

Ridge ecological assessment -

For the proposed South Hills development project on Erf 1202 South Hills, Portion 65 of the farm Klipriviersberg 106 I.R. and Holding 88 Klipriviersberg Estate, Gauteng.



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Purpose and Scope

To identify ecologically sensitive areas on and around the ridge with regards to fauna and flora, as well as abiotic factors on Holding 88 Klipriviersberg Estate, Portion 65 of the farm Klipriviersberg 106 I.R. and Erf 1202 South Hills. The effect of the proposed development on the ecological and recreational or cultural values of the ridge and surrounding areas is taken into consideration, and recommendations for mitigating such effects are provided.

Appointment of specialist

Animalia Zoological & Ecological Consultation CC was appointed by Thibane, Strydom & Associates to undertake a ridge ecological assessment on the site of the proposed development consisting of Holding 88 Klipriviersberg Estate, Portion 65 of the farm Klipriviersberg 106 I.R. and Erf 1202 South Hills in Gauteng. See Appendix A for details on the specialist.

Independence:

Animalia Zoological & Ecological Consultation CC has no connection with the developer. Animalia Zoological & Ecological Consultation CC is not a subsidiary, legally or financially of the developer; remuneration for services by the developer in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project.

TABLE OF CONTENTS

1. Introduction	
1.1 Study area	5
1.2 Land use and existing impacts on the site	8
1.3 Topography, climate and vegetation unit	9
2. Methods	11
2.1 Uncertainties, assumptions and limitations in the study	11
3. Results	12
3.1 Abiotic functionality of the ridge in the ecology	12
3.2 Ridge faunal biodiversity	13
3.3 Cultural and recreational value of the ridge	17
3.4 Ridge ecological sensitivity map	18
4. Effects of the proposed development and proposed mitigations and recommendations	20
4.1 Destruction of habitat and biodiversity	20
4.2 Additional rainwater runoff and erosion	20
4.3 Crime, vagrants and poaching	21
4.4 Illegal dumping	22
4.5 Alien invasive plants	22
5. Conclusion	24
6. References	26
Appendix A	29

INTRODUCTION

1.1 Study Area

The South Hills development site is in the grid squares 2628AA and 2628AC in Gauteng (figure 1, 2), with the centre point of S 26.250785° and E 28.077614° (decimal degrees). The study site is a total area of approximately 204ha.

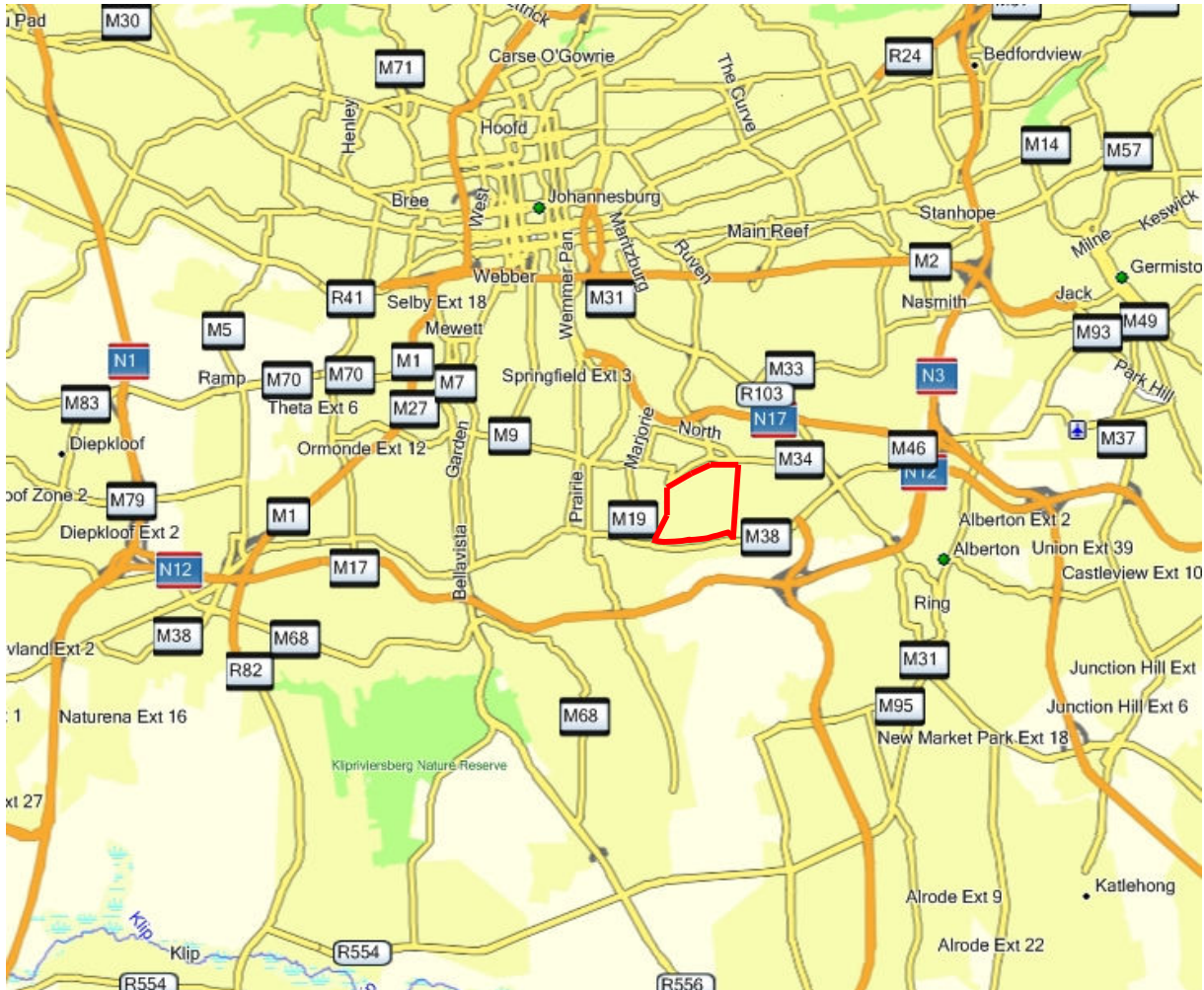


Figure 1: Road map with a rough indication of the proposed site locality (red outline).



Figure 2: Satellite image of the site with boundaries indicated. Note the dense populations of invader vegetation along the watercourse.

According to data obtained from the Gauteng Department of Agriculture and Rural Development (GDARD) in October 2009, the study site is inside the urban edge. Figure 3 illustrates features or areas designated under the Conservation Plan (C-Plan) for Gauteng (Version 2 of 2005, revised in 2007). A non-perennial river flows directly through the centre of

the site bisecting it to the west and east. Topographically the site holds a Class 3 ridge according to the Ridges v.6 shapefiles model, which stems from the southern border of the site and extends to the centre. The site contains areas identified as irreplaceable. These areas are deemed irreplaceable due to primary vegetation occurring on the site, Red List plant species confirmed, Red List plant metapopulations present on site and historical Red List plants found on the site.

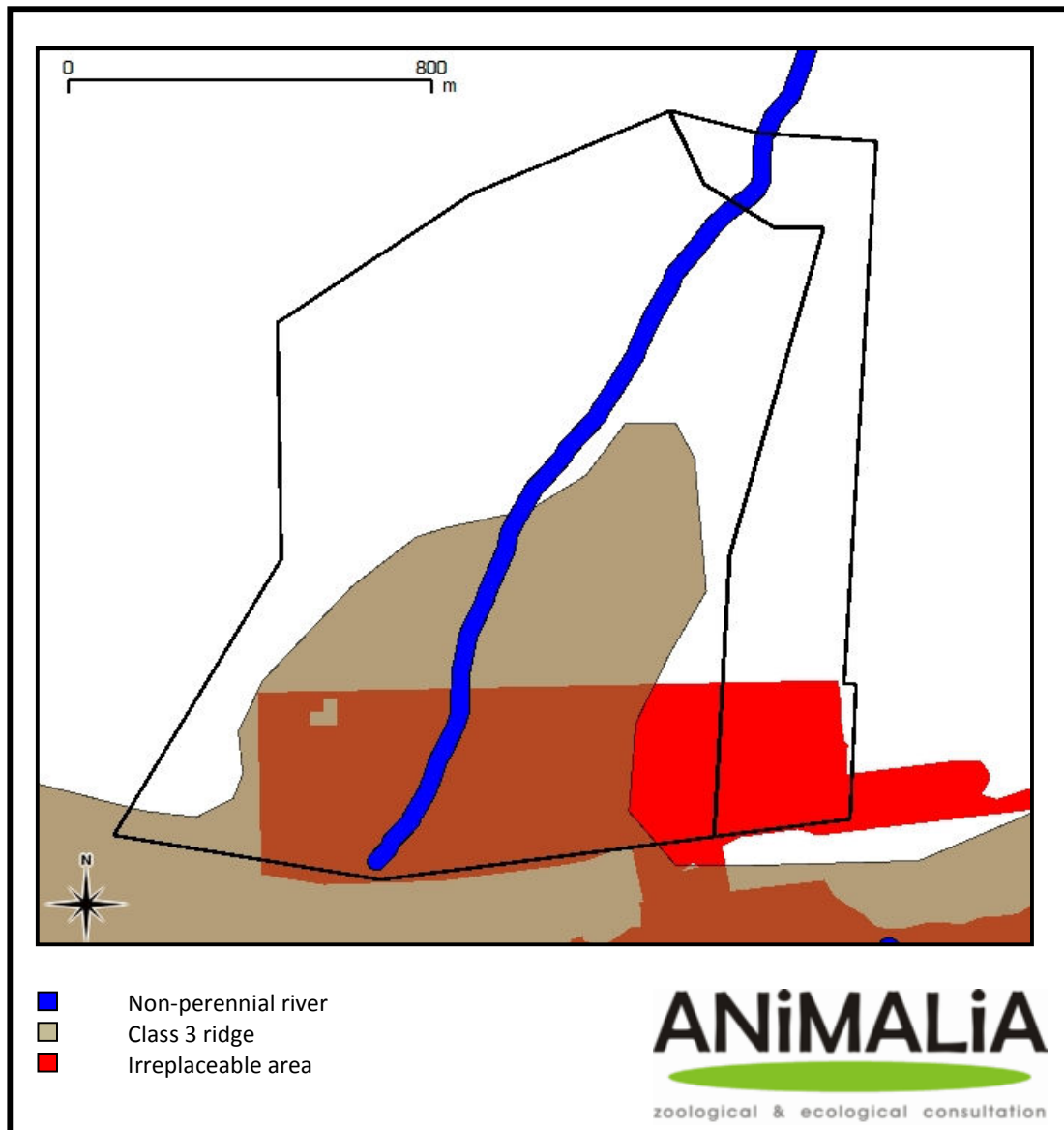


Figure 3: Desktop study map indicating the Class 3 ridge, non-perennial river and location of irreplaceable areas.

1.2 Land use and existing impacts on the site

Current land uses include a fenced off storage facility for domestic and garden refuse, two sports fields, a carwash, at least 20 shelters of squatters and open natural space.

Levels of impact on the site vary considerable in different areas of the site. Illegal dumping of building rubble and other waste is prevalent on Erf 1202 South Hills especially on the north-eastern parts of the Erf, this is due to an access road onto the site in this area. Litter around the waste storage facility is very prevalent and may be dispersed all over the site by the squatters and windy conditions. Although this litter can be cleaned up easier and have a lower impact on the veld than the mounds of building rubble on Erf 1202 South Hills.



Figure 4: Hunting dogs used by the vagrants to poach small game.

From an ecological point of view certain animals is impacted by poaching pressure from the squatters. This includes any animals of a suitable size such as the Helmeted Guineafowl, small antelope, tortoises, small carnivores, any other birds that may be caught easily. Hunting dogs is used by the vagrants to assist in capturing of food animals (figure 4).

Some of the rocky outcrops is impacted and dominated by alien invader stands of Black Wattle trees (*Acacia mearnsii*), the biodiversity on these rocky outcrops were less. Certain areas on the

hill slopes or in the grasslands have small clumps of Black Wattle potentially threatening the indigenous biodiversity. The watercourse is the most impacted by alien invaders and species of weeds associated with disturbed soil conditions.

Certain areas along this watercourse are eroded to a high degree. The main reason for this may be due to the fact that there is almost no undergrowth in the dense stands of Black Wattle and Bluegum trees which doesn't have the ideal root systems for stabilising topsoil, and when they are cut down (as is the case in some areas on the site) the erosion increases dramatically. Erosion on the ridge itself was very low.

1.3 Topography, climate and vegetation unit

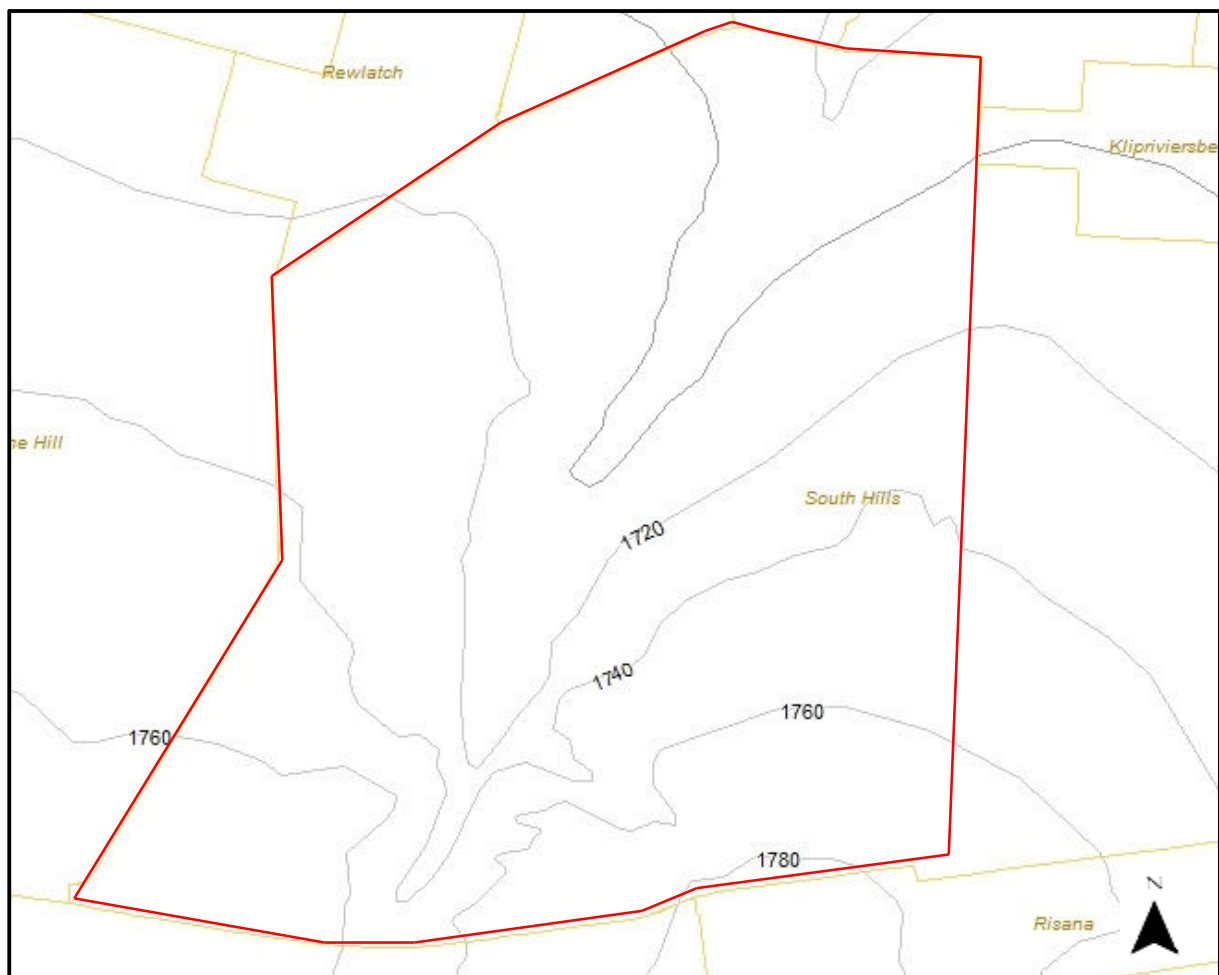


Figure 5: Contour map (20m) indicating the ridges on the southern part of the site and the valley bisecting the site.

According to the geohydrological report prepared by WSM Leshika (2009) the topography of the site varies from 1688 meters above sea level in the north, to 1787 in the south. The terrain rises to the south, with the highest point being the southeast corner. The terrain slopes steeply towards a first order stream that runs northwards through the middle of the property. This stream is ephemeral (storm-event driven), except in its lower reach. The property is part of Quaternary catchment C22B, which drains southwards via the Klipspruit, which enter the Vaal river at Vereeniging.

The dominating vegetation type of the broader area and the northern parts of the site is classified as the Soweto Highveld Grassland which is found in Gauteng and Mpumalanga. This bioregion has a Mean Annual Precipitation (MAP) of 662 mm, with large fluctuations between maximum summer and minimum winter temperatures and large diurnal temperature fluctuations with frequent frost occurrences; typical of a cool-temperate climate (Mucina & Rutherford, 2006).

The landscape is gently undulating on the Highveld plateau. In undisturbed areas only scattered wetlands or rocky outcrops may break the continuous grassland cover of short to medium-high tufted grasses. In general the dominating grass species of the vegetation unit are *Themeda trianda*, *Elionurus muticus*, *Eragrostis racemosa*, *Heteropogon contortus* and *Tristachya leucothrix*.

The conservation status of this vegetation type is currently classified as Endangered, with a target of 24% to be conserved of which only 0.2% is formally conserved in reserves, with only 52.7% still remaining (Mucina & Rutherford, 2006).

The vegetation unit of the southern ridge part of the site is classified as Andesite Mountain Bushveld forming part of the greater Savanna biome. Currently this vegetation unit is classified as Least Threatened and 85% are unmodified with 6.8% formally protected in reserves. But biodiversity are usually high in such rocky habitats (Mucina & Rutherford, 2006). Refer to the relevant vegetation assessment conducted end of November 2009 for a more detailed description of the vegetation.

The geology and lithology of the general area can in short be described as conglomerate and andesite of the Pretoria Group and theoleitic basalt from the Kliprivierberg Group. The soils are mostly shallow rocky soils of mainly Mispah and Glenrosa forms (Coetzee, 1986; Mucina & Rutherford, 2006).

1. Methods

The on-site visits was conducted on 19, 13, 14 October 2009 and 24 November 2009. Ecological aspects were noted with all site visits. Regarding the biodiversity component of the ridge, host plant species of possible Protected butterflies were searched for. The basic habitat types on the site were identified for comparison of literature described habitats that are suitable for red data species. Spoor and dung were investigated, and bio-acoustics were used to scan for Red Data bird species. On foot transects through the site and over the ridges were done throughout the survey.

2.1 Uncertainties, assumptions and limitations in the study

When surveying animals long periods of time are usually required, up to weeks or months of continuous trapping in the case of many small mammals. Due to time constraints such long periods of trapping was impractical and therefore trapping was totally excluded from the survey. The fact that most fauna evade humans, that nocturnal surveys were unfavourable and that Red Data species are scarce therefore not easily encountered, made the approach of estimating a probability of occurrence for important species more favourable. Crime and safety risks hindered nocturnal surveys.

2. RESULTS

3.1 Abiotic functionality of the ridge in the ecology

This ridge play a vital role in supplying water to the non-perennial stream, it is part of Quaternary catchment C22B (Sami, 2009), which drains southwards via the Klipspruit and enter the Vaal river at Vereeniging. The steep slopes and geohydrology of the ridge determines the volume of water discharge into the non-perennial stream, which in turn supports the sensitive and important wetland and riparian zones.

The geology of the ridge gives rise to large rocks and boulder like structures, with many crevices, gaps and hollows between them. Such large rocks provide invaluable and irreplaceable shelter to many plants and animals, either from harsh environmental conditions or predators. The fact that fire usually doesn't enter between the crevices of rocky boulders and tends to move swiftly in the grasslands, makes rocky ridges ideal habitat for more fire sensitive species of fauna and flora. Also, microclimates are created in between or behind large rocks where the amount of sunlight is limited and moisture tends to persist longer; something that won't be found in featureless grasslands.

3.2 Ridge faunal biodiversity

Table 1: Species of conservation concern that may occur on the site, and their “Probability of Occurrence” (POC) estimated on grounds of the characteristics of available and suitable habitat (Stuart & Stuart, 2001; Sinclair, *et al.*, 2002; NEMIBA, 2004; Skinner & Chimimba, 2005; Government Gazette, 23 February 2007; SANBI, 2009; GDACE, 2009).

CR = Critically Endangered; **EN** = Endangered; **VU** = Vulnerable; **NT** = Near Threatened; **PR** = Protected

Common name	Genus and species	POC	Suitable habitat / Rational	Conservation status
Mammals				
Rough-haired Golden mole	<i>Chrysospalax villosus</i>	Low	Prefer dry, sandy grassland on the fringes of marshes and wetlands. The grasslands around the wetland/riparian area is mostly rocky due to ridge catchment area.	CR
Juliana’s golden mole	<i>Neamblysomus julianae</i>	Low	Prefers sandy soil bushveld and grassland with rocky outcrops. Endemic to Savanna biome. Very improbable in northern part of site.	VU
South African Hedgehog	<i>Atelerix frontalis</i>	High	Especially in the ridge and rocky outcrop areas where dry cover and shelter is readily available.	PR
Black-footed cat	<i>Felis nigripes</i>	Very low	Bordering distribution range. But prefers arid open terrain with shrub cover. Utilizes burrows dug by other mammals, no such burrows observed.	PR
Spotted-necked otter	<i>Lutra maculicolus</i>	Low	Prefers larger rivers and large permanent pools. But possible to wander upstream and utilise the wetland on the northern part of the site	PR
Cape fox	<i>Vulpes Chama</i>	Very low	Prefers open grassland, but with <i>Acacia</i> thickets. Hunting pressure from hunting dogs severe.	PR
White tailed mouse	<i>Mystromys albicaudatus</i>	High	Follow Grassland biome closely, but have been recorded on rocky ridges with good grass cover and crevices. May occur over most of the site, especially <u>around</u> the rocky ridges	EN
Birds (GDARD Priority Red List Species)				
Blue crane	<i>Anthropoides paradiseus</i>	Very low.	Large wetlands and associated moist grasslands. Wetland area on the site is small and surrounding grasslands is dry hill slopes.	EN

Black stork	<i>Ciconia nigra</i>	Low	Seek food in streams and manmade dams. Solitary. Stream on southern part of site is ephemeral, small wetland pond in northern part most probable habitat.	VU
Blue korhaan	<i>Eupodotis caerulescens</i>	Medium	Open short grassland such as found in the upland areas of the site. Probably under high hunting pressure from vagrants.	VU
White-bellied korhaan	<i>Eupodotis barrowii</i>	Low	Open grassland, but prefers higher grass than other species of korhaan. Grass on site is relatively short.	Unspecified
Lesser Kestrel	<i>Falco naumanni</i>	Very high	Hunts over open grassland and roost in high trees in urban areas. The high Bluegum trees and open grassland on the site makes probability of this species very high. Frequent summer visitor to the region, therefore damage to suitable habitat locally will affect species populations elsewhere.	VU
African Marsh Harrier	<i>Circus ranivorus</i>	Medium	Wetlands, waterlogged grasslands and surrounding areas. The Wemmerpan is situated approximately 2km's to the north west of the site, where this species may be active. Therefore occasional visits to the wetland area on the site may occur.	PR
Martial Eagle	<i>Polomaetus bellicosus</i>	Low	Mostly associated with Savanna, but occupies a wide variety of habitats.	VU
Secretary bird	<i>Sagittarius serpentarius</i>	Very low	Open grassland and Savanna. Within the distribution range but unlikely to occur on site due to hunting pressure and human disturbance.	NT
Invertebrates (GDARD High priority species)				
	<i>Lepidochrysops praeterita</i>	Low	Host plant species <i>Becium obovatum</i> confirmed on site in the grassland areas around the ridge. But species seems to be limited to the Walkerville – Glenharvie - Potchefstroom ridge system. Previously recorded from grid square 2628AC (GDACE, 2009).	IUCN Red List
	<i>Aloeides dentatis</i> (Roodepoort type)	Very high	Grassland, flat and mostly rocky terrain. Previously recorded from grid square 2626AC. Ridge is potential habitat.	IUCN Red List
	<i>Aloeides dentatis</i> (Suikerbosrand type)	Very high	Grassland, flat and mostly rocky terrain. Previously recorded from grid square 2626AC. Ridge is potential habitat.	IUCN Red List
	<i>Metisella meninx</i>	High	Grasslands and wetlands. Occur throughout the entire province.	IUCN Red List

	<i>Orachrysops mijburghi</i>	Medium	Grasslands and rocky ridge terrain. Previously recorded in other 2628 grid squares	IUCN Red List
	<i>Chrysoritis aureus</i>	Medium	Grasslands and rocky ridge terrain. Previously recorded in other 2628 grid squares	IUCN Red List

National Environmental Management Act (NEMBA) regulations on Threatened and Protected Species

The National Environmental Management: Biodiversity Act (No. 10 of 2004), (NEMBA) was signed into law in mid-2004 and entered into effect on 1 September, 2004. The Act provides for the consolidation of biodiversity legislation through establishing national norms and standards for the management of biodiversity across all sectors and by different management authorities. Chapter 4, Part 2 of the Biodiversity Act provides for listing of species as threatened or protected. If a species is listed as threatened, it must be further classified as critically endangered, endangered or vulnerable. The Act defines these classes as follows:

- **Critically endangered species:** any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered species:** any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- **Vulnerable species:** any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- **Protected species:** any species which is of such high conservation value or national importance that it requires “national protection”. Species listed in this category will include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Other birds confirmed on the site

A light form of the Black Sparrowhawk (*Accipiter melanoleucus*) was observed to nest in a high Bluegum tree along the watercourse (figure 6).



Figure 6: Black Sparrowhawk in its light form and its nest that was a few meters away from the perch.

Also noted the following:

Common Quail	(<i>Coturnix coturnix</i>)
Helmeted Guineafowl	(<i>Guttera edouardi</i>)
Hadedda Ibis	(<i>Bostrychia hagedash</i>)
Cape Sparrow	(<i>Passer melanurus</i>)
Southern Red Bishop	(<i>Euplectes orix</i>)
Southern Masked Weaver	(<i>Ploceus velatus</i>)
Black-chested Prinia	(<i>Prinia flavicans</i>)
Crested Barbet	(<i>Stactolaema olivacea</i>)
Crowned Lapwing	(<i>Vanellus coronatus</i>)
African Wattled Lapwing	(<i>Vanellus senegallus</i>)

Common Baboon Spiders (*Harpactira* sp.) was confirmed nesting in burrows in the western grassland area.

3.3 Cultural and recreational value of the ridge

Local religious gatherings have been noticed comprising of less than 20 people at set gathering points clearly marked with white (figure 7). No impacts on the environment due to these gatherings could be found, and the ceremonies seemed to be more popular in the ridge area in the south eastern part of the site (figure 8). Similar gathering points were also noted closer to the surrounding roads but appeared neglected.



Figure 7: A religious gathering point on the ridge.



Figure 8: Some individuals practicing their religion in the nature surroundings of the ridge.

3.4 Ridge sensitivity map (consolidated with wetland and riparian sensitivity; refer to the latest vegetation assessment for floral sensitivity)

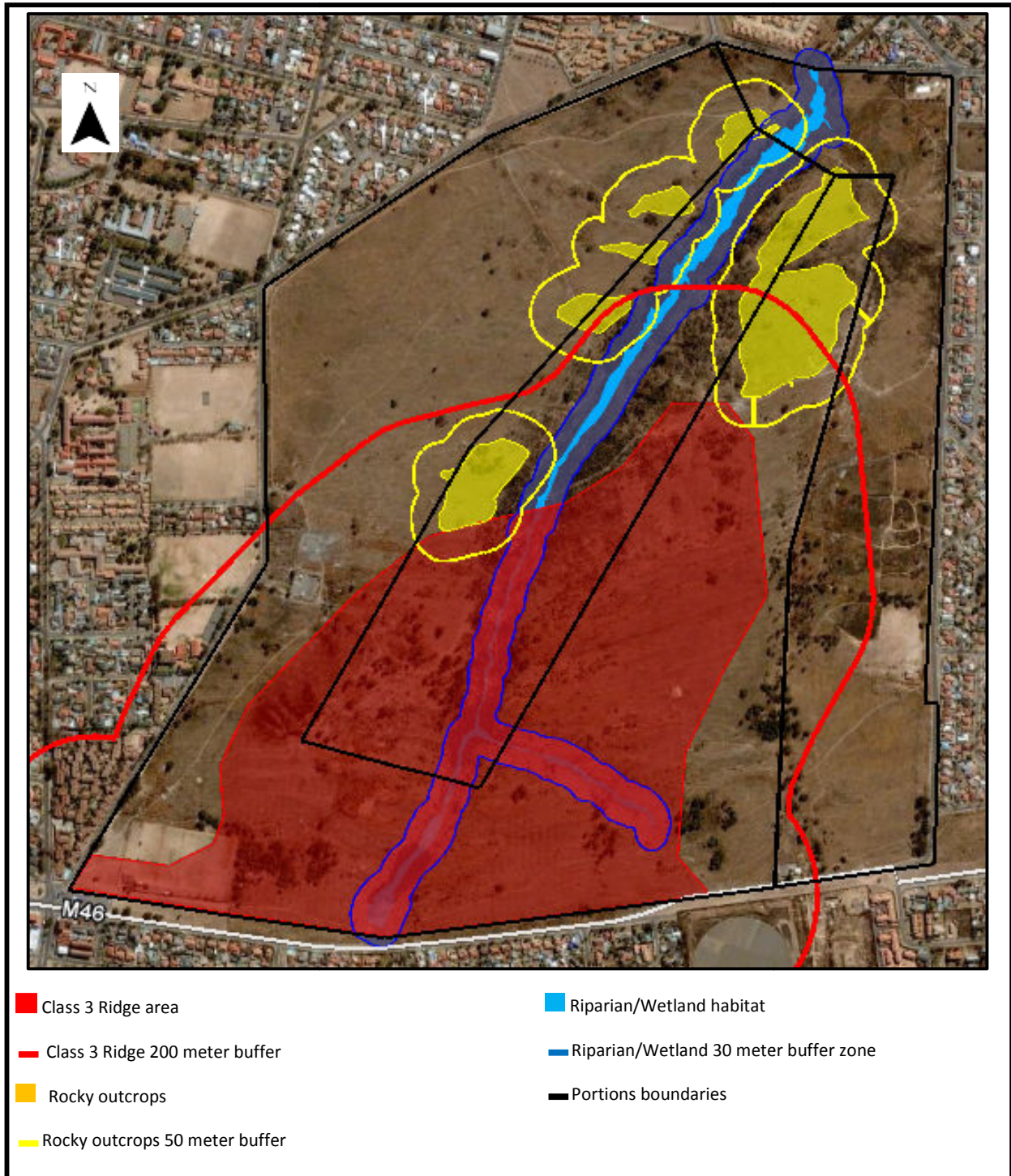


Figure 9: The sensitivity features and their buffers of the ridge ecological assessment and riparian/wetland delineation.

In the sensitivity map (figure 9) buffer zones are governed and motivated by several factors.

The Class 3 ridge is designated as sensitive and a 200 meter buffer zone applied. The ridge and surrounding grassland is potential suitable habitat for the Protected lepidopteran *Aloeides dentatis dentatis*, as well as high biodiversity of fauna (see table 1), and therefore the demarcated sensitivity and buffer is governed by the following:

- i) Gauteng Department of Agriculture and Rural Development (GDARD) – Minimum Requirements for Biodiversity Assessments (November 2009):

“All ridges must be designated as sensitive.”

“Where the interface between the lower slopes and adjacent land is deemed important for certain species, a buffer zone of 200m must be mapped and designated as sensitive.”

For *Aloeides dentatis dentatis* habitat: “A buffer of 200 meter wide within the urban edge.”

A 200m buffer zone for Class 3 ridges containing habitat suitable for important/rare fauna must be designated as sensitive.

Wetlands and riparian habitats are considered to be sensitive according to GDARD, DWAF and according to the National Water Act.

- i) The GDARD document is quoted, as follows: “*The wetland and a protective buffer zone, beginning from the outer edge of the wetland temporary zone, must be designated as sensitive. Rules for buffer zone widths are as follows:*
 - a. **30m** for wetlands occurring inside the urban edge”
- ii) The GDARD document is quoted, as follows: “Riparian zones and buffer zones must be designated as sensitive”. Rules for buffer zone widths are as follows:
 - **32m** for riparian areas occurring inside the urban edge.

The rocky outcrops and their 50 meter buffer zones are demarcated as sensitive due to the ability of these habitats to sustain high levels of biodiversity and provide refuge as well as corridors for many species on the site. Additionally these habitats may be suitable for South African Hedgehog (*Atelerix frontalis*) by providing dry shelter and coverage from predators. *A. frontalis* is an active foraging animal and requires enough space to search for its food (invertebrates, mice, lizards, fungi, certain fruits) sustaining its high metabolism (Skinner & Chimimba, 2005). Therefore a buffer zone of 50 meters has been demarcated.

4. EFFECTS OF THE PROPOSED DEVELOPMENT and PROPOSED MITIGATION MEASURES AND RECOMMENDATIONS

4.1 Destruction of habitat and biodiversity

If the proposed development would be allowed to extent too close to the sensitive habitats it would affect the biodiversity associated with these habitats negatively, if a ridge habitat is destroyed many species of fauna and flora that is adapted to live specifically on ridges will be lost in that area. The grassland parts of the site are equally important to the ecology of the entire site. If all the grassland areas on the site are destroyed the remaining ridge and rocky outcrop areas would be cut off from other natural areas causing fragmentation of habitats. According to Caro (1998) the fragmentation of habitats into small isolated patches, is directly associated with a decline in the numbers of the isolated animals.

Proposed mitigatory measures or recommendations

The buffer zones indicated in the sensitivity map (figure 9) must be strictly adhered to, and the areas covered by the buffers be treated as environmentally sensitive. No vehicles, storage of building materials or rubble, construction or landscaping are allowed in the sensitive and buffer areas. The sensitive areas as well as their buffer zones are provided in shapefiles accompanying the report.

If electric fencing are installed on any boundary wall/fence next to the watercourse it is recommended that small (tennis ball sized) bright coloured plastic markers be attached to the top strand of the electric fence. This is to prevent water birds, Ibis for example, and other less agile species flying into the electric fence which may be camouflaged in the upward sloping background of the hill slopes.

4.2 Additional rainwater runoff and erosion

Natural seepage through the soils and grassy habitat of the site delays water discharge into the stream. But the proposed development collectively contains large areas of impermeable surfaces like paving and roofs. This will result in an increased runoff of rainwater into the stream, contributing to the already problematic and hazardous “flash floods” occurring in urban areas after heavy summer rain storms.

Proposed mitigatory measures or recommendations

The demarcated buffer zones will keep the catchment area of the watercourse permeable for rainwater and subsurface flow. If any impermeable surfaces are present, then storm water runoff and subsurface seepage under the development site should be strictly managed and allowed to seep away gradually into the stream. Energy dissipaters in the form of attenuation ponds, gabions, grass blocks or other suitable structures must be installed. Stormwater may not be released directly into the watercourse or the buffer zone as specified in GDARD (2009). A storm water management plan **must** address this problem, with proposed mitigations for the construction as well as operational phases of the development. Such a plan **must** also address the problem of erosion.

4.3 Crime, vagrants and poaching

The crime risk is very high on this site. The fact that the site is surrounded by urban development, and that most parts of the site is not easily accessible or visible from the surrounding suburbs, makes it a suitable area for criminals to take refuge (figure 10). Apart from the obvious safety risks involved for the nearby residents, the crime also hinders much needed processes such as cleaning up of the area from litter, thorough biodiversity assessments (such as nocturnal surveys). During the field survey in October 2009 two botanists and a security guard accompanying them was held at gunpoint and robbed of some belongings.



Figure 10: A large kitchen knife found on the site, typical of the type that are dumped after use in a robbery.

The vagrants residing on the site is adding to the safety risk of the area and impacts negatively on the ecology. Litter is very abundant around their shelters and the surrounding areas are

accidentally set alight by fires frequently. The pressure of poaching by the vagrants on small game is severe with over 20 shelters scattered all over the site.

Proposed mitigatory measures or recommendations

The open space areas demarcated as sensitive and their buffers have potential to be included in an urban ecological park area suitable for recreational purposes. The existing impacts on the site may be mitigated and managed, and the area rehabilitated to support high levels of biodiversity. Hiking trails, resting/picnicking areas and areas with bird watching hides (e.g. at wetland pond) are possible uses for such an ecological urban park. Although these areas must be patrolled on a regular basis by police officers or armed security guards to render them safe enough for public access. Such a constant presence of law enforcing officials will render the site less suitable for refuge by criminals. Erecting a fence with controlled access around the open space and natural areas will prevent access of vagrants and criminals into these areas.

4.4 Illegal dumping

Dumping of building rubble and domestic waste impacts heavily on a veld ecosystem since all plants under the rubble heaps may die off. Furthermore, the chemical composition and PH of the soil under and around the heaps may be changed by pollutants and/or toxins seeping downwards. When some types of waste are set alight by veld fires they may burn with a high heat and sterilize the soil underneath the heap completely, destroying the micro-organisms present in healthy soils.

Proposed mitigatory measures or recommendations

No access roads onto sensitive and open space areas must be present and such areas must be fenced off. If no vehicles can access an open space area then the probability of dumping is less.

4.5 Alien invasive plants

This is an already occurring problem on the site and its riparian habitat. The municipality or developer is responsible for eradicating the alien invader plants occurring on site and in the riparian habitat. Practical methodologies for the eradication of alien invader plants should be included in a document giving clear guidelines on the process and handed over to the local municipality, or developer and future managing agents if a development would go on. Specific

details and environmental issues regarding eradication of the alien invaders should be addressed in a relevant Ecological Management Plan.

It is important to note that the Black Sparrow Hawk observed on the site was utilising big alien Bluegum trees as nesting space (figure 6), therefore the Ecological Management Plan must consider this and alien invaders should be cut down selectively.

5. CONCLUSION

In conclusion the areas designated as sensitive and their respective buffer zones must be treated accordingly. No vehicles, machinery, storage, structures, construction or landscaping are allowed in the sensitive and buffer zones. The demarcated sensitive areas are essential for the functionality of the ecology on the site and the safe guarding of the biodiversity present. It should be noted that the sensitivity map (figure 9) is excluding the vegetation and Red Data plant sensitivity; refer to the relevant vegetation assessment (of beginning December 2009) for a vegetation sensitivity map. The vegetation sensitivity map and figure 9 must both be followed and adhered to with equal respect.

The ridge has a high ecological and aesthetical value in the surrounding as well as downstream areas, and the potential for utilising this site as an urban ecological park is high. Although the security of residents are at stake on the ridge, and this needs to be managed.

It is strongly recommended that a Rehabilitation Plan be drafted, and incorporated into the relevant Ecological Management Plan to rehabilitate the watercourse and surrounding areas from ongoing deleterious impacts by large communities of alien invader trees and severe erosion, whether development on the site will go on or not.

Take note:

- The current environmental management on the site is **insufficient** and will not result in long term ecological sustainability of the site; vagrant, poaching, alien vegetation and erosion impacts will eventually cause degradation of the site ecology and sensitive features.
- Management of the ecology and biodiversity on the site **must** be improved.
- A long term environmental management program must be implemented to sustainably conserve the ecologically sensitive features on the site.

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Appendix A

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- **Initiation of PhD (Biodiversity and Conservation) - 2009**
- **MSc (Biodiversity and Conservation) - 2008**
 - The potential of using insectivorous bats (Microchiroptera) as a means of insect pest control in agricultural areas.
- **Hons (Biodiversity and Conservation) - 2006**
 - Research project: Preliminary study of the terrestrial Arthropoda associated with bat guano in caves of the Cradle of Humankind World Heritage Site
- **BSc (Zoology and Botany) – 2005**

- *Attended the Terrasoil Wetland Delineation and Soil Classification Course*

Affiliations to professional bodies and societies

- International Association for Impact Assessment – South Africa (IAIAsa)
- Zoological Society of Southern Africa (ZSSA)
- Entomological Society of Southern Africa (ESSA)
- Society for Conservation Biology (SCB)
- Herpetological Association of Africa (HAA)
- Bat Conservation International (BCI)
- Serving on the research committee of the Gauteng and Northern Regions Bat Interest Group (GNoRBIG).
- Pending Pr.Sci.Nat. – SACNASP (Ecology)

Experience

Animalia Zoological & Ecological Consultation CC

- Wetland delineation for the proposed Coolbreeze development on the farm Spaarwater, Ekurhuleni.
- Wetland delineation for the proposed development on the farm Witpoortjie 231R, Ekurhuleni, Gauteng.
- Riparian development for a proposed township in Rembrandt Park Ext. 13.
- Riparian delineation for the proposed township on Portion 571 in Boschkop 199 I.Q.
- Specialist survey of wetland mammals on Kookfontein farm, Vereeniging.
- Specialist survey of amphibians in the Sasolburg area.
- Specialist survey of reptiles in the Kibler Park area, Gauteng.
- Freelance consultation on artificial housing of bats and bat house design.
- Cave specialist study for a proposed water pipeline in Laudium, Gauteng.
- Cave specialist study for the Apies River: Fountains Access project in Pretoria.
- Ecological study for the proposed Coolbreeze development on the farm Spaarwater, Ekurhuleni.
- Specialist survey of Bullfrog (*Pyxicephalus adspersus*) in Rynfield, Benoni.
- Specialist bullfrog rehabilitation plan compilation for a stand in Rynfield, Benoni.
- ESO of bullfrog rehabilitation process.
- Specialist study of Bullfrog (*Pyxicephalus adspersus*) in Withok Estates, Brakpan.
- Specialist reptile study for Janho Quarry in Gauteng.
- Ridge Ecological assessment for Portion 44 of Elandsfontein 352 JR.
- Specialist Reptile assessment for the Founders Community School project on Portion 44 of Elandsfontein 352 JR.