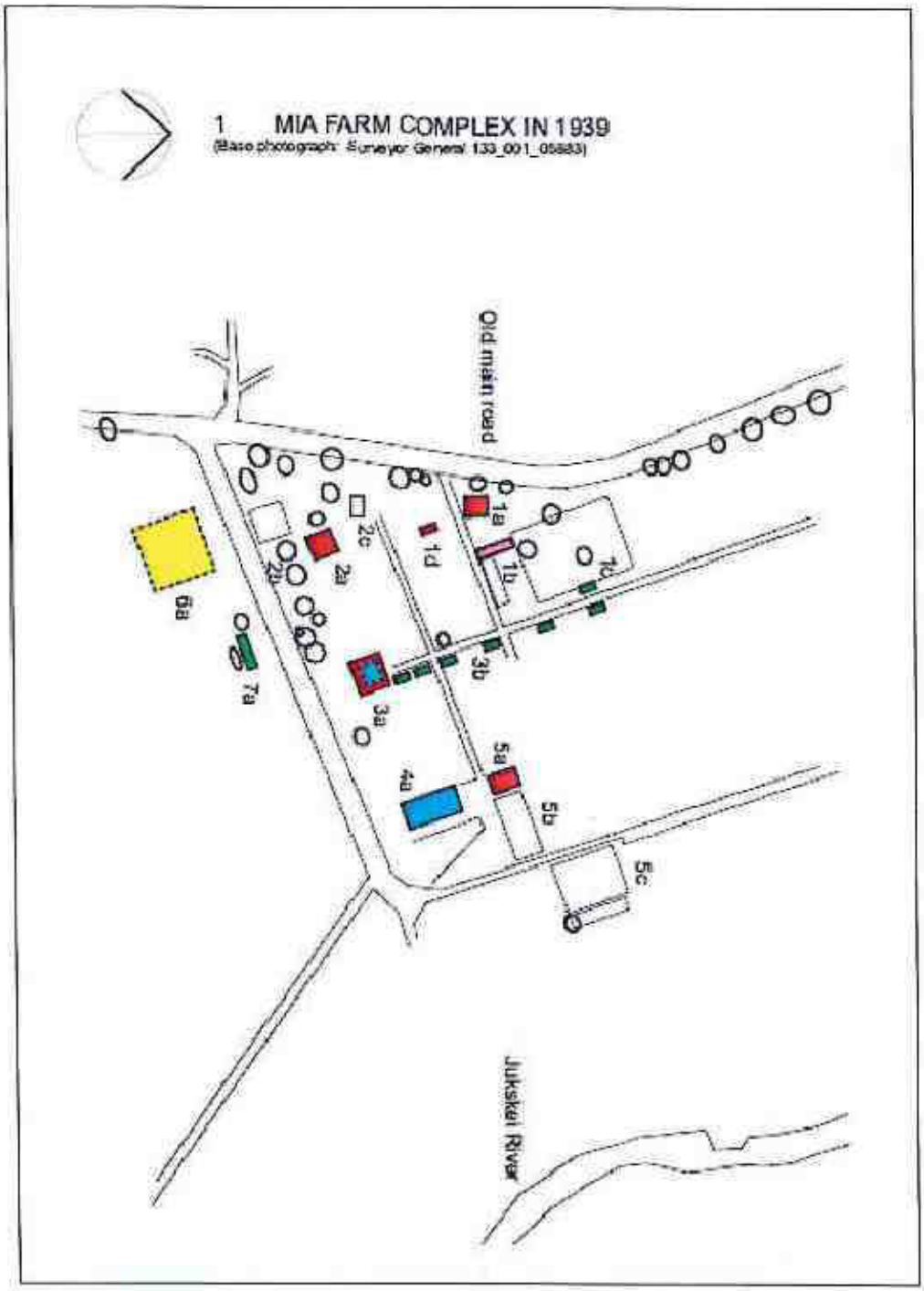


FIGURE 5: Farmstead layout 1938-1939

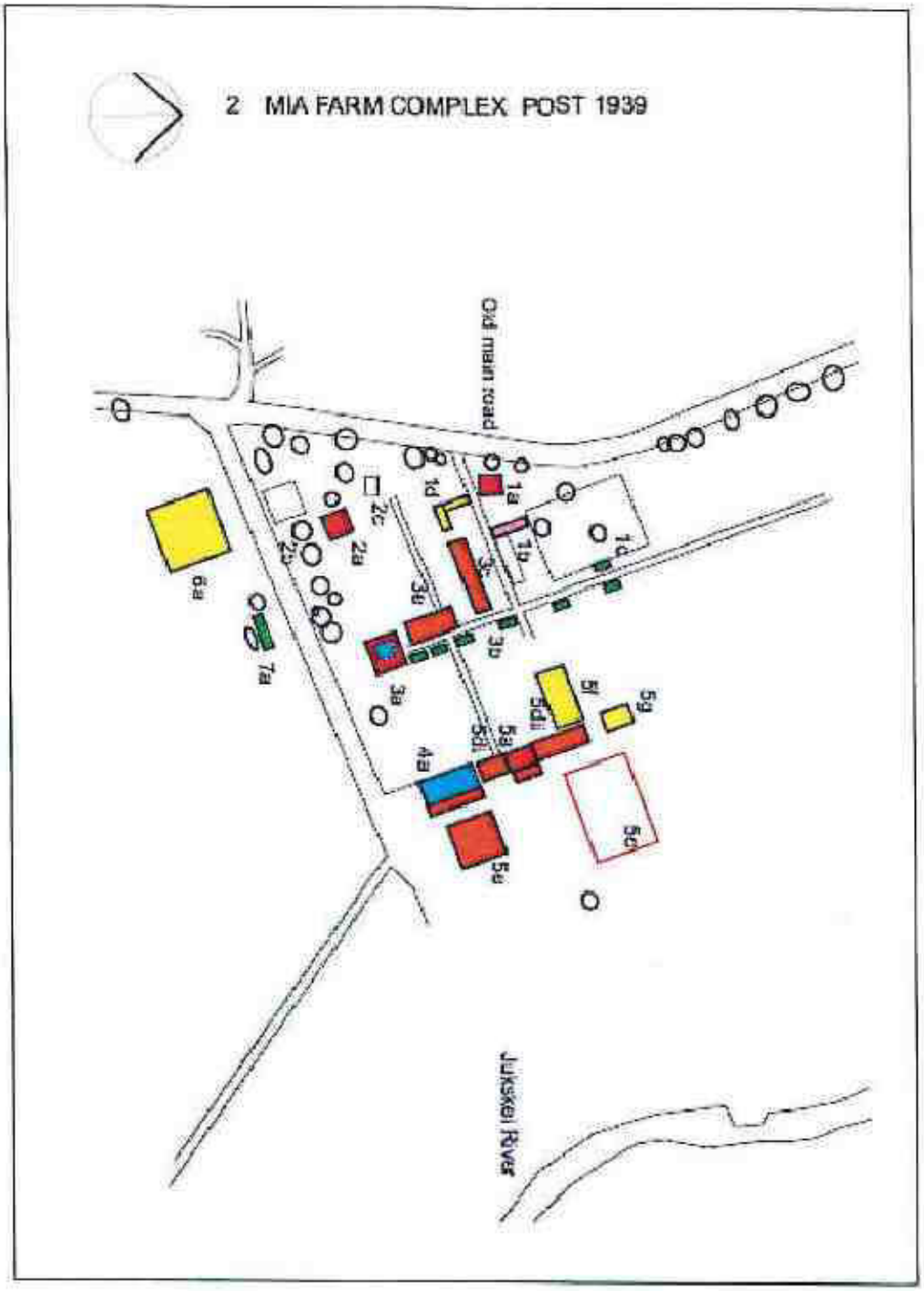


FIGURE 6: Farmstead layout post 1939

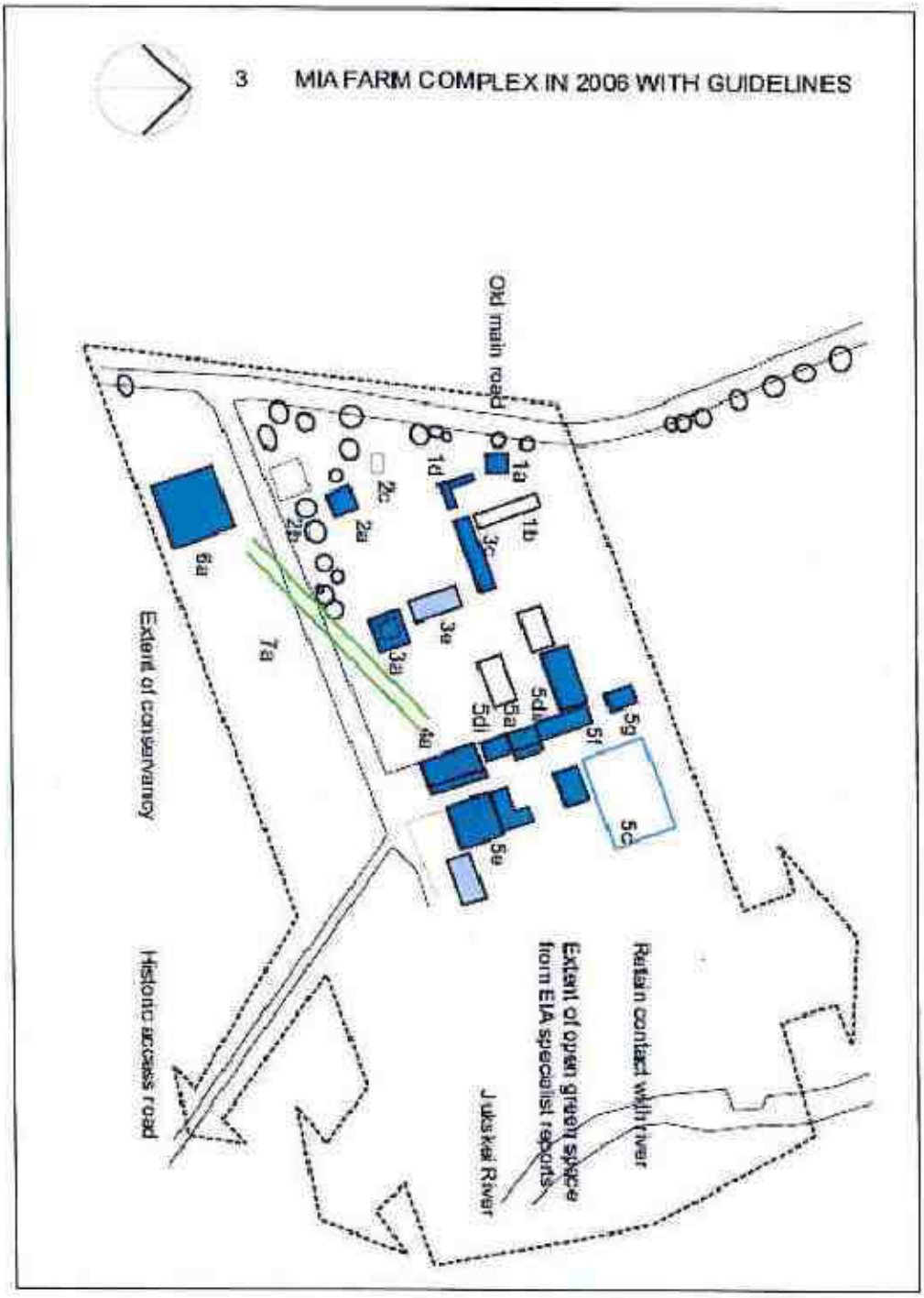


FIGURE 7: Original mitigation proposals

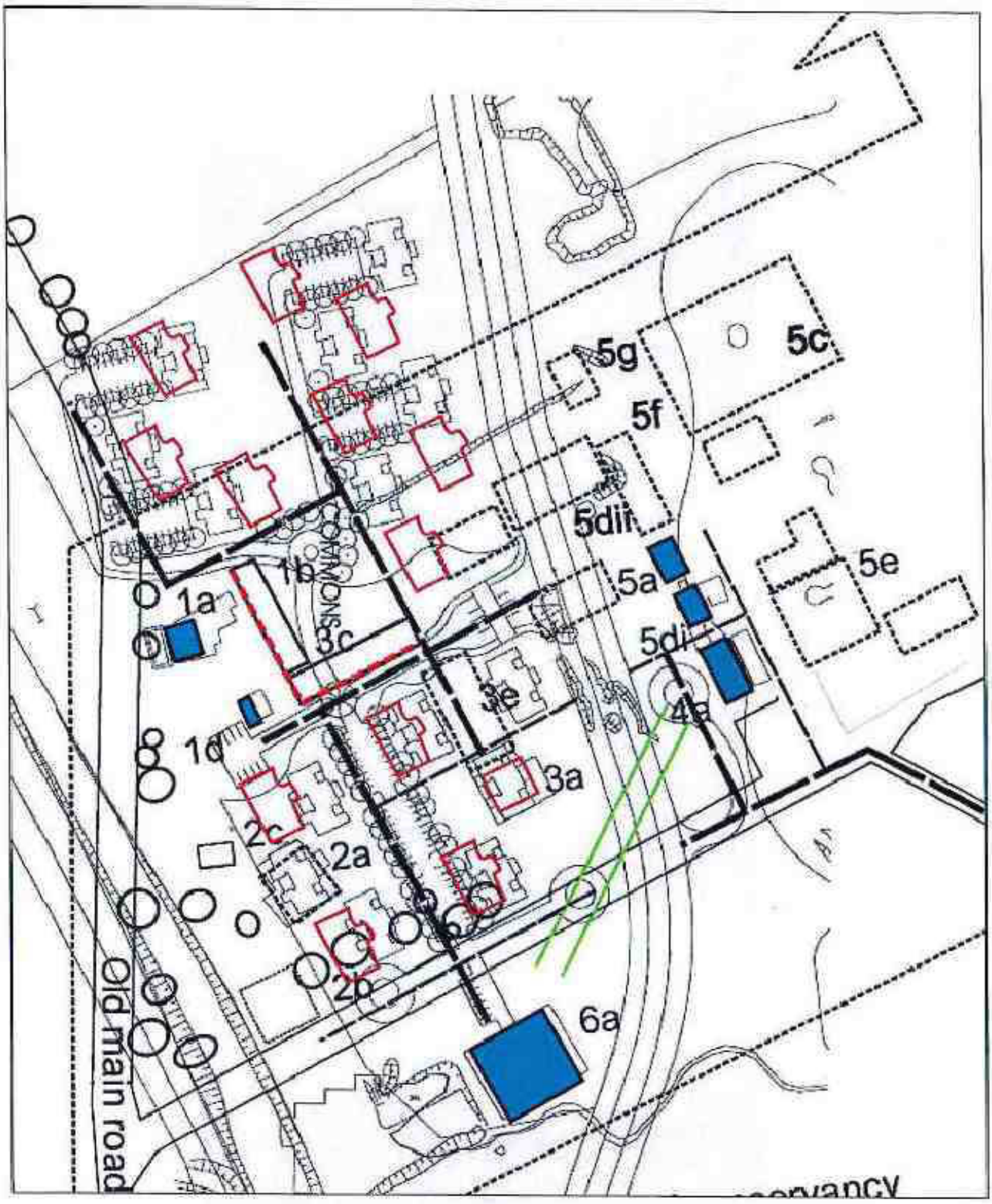
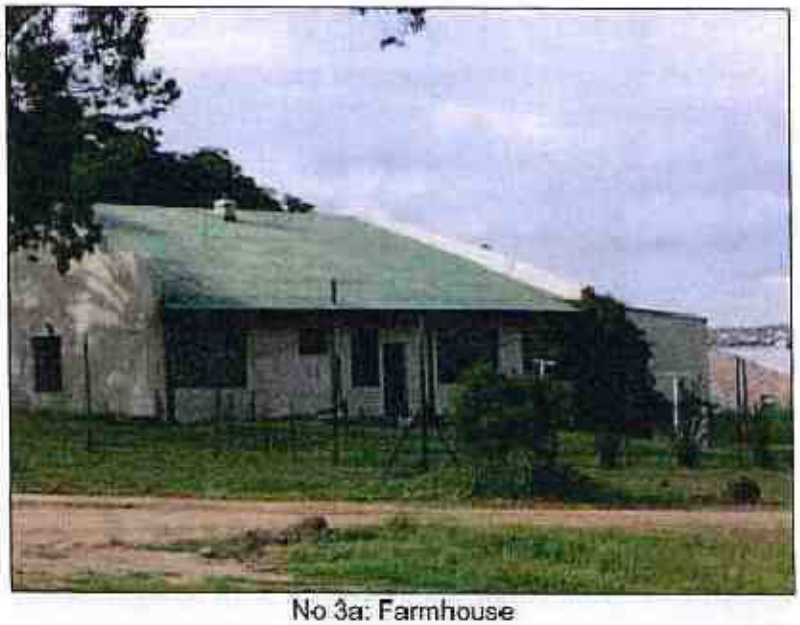


FIGURE 8: Revised mitigation proposals. Buildings in blue will be preserved.

No 1a: Old farm house (to be preserved)

No 1d: Pumphouse and reservoir (to be preserved), with No 3c (left): Face brick store

No 2a: Farmhouse



No 3a: Farmhouse

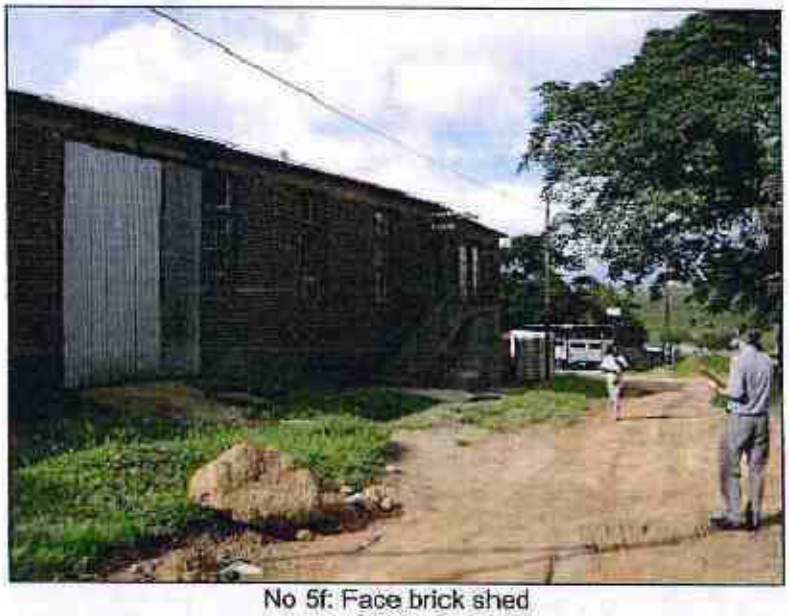
No 3e

No 4a: Old milking shed (to be preserved)

No 5a, front: Small historic building, unknown function
No 5d(ii), background: Face brick stores (all to be preserved)

No 5c: Cattle enclosure

No 5e: Store building



No 5f: Face brick shed

No 6a: Housing and office/workshop complex (to be preserved)

Buildings 3a (left) and 3e (right)

Buildings 4a (centre) and 5e (right)

Buildings 5g (left) and 5f (right)

ITEM NO 2: Sewage treatment plant			
Location	See map		
GPS coordinates	See map		
Original name	None		
Other reference	None		
Existing documentation	Presumably in municipal archives		
Description and discussion: Original buildings			
Sewage treatment plant consisting of a fenced-off area with offices, storerooms, laboratory, treatment ponds etc. Adjacent to it is a large, unused rectangular pond.			
Description and discussion: Alterations to original buildings			
None			
Description and discussion: Additions to main buildings			
None			
Setting			
Located near northern corner of development area, on open grassland			
Current heritage conservation status			
This is a modern insertion into the landscape and has no specific heritage value. Its heritage conservation status is low.			
Cultural significance			
No	Criteria	Applicability	Rating
a	Importance in the community or pattern of history	None	Low
b	Possession of uncommon, rare or endangered aspects of natural or cultural heritage	None	Low
c	Potential to yield information to understand the natural or cultural heritage	None	Low
d	Importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects	None	Low
e	Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group	None	Low
f	Importance in demonstrating a high degree of creative or technical achievement at a particular period	None	Low
g	Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons	None	Low
h	Strong or special association with the life and work or a person, group or organisation of importance in history	None	Low
i	History of slavery/labour	None	Low
j	Economic importance	Possibly	Medium
Impact assessment			
Due to its low cultural significance and heritage conservation value, the proposed development will have no negative impact on this site			
Summarised conservation indicators			
Age of property and protection status			
The plant probably dates back to the 1960s and does not fall under the 60-year protection clause of the NHRA			
Compelling/No reasons for conservation			
There are no compelling reasons for conserving the plant and incorporating it into the proposed development			
Conditions for further conservation/demolition			
Document before removal			

ITEM NO 2: Sewage treatment plant	
Legal requirements	
Document before removal	
Summary of management actions	
Document plant before removal	
Summary of impact significance	
With mitigation	Low
Without mitigation	Low
Photos	

ITEM NO 3: Cemetery			
Location	Near sewage treatment plant		
GPS coordinates	S 26deg 00'40.4" E 28 deg 05'44.3"		
Original name	Unknown		
Other reference	None		
Existing documentation	None		
Description and discussion: Original structures			
Large cemetery with a number of adult and children's graves, presumably associated with the Waterval farm workers and their families and other residents on or near the farm. The dates on the tombstones reflect the period 1930s-1970s. The approximate number of graves is 70.			
Description and discussion: Alterations to original structures			
None			
Description and discussion: Additions to structures			
None			
Setting			
Located on high rocky area			
Current heritage conservation status			
Some of the graves appear to be looked after whilst other are derelict. In general the cemetery is overgrown. Its heritage conservation status is medium.			
Cultural significance			
No	Criteria	Applicability	Rating
a	Importance in the community or pattern of history	None	Low
b	Possession of uncommon, rare or endangered aspects of natural or cultural heritage	None	Low
c	Potential to yield information to understand the natural or cultural heritage	Oral information sources associated with living descendents	Medium
d	Importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects	None	Low
e	Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group	None	Low
f	Importance in demonstrating a high degree of creative or technical achievement at a particular period	None	Low
g	Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons	African farm workers living on or near Waterval	High
h	Strong or special association with the life and work or a person, group or organisation of importance in history	One of the graves is that of a bishop	High
i	History of slavery/labour	History of rural settlement in Midrand	Medium
j	Economic importance	None	Low
Impact assessment			
The proposed development will have a high negative impact on this site			
Summarised conservation indicators			
Age of property and protection status			
The site is protected in terms of the NHRA			
Compelling/No reasons for conservation			
It would seem impractical to conserve the cemetery in situ and it is therefore recommended to relocate the graves to an existing municipal cemetery			
Conditions for further conservation/demolition			
Record before relocation			

ITEM NO 3: Cemetery	
Legal requirements	
The NHRA and its Regulations provide for the protection and relocation of graves and the processes associated with it	
Summary of management actions	
Document graves and setting of cemetery Relocate cemetery	
Summary of impact significance	
With mitigation	High positive (relocation of graves)
Without mitigation	High negative (inappropriate incorporation of graves in golf course development)
Photos	

ITEM NO 4: Water furrow	
Location	See map (linear feature)
GPS coordinates	See map (linear feature)
Original name	Unknown
Other reference	None
Existing documentation	Maps and aerial photos

Description and discussion: Original structure

This historic water furrow begins close to the rapids in the Jukskei River (near the N 1) and runs west and more or less parallel to the river, joining a small tributary in the north-western corner of the development area.

Description and discussion: Alterations to original structure

None

Description and discussion: Additions to main structure

None

Setting

Runs close to river bank on grassy plain of farm

Current heritage conservation status

The furrow is in use and well maintained and its heritage conservation status is high

Cultural significance

No	Criteria	Applicability	Rating
a	Importance in the community or pattern of history	None	Low
b	Possession of uncommon, rare or endangered aspects of natural or cultural heritage	None	Low
c	Potential to yield information to understand the natural or cultural heritage	None	Low
d	Importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects	None	Low
e	Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group	The furrow creates an attractive water landscape with scenic qualities	Medium
f	Importance in demonstrating a high degree of creative or technical achievement at a particular period	Irrigation system designed for farm	Medium
g	Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons	None	Low
h	Strong or special association with the life and work or a person, group or organisation of importance in history	None	Low
i	History of slavery/labour	None	Low
j	Economic importance	Can be used for farming and recreation	High

Impact assessment

The proposed development could have a negative impact on the furrow if the golf courses and residential erven do not take it into account

Summarised conservation indicators

Age of property and protection status

The furrow is older than 60 years (appears on 1938 aerial photo) and is protected in terms of the NHRA

Compelling/No reasons for conservation

The furrow could contribute to the scenery and can be used for creating water features and irrigating golf courses and gardens. There are compelling reasons to incorporate it into the development design. This has been agred to by the developers.

Conditions for further conservation/demolition

Document water furrow

ITEM NO 4: Water furrow	
Legal requirements	
Protected in terms of NHRA	
Summary of management actions	
Document furrow (route and photos) before any alterations Incorporate it into design of development	
Summary of impact significance	
With mitigation	Low (incorporate into design and conserve)
Without mitigation	High negative (demolish)
Photos	

ITEM NO 5: Dams and weirs in Jukskei River	
Location	See map (linear feature)
GPS coordinates	See map (linear feature)
Original name	None
Other reference	None
Existing documentation	None

Description and discussion: Original structures

Series of dams, reservoirs and weirs in the river designed to stem the flow of water and create reservoirs for irrigation purposes

Description and discussion: Alterations to original structures

None

Description and discussion: Additions to structures

A large kind of lookout building stands above a circular reservoir

Setting

Set in river landscape with riverine vegetation

Current heritage conservation status

Some of the dams and weirs appear to be functioning. The condition is fair. The heritage conservation status of this system is medium. They support biological diversity and two large water monitors were observed in one of the reservoirs

Cultural significance

No	Criteria	Applicability	Rating
a	Importance in the community or pattern of history	None	Low
b	Possession of uncommon, rare or endangered aspects of natural or cultural heritage	None	Low
c	Potential to yield information to understand the natural or cultural heritage	Oral information from residents of the farm as to how the system originated	Medium
d	Importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects	None	Low
e	Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group	None	Low
f	Importance in demonstrating a high degree of creative or technical achievement at a particular period	Part of irrigation system designed for farm	Medium
g	Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons	None	Low
h	Strong or special association with the life and work or a person, group or organisation of importance in history	None	Low
i	History of slavery/labour	None	Low
j	Economic importance	Can be used for farming and recreation	High

Impact assessment

It is unlikely that the proposed development will have a negative impact on these structures since they form part of the river system that must be protected

Summarised conservation indicators

Age of property and protection status

Some of the weirs are older than 60 years (appear on 1928 aerial photo) and are therefore protected by the NHRA

Compelling/No reasons for conservation

Because these structures contribute to the scenery and wildlife of the area, there are no compelling reasons for demolition. However, should hydrological and biodiversity studies show the opposite, Cultmatrix will support a conditional authorisation for demolition

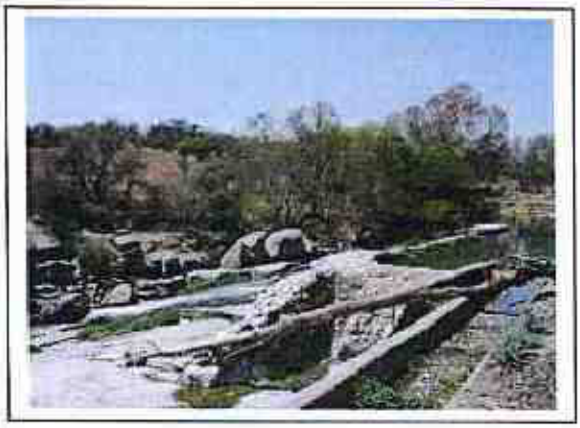
Conditions for further conservation/demolition

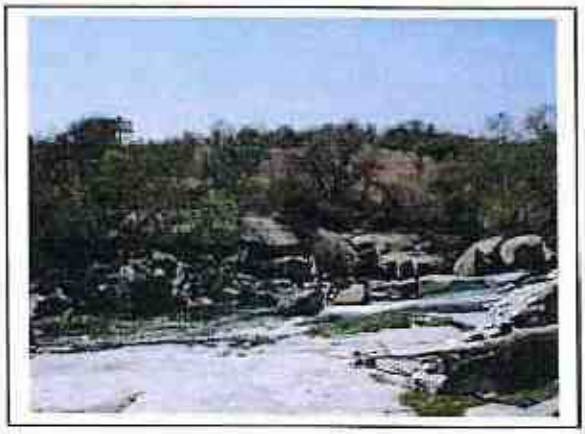
Document (maps, plans, photos) before alterations or demolition

ITEM NO 5: Dams and weirs in Jukskei River	
Legal requirements	
Parts are protected by the NHRA	
Summary of management actions	
Document weirs, dams, reservoirs and other structures Demolish recent unsightly additions Repair existing structures Incorporate into development design Provide for river management in terms of Water Act and other legislation (implying alterations)	
Summary of impact significance	
With mitigation	Low (document and incorporate into design)
Without mitigation	High negative (destruction without documentation)
Photos	

ITEM NO 6: Rapids in Jukskei River			
Location	See map		
GPS coordinates	S 26 deg 01'34.2" E 28 deg 05'58.1"		
Original name	The "Waterval"		
Other reference	Unknown		
Existing documentation	Unknown		
Description and discussion: Original site			
Small rapids in river with river water running over sloping granite surface			
Description and discussion: Alterations to original site			
None			
Description and discussion: Additions to site			
A weir was constructed just above the rapids for purposes of feeding the furrow, which starts at this point			
Setting			
Set in scenic riverine vegetation close to N 1			
Current heritage conservation status			
The rapids are functioning and from a cultural and biodiversity perspective their heritage conservation value is high			
Cultural significance			
No	Criteria	Applicability	Rating
a	Importance in the community or pattern of history	Gave name to farm	High
b	Possession of uncommon, rare or endangered aspects of natural or cultural heritage	Intact river feature in urban environment	High
c	Potential to yield information to understand the natural or cultural heritage	Biodiversity studies	High
d	Importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects	None	Low
e	Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group	Scenic area	High
f	Importance in demonstrating a high degree of creative or technical achievement at a particular period	None	Low
g	Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons	None	Low
h	Strong or special association with the life and work or a person, group or organisation of importance in history	None	Low
i	History of slavery/labour	None	Low
j	Economic importance	Feeds water furrow	Medium
Impact assessment			
The proposed development could have a high negative impact on this important feature without careful design and layout			
Summarised conservation indicators			
Age of property and protection status			
Protected in terms of NHRA as part of natural heritage and as intangible heritage feature (place name)			
Compelling/No reasons for conservation			
Because of its sensitivity, biodiversity, intangible heritage significance and source for the furrow, there are compelling reasons for conserving it			
Conditions for further conservation/demolition			
Proper biodiversity studies; document weir and furrow start			

ITEM NO 6: Rapids in Jukskei River	
Legal requirements	
Protected in terms of environmental and heritage legislation	
Summary of management actions	
Document structures Make site accessible to residents of golf course Maintain site Incorporate into development design Site interpretation	
Summary of impact significance	
With mitigation	High positive (conservation and documentation)
Without mitigation	High negative (destruction without documentation and research)
Photos	





ITEM NO 7: Tree lane	
Location	See map (linear feature)
GPS coordinates	See map (linear feature)
Original name	None
Other reference	None
Existing documentation	None

Description and discussion: Original site

Lane of pine trees running along old track on south side of river. This track appears on the 1938-39 aerial photo and on old farm maps and connected the farmstead directly with the old Pretoria-Johannesburg road. It was presumably the main access to the farm.

Description and discussion: Alterations to original site

In places the pines have disappeared, leaving gaps in the lane

Description and discussion: Additions to site

None

Setting

Rural setting with Highveld grass plains

Current heritage conservation status

The pines are mature and some of them show signs of dying. In places the lane has been broken where trees have disappeared. Its heritage conservation status is low to medium, since they still are a landscape feature.

Cultural significance

No	Criteria	Applicability	Rating
a	Importance in the community or pattern of history	None	Low
b	Possession of uncommon, rare or endangered aspects of natural or cultural heritage	None	Low
c	Potential to yield information to understand the natural or cultural heritage	None	Low
d	Importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects	None	Low
e	Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group	Landscape feature	Medium
f	Importance in demonstrating a high degree of creative or technical achievement at a particular period	None	Low
g	Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons	None	Low
h	Strong or special association with the life and work or a person, group or organisation of importance in history	None	Low
i	History of slavery/labour	None	Low
j	Economic importance	None	Low

Impact assessment

The impact of the proposed development could be where the lane cannot be incorporated in the layout and must be removed.

Summarised conservation indicators

Age of property and protection status

None

Compelling/No reasons for conservation

Because the trees are ageing and the lane is incomplete, there are no compelling conservation reasons. However, we recommend retaining the memory of the lane in the landscape design if possible. The developers has already provided for this.

Conditions for further conservation/demolition

Document before removal

ITEM NO 7: Tree lane	
Legal requirements	
This feature is older than 60 years and is protected by the NHRA.	
Summary of management actions	
Document lane and road Incorporate memory of the place into new landscape design	
Summary of impact significance	
With mitigation	Low
Without mitigation	Low
Photos	

ITEM NO 8: Ruins	
Location	On open plains east of N 1 (2 sites) and at base of cell phone mast near sewage treatment plant
GPS coordinates	S 26 deg 02'30.9" E 28 deg 07'04.0" S 26 deg 02'42.2" E 28 deg 07'04.7" S 26 deg 02'00.7" E 28 deg 07'40.4" S 26 deg 01'59.5" E 28 deg 07'51.4" S 26 deg 02'05.3" E 28 deg 08'04.8"
Original name	Unknown
Other reference	None
Existing documentation	Some appear on 1938 aerial photo

Description and discussion: Original building

Ruins of rectangular mud brick dwellings, presumably occupied in the past by farm workers and tenants elsewhere on the farm. Middens (rubbish dumps) occur at all of them. There are about 4-5 individual ruins that could be identified.

Description and discussion: Alterations to original building

None

Description and discussion: Additions to main building

None

Setting

East of N 1: On open plains and near main Allendale road. West of N 1: At cell phone mast. Other ruins have also been observed but it is uncertain of these fall in the development area.

Current heritage conservation status

These structures are ruins and their conservation value is thus low

Cultural significance

No	Criteria	Applicability	Rating
a	Importance in the community or pattern of history	None	Low
b	Possession of uncommon, rare or endangered aspects of natural or cultural heritage	None	Low
c	Potential to yield information to understand the natural or cultural heritage	None	Low
d	Importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects	None	Low
e	Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group	None	Low
f	Importance in demonstrating a high degree of creative or technical achievement at a particular period	None	Low
g	Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons	None	Low
h	Strong or special association with the life and work or a person, group or organisation of importance in history	None	Low
i	History of slavery/labour	Associated with farm workers and tenants	Medium
j	Economic importance	None	Low

Impact assessment

The proposed development will have a low impact due to the low significance and conservation value of these sites

Summarised conservation indicators

Age of property and protection status

Some structures are probably older than 60 years (appear on 1938 aerial photo) and are protected by the NHRA

Compelling/No reasons for conservation

Due to the low significance and conservation value, there are no compelling reasons to conserve the ruins

Conditions for further conservation/demolition

Document larger and more visible ruins (plans, photos) before demolition. Sampling of middens is recommended in order to retrieve any interesting artefacts associated with the history of the farm

ITEM NO 8: Ruins	
Legal requirements	
Sampling requires an archaeological excavation permit from SAHRA. Authorisation of demolition of old structures is subject to submission of documentation.	
Summary of management actions	
Document structures Demolish Sample middens	
Summary of impact significance	
With mitigation	Low
Without mitigation	Low
Photos	

ANNEXURE 2: TABLE SUMMARISING ANTICIPATED IMPACTS ON HERITAGE RESOURCES

ITEM	NATURE OF IMPACT	EXTENT	SITE NO'S	SEVERITY RATING (Intensity factor x duration factor = value = rating				PROBABILITY RATING	IMPACT SIGNIFICANCE RATING (Severity rating x Probability rating)	RISK CONS	RECOMMENDED MANAGEMENT INTERVENTIONS
				INTENSITY	DURATION	VALUES	RATING				
1	Loss of historical fabric and layering due to demolition, alteration, new uses, insertions, additions	Site	1,4,5,7	Factor 4	Factor 4	16	5	4	20 = High	Neg	Conserve and incorporate in new development
2	Loss of urban form due to changed subdivision patterns and form of new development	Local	1,4,5,7	Factor 4	Factor 2	8	3	4	12 = Medium to high	Neg	Conserve and incorporate in new development
3	Loss of social fabric due to urban renewal	Local	None	Factor 1	Factor 2	2	2	3	6 = Low	None	None
4	Loss of historical patterns of public access and use due to privatisation of public spaces or controlled public access	Site	None	Factor 1	Factor 2	2	2	2	4 = Low	None	None

ITEM	NATURE OF IMPACT	EXTENT	SITE NO'S	SEVERITY RATING (Intensity factor x duration factor = value = rating				PROBABILITY RATING	IMPACT SIGNIFICANCE RATING (Severity rating x Probability rating)	RISK CONS	RECOMMENDED MANAGEMENT INTERVENTIONS
				INTENSITY	DURATION	VALUES	RATING				
5	Loss of historical architectural character due to incompatible new treatment and use	Site	1	Factor 2	Factor 4	8	3	4	12 = Medium to high	Neg	Conserve and incorporate in new development
6	Loss of rural landscape pattern due to new pattern of subdivision and land use	Site	1,4,5,7	Factor 4	Factor 4	16	5	4	20 = High	Neg	Incorporate into memory of new layout
7	Loss of scenic landscape and network due to intrusive new infrastructure and severance of linkage routes	Local	None	Factor 4	Factor 5	20	5	5	25 = Very high	Neg	Mitigate negative visual impact, retain green zones/corridors, plant vegetation
8	Incompatibility of new development related to urban form, rural development, architectural character	Local	1,4,5,7	Factor 2	Factor 2	4	2	3	6 = Low	None	Incorporate into memory of new layout
9	Displacement of historical communities	Site	None	Factor 1	Factor 2	2	2	2	4 = Low	None	None (there are no historical communities affected)

ITEM	NATURE OF IMPACT	EXTENT	SITE NO'S	SEVERITY RATING (Intensity factor x duration factor = value = rating				PROBABILITY RATING	IMPACT SIGNIFICANCE RATING (Severity rating x Probability rating)	RISK CONS	RECOMMENDED MANAGEMENT INTERVENTIONS
				INTENSITY	DURATION	VALUES	RATING				
10	Loss of important historical features/elements including structures, planting patterns, furrows, open space networks related to upgrading and renewal schemes	Local	1,3,4,5,7	Factor 4	Factor 4	16	4	4	16 = Medium to high	Neg	Incorporate into memory of new layout, conserve and incorporate in new development
11	Visual impacts associated with siting and design of new facilities	Local	None	Factor 4	Factor 4	20	5	4	20 = High	Neg	Mitigate negative visual impact, retain green zones/corridors, plant vegetation
12	Impacts on buried structures and deposits related to new building work and infrastructure	Site	1,4,5	Factor 2	Factor 2	4	2	3	6 = Low to medium	Neg	Monitor uncovering of buried sites and objects
13	Loss of relationship with setting related to inappropriate siting of new development	Local	1,4,7	Factor 2	Factor 4	8	3	4	12 = Medium	Neg	Mitigate negative visual impact, retain green zones/corridors, plant vegetation, incorporate into memory of new layout

ITEM	NATURE OF IMPACT	EXTENT	SITE NO'S	SEVERITY RATING (Intensity factor x duration factor = value = rating				PROBABILITY RATING	IMPACT SIGNIFICANCE RATING (Severity rating x Probability rating)	RISK CONS	RECOMMENDED MANAGEMENT INTERVENTIONS
				INTENSITY	DURATION	VALUES	RATING				
14	Removal of historical fabric and meanings: misinterpretations of past associations and tendency to over-restore or reconstruct sites to earlier states	Site	1	Factor 2	Factor 5	10	4	3	12 = Medium	Neg	Conserve and rehabilitate/adapt historic structures
15	Different values in interpretation of heritage	Local	1,3,4,5,7,8	Factor 1	Factor 2	2	2	2	4 = Low	None	Public participation process for HIA
16	Disturbance of human remains in unmarked locations (unpredictability of presence)	Site	None	Factor 1	Factor 2	2	2	3	6 = Low	Neg	Monitor remains during construction work
17	Loss of human dignity associated with disturbance of human remains	Site	None	Factor 1	Factor 2	2	2	3	6 = Low	Neg	Monitor remains during construction work
18	Loss of respect for religious affiliations and practices	Site	3	Factor 2	Factor 3	6	3	2	6 = Low	Neg	Public participation process as part of HIA
19	Inappropriate memorialisation of human remains	Site	None	Factor 1	Factor 2	2	2	2	4 = Low	None	None

ITEM	NATURE OF IMPACT	EXTENT	SITE NO'S	SEVERITY RATING (Intensity factor x duration factor = value = rating				PROBABILITY RATING	IMPACT SIGNIFICANCE RATING (Severity rating x Probability rating)	RISK CONS	RECOMMENDED MANAGEMENT INTERVENTIONS
				INTENSITY	DURATION	VALUES	RATING				
20	Conflicting interpretations of events due to range of value systems	Local	None	Factor 1	Factor 2	2	2	2	4 = Low	None	Public participation
21	Over-exploitation of natural resources associated with traditional uses	Site	None	Factor 1	Factor 2	2	2	2	4 = Low	None	None
22	Visual intrusion of new development in historical spaces, axes, view corridors	Local	1,4,5,7	Factor 4	Factor 4	8	3	5	20 = Very high	Neg	Conserve memory of landscape patterns in new layout
23	Loss of historical context due to urbanisation	Site	1,7	Factor 4	Factor 3	12	4	4	16 = High	Neg	Conserve memory of landscape patterns in new layout
24	Inappropriate changes in use in contrast to regional character	Local	None	Factor 2	Factor 2	4	2	4	8 = Medium	Neg	Conserve and adapt farmstead to retain memory of original function

STANDARDIZED SET OF CONVENTIONS USED TO ASSESS THE IMPACT OF PROJECTS ON INDIVIDUAL HERITAGE FEATURES

Category of heritage significance of feature
One or more of the categories (a) to (i) in terms of Section 3(3) of the NHRA

From a heritage perspective there should be a distinction between significance embedded in the physical fabric, or in associations with events or persons, or in the experience of the place.

Conservation value of heritage feature (individual)
Worth, conservation utility, and desirability to conserve: low, medium, high

Duration of the impact

- Short term	1-5 years Factor 2
- Medium term	5-10 years Factor 3
- Long term	Risk will only cease after the operational life of the activity, either because of natural processes or by human intervention Factor 4
- Permanent (irreversible)	Mitigation, either by natural process or by human intervention, will not occur in such a way that the risk can be considered transient Factor 5

Extent of the impact
- On a site scale (not beyond the development)
- On a local scale (suburb, town)
- On a metropolitan or regional scale
- On a national or international scale

Impact significance rating

This is calculated by multiplying the **severity rating** with the **probability rating.**

The impact significance factor should influence the development project as described below.

LEVEL	RATING	POSITIVE RISK CONSEQUENCE	NEGATIVE RISK CONSEQUENCE
Low	4-6	No influence on proposed development	No influence on proposed development
Medium	7-12	Proposed development should be approved	Proposed development should be mitigated or mitigation measures should be formulated before it can be approved
High	13-18	Points towards a decision to approve the development and with	Points towards a decision to terminate development proposal or to formulate and

		enhancement in final design	perform mitigation to reduce significance level to at least low
Very high	19-25 and above	The development should be approved	If mitigation cannot be effectively implemented the development proposal should be terminated

Intensity of impact

- Low	Functions and processes of natural or human origin are not affected and only minor risks may occur Factor 1
- Medium	Natural or heritage environment is affected but functions and processes of natural or human origin can continue through often in an altered manner Factor 2
- High	Natural or heritage environment is affected to the extent that functions and processes of natural or human origin will temporarily or permanently cease Factor 4

Legal requirements:
Specific legislation and permit requirements that potentially could be infringed upon by the proposed project, if mitigation is necessary.

Nature of the impact
Impact of the activity (development) on a heritage resource with indications about its positive and/or negative effects. The statement of significance informs it. The nature of the impact may be historical, aesthetic, social, linguistic, architectural, intrinsic, associational, contextual (visual or non-visual) or a combination of the above.

Probability of the impact
Probability describes the likelihood of the risk actually occurring and is rated as follows:

- Improbable	Low possibility of risk to occur either because of design or historic experience Rating 2
- Probable	Prominent possibility that risk will occur Rating 3
- Highly probable	Most likely that risk will occur Rating 4

- Definite	Risk will occur regardless of any prevention measures Rating 5

Recommended management action:
For each impact, the recommended practically attainable mitigation actions that would result in a measurable reduction of the impact must be identified. This is expressed according to the following:

1. Avoidance: Preserve feature at all costs and restore/rehabilitate/enhance it together with interpretation
2. Mitigation: Preserve feature if possible, otherwise salvage excavation and/or documentation/recording before demolition/alteration, followed by preserving its memory in design and scale of development
3. None: No further action required

Severity rating

The severity rating is calculated from the multiplying the **intensity factor** with the **duration factor**, e.g. 2 x 3 = 6 (factor).

RATING	FACTOR
Low severity: rating = 2	Calculated values 2 to 4
Medium severity: rating = 3	Calculated values 5 to 8
High severity: rating = 4	Calculated values 9 to 12
Very high severity: rating = 5	Calculated values 13 to 16 and more
Severity factors below 3 indicate no risk	