BASIC ASSESSMENT OF THE PREDICTED IMPACT OF THE SHANGONI INITIATIVE, (KRUGER NATIONAL PARK) ON VERTEBRATES AND THEIR HABITATS

by

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Commissioned by Envirolution Consulting on behalf of SANParks

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DECLARATION OF PROFESSIONAL STANDING AND INDEPENDENCE:

We,

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Jacobus Casparus Petrus van Wyk (SACNASP # 400062/09)
Michelle Leigh Thompson (SACNASP registration pending)
declare that we:

- hold higher degrees in the biological sciences, which allowed registration by S.A. Council for National Scientific Professions (SACNASP) as Professional Zoologists that sanction us to function independently as specialist scientific consultants;
- declare that as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003 this project was our own work from inception and reflects exclusively our observations and unbiased scientific interpretations, and executed to the best of our abilities;
- abide by the Code of Ethics of the SACNASP;
- are committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas we appreciate opportunities to learn through constructive criticism and debate, we reserve the right to form and hold our own opinions within the constraints of our training, experience and results and therefore will not submit willingly to the interests of other parties or change our statements to appease or unduly benefit them
- are subcontracted as specialist consultants for the project "Basic Assessment of the Predicted Impact of the Shangoni Initiative, (Kruger National Park) on Vertebrates and Their Habitats", as described in this report;
- have no financial interest in the proposed development other than remuneration for the work performed;
- do not have, and will not have in the future, any vested or conflicting interests in the proposed development;
- undertake to disclose to the consultant and its client(s) as well as to the competent authority any material information that may have the potential to influence any decisions by the competent authority, as required in terms of the Environmental Impact Assessment Regulations 2006;
- reserve the right to only transfer our intellectual property contained in this report to the client(s), (party or company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, we recognise that written consent from the client will be required for any of us to release of any part of this report to third parties.
- In addition, remuneration for services provided by us is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorising this proposed project.

I.L. Rautenbach J.C.P. van Wyk A.E. Mckechnie M. Thompson

DISCLAIMER:

Even though every care is taken to ensure the accuracy of this report, faunal and environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are made, to some extent, on reasonable and informed assumptions built on *bona fide* information sources, as well as deductive reasoning. A more factual report, based on field collecting and observations, can only be derived over several years and seasons of research, to account for fluctuating environmental conditions and animal migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. The vertebrate team can therefore not accept responsibility for conclusions and mitigation measures, made in good faith, based on own databases, and on the information provided at the time of the directive. Although the authors exercised due care and diligence in rendering services and preparing documents, they accept no liability and the client, by accepting this document, indemnifies the authors against all actions, claims, demands, losses, liabilities, costs, damages and expenses that arise from or in connection with services rendered, directly or indirectly, by the authors and use of this document. This report should therefore be viewed and acted upon with these limitations in mind.

EXECUTIVE SUMMARY

The conservation status of the study area to be affected by the development and adjacent land is rated as **Medium-*High,*** *i.e. Land where sections are disturbed but that is still ecologically sensitive to development/disturbance*. The numerical significance (impact) values for the tourist amenities and for the upgraded road fall within the Moderate Environmental Significance class, in the case of public amenities only marginally.

In order not to risk disturbances to three breeding vulture pairs by noise and movements in a public amenity, we recommend that the southern sites in the vicinity of the vulture nests are not considered for development. However, the five northern sites (Original Picnic Site, the Tented Camp Alternative 1, the Picnic Site Alternative 2, Picnic Site Alternative 1, and Camping Site Original) can be developed in any combination for any of the three stated purposes.

Runoff water from the upgraded road will be managed as on other roads in the Kruger Park, which is rated as adequate.

The conservation status of no vertebrate species will be jeopardized, given allowances for the three vulture nests.

Servicing eco-tourism is one of SANParks two main mandates. It is therefore heartening that resting / overnight amenities will be considered when straddling riparian zones and mopane woodland – the first as an allowance to eco-tourism attraction and the latter for siting ablutions. Damage in the riparian zones will be minimal since no large trees will be removed and understory is underdeveloped. It is suggested that a 'light footprint" development regime is applied with easily rehabilitated developments (viz. rustic structures, grass-brick paving) and decisive respect for mature trees. However, the SANParks notion that campers will park their vehicles some distance from their camping site is not client-friendly; for vacationing visitors a vehicle is akin to a mobile suitcase with headlights – there is always something required in the vehicle, apart from locking valuables. There is also the imperative of providing for campers with rooftop tents. SANParks is encouraged to plan around this visitor imperative.

Nowhere will sensitive ecosystems or ecological services be affected.

It is concluded that the impact of the development will be negligible. The footprint of the gate and reception / educational facilities will be small (each < than one hectare). The fenced sites for the picnic site, tented rest camp and camping will be respectively < 3 hectares. Collectively these will spatially be insignificant when measured against the total landmass of the entire park, apart from the fact that environmental damage will be limited to land-clearing of brush and undergrowth. The upgrade of the existing roads road will slightly increase its impact, and rehabilitate the blacktop surface will be more extensive, should that will ever be an issue. The existing road (and by implication the upgraded road under contention) does not impinge on the riparian zone, but generally no buffer zone outside the edge of the riparian zone is allowed. This is interpreted as being in the best interests of clients to maximize sightings of wildlife.

The new short road alignment close to the to-be-constructed high-water bridge will be short and will traverse shrub mopane. This imperative is considered to be minor.

It is contended that the proposed development will be in line with SANPark's commitment to its clients and will not detract significantly from its conservation mandate.

1. INTRODUCTION

We were commissioned by Envirolution Consulting (on behalf of the S.A. National Parks Board) to conduct a basic assessment of the predicted environmental impact of a new access gate and associated ecotourism desiderata in the Shingwedzi / Gyiani district. The project will entail a new access gate to the Kruger National Park, a high water bridge, a reception / education building, a picnic site, a tented camp, a camping terrain, and a 50km road upgrade to connect the access gate with the H1-6 Road between Shingwedzi and Mopane Rest Camps (the [study] site).

Primarily this report focuses on the reigning status of threatened and sensitive vertebrates concluded to occur on and along the proposed development cluster and whose conservation status should be considered in the decision-making process. The report also remarks on sensitive ecosystems and/or services. In addition, special attention is paid to the qualitative and quantitative habitat conditions for Red Data species deemed present on the site and mitigation measures to ameliorate the effect of the proposed development. The secondary objective of the investigation is to compile a complete list of vertebrate species richness of the study area. The predicted impact of the development on species richness and habitat quality is discussed.

2. ASSIGNMENT – Protocol

This assignment is in accordance with the 2014 Environmental Impact Assessment (EIA) Regulations No. R. 982 (Department of Environmental Affairs and Tourism, 18 June 2010) emanating from Chapter 5 of the National Environmental Management Act, 2004 (Act No. 10 of 2004).

The project is interpreted as follows: Compile a scholarly report of the vertebrate fauna and habitats of the site, with emphasis on Red Data species and any critical ecosystems that may occur on / along the site. In order to compile this information, we had to define the extent and conservation condition of the major habitat types and to test the environmental feasibility of these locations:

2.1 Initial preparations:

Obtain all relevant maps and information on the natural and disturbed environments of the area under scrutiny, including on Red Data vertebrate species that may occur within the areas to be affected.

2.2 Faunal assessment

- Compile lists of the vertebrates that can be expected in the area and highlight Red Data species.

- Assess the quantitative and qualitative condition of suitable habitat for the Red-listed vertebrates that may occur in the area.
- Express an opinion pertaining to the conservation status of the Red Data species and their habitats.

2.3 General

- Identify and describe particular ecologically sensitive areas.
- Identify problem areas in need of special treatment or management, e.g. areas with bush encroachment, erosion, water pollution, degradation or reclamation.
- Make recommendations on aspects that should be monitored during development.
- Calculate and comment on significance ratings for the proposed development.

3. RATIONALE

Environmental conservation is no longer the prerogative of vocal left-wing 1960s-style green activist NGOs. Instead it is now universally appreciated that a rapidly-growing and more demanding human population is continuing to place exponential stress on the Earth's resources with irredeemable costs to ecosystems. It is also recognized that ecosystems are in fact nature's 'engine room' to manufacture fundamental life-support products for plants, animals and humans. Environmental degradation ranges from mega-problems such as global warming, demand for power, land-use practices to smaller-scale issues such as indiscriminate use of household chemicals.
The new conservation awareness is settling at all levels ranging from consumers, school curricula, communities to governments. This new consciousness is typified by vigorous debate and empathy, and sometimes by decisiveness (viz. new legislation).

In South Africa a number of acts and regulations call developers (and by implication consumers), the scientific community and conservation agencies to task to minimise environmental impact. These include:

The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996),
The Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983),
The Environmental Conservation Act, 1989 (Act No. 73 of 1989),
The National Environment Management Act, 1998 (Act No. 107 of 1998) as amended in 2010,
The National Environmental Management Biodiversity Act, 2004. (Act 10 of 2004),
The National Environmental Management Biodiversity Act, 2004. (Act 10 of 2004), Draft List of Threatened Ecosystems. Government Gazette RSA Vol. 1477, 32689, Cape Town, 6 Nov 2009,
The National Environmental Management: Waste Act [NEM:WA] (Act 59 of 2008),
The National Forests Act, 2006 (Act 84 of 1998 as amended in 2006),
The National Heritage Resources Act, 1999 (Act No. 25 of 1999),
The National Environmental Management: Protected Areas Act (Act 57 0f 2003),
The Mineral and Petroleum Resources Development Act 28 of 2002,
The National Water Act, 1998 (Act No. 36 of 1998), and
The Environmental Impact Assessment Regulations Notice 733 of 2014.

The conduct of natural scientists is directed by The Natural Scientific Professions Act (Act 27 of 2003). Nowadays a development prerogative is to precede new constructions by a multidisciplinary environmental investigation to assess the conservation costs. This is to ensure that best conservation practices are applied during the planning, construction and operational phases of new developments.

3.1 Background: Ecological impacts of roads

Roads and their associated traffic have wide range of potential ecological impacts on vertebrates, including increased levels of pollutants (e.g., noise, exhaust gases), habitat fragmentation, edge effects, and direct mortality (roadkills) (Spellerberg 1998). As background to these impacts, we present here a brief literature review of the impacts of roads on birds; the impacts on other vertebrate taxa fall into similar broad categories.

The available literature suggests that roads have significant negative effects on birds only when road density and/or traffic volume is high. In Holland, for instance, busy roads (more than 5,000 vehicles per day) led to large reductions in the densities of open habitat and woodland species in road-side habitats (Reijnen et al. 1997). In a study of the determinants of avian community structure in Big Bend National Park, Texas, U.S.A., Gutzwiller and Barrow (2003) found that even moderate road densities can affect bird species abundance. In the vicinity of busy roads, roadkills can significantly affect the demography of breeding bird populations (Mumme et al. 2000). The effects of roads on avian biodiversity are often not immediately apparent, but may take decades to manifest themselves (Findlay and Bourdages 2000).

In contrast to major roads with high traffic volumes, minor roads have much less severe impacts on bird communities. (Forman et al. 2002), for instance, found that traffic volumes of 3,000 – 8,000 vehicles per day had no effect on grassland bird distribution near Boston, U.S.A., whereas busier roads significantly affected abundance and/or breeding. Although their impacts are less severe, minor roads can affect bird communities in several ways. In the case of grassland birds, roads can create new habitats (e.g., in drainage ditches), with the result that some species prefer roadside habitats, while other species avoid them (Sutter et al. 2000). In forested landscapes, the ecological effects of roads are usually more complex. In the Green Mountain National Forest in Vermont, unpaved roads did not affect nest predation rates, but did influence avian distribution, with some species exhibiting higher abundance away from roads, but other species more abundant along road edges (Ortega and Capen 2002). In the White Mountain National Forest in New Hampshire, forest roads had negligible effects on the breeding success of forest birds (King and DeGraaf 2002).

In other cases, roads can have subtler influences manifested in avian behaviour patterns. (Develey and Stouffer 2001), for example, found that understory birds in Amazonian Brazil were reluctant to cross even narrow roads, and roads frequently formed territory boundaries. Even narrow roads with low traffic volumes can reduce local movements of birds, with forest understory species often being reluctant to cross roads (Laurance et al. 2004). In general, the effects of road construction and other habitat changes in forests can vary widely between species, with some species decreasing in abundance, and others increasing (Thiollay 1999). In rehabilitated dune forest near St Lucia, KwaZulu-Natal, edges associated with forest roads are a significant

determinant of avian species richness and community composition (Weiermans and van Aarde 2003).

4. SCOPE AND OBJECTIVES OF THE STUDY

- To define and describe vertebrate habitat types identified on / along the site;
- To qualitatively and quantitatively assess the significance of vertebrate habitat components and their current general conservation status;
- To identify and comment on ecologically sensitive areas;
- To comment on connectivity;
- To provide a list of mammals, birds, reptiles and frogs that occur or might occur on site, and to identify species of conservation importance (Red Data species);
- To highlight potential impacts of the proposed development on the vertebrate species richness of the study site;
- To provide management recommendations that mitigate negative and enhance positive impacts, should the proposed development be approved, and to
- Calculate and comment on significance ratings for the proposed development.

5. METHODS

The study area was visited daily between 18 and 21 April 2016. The habitat features of each of the gate setting, bridge location, the reception / education centre site and three localities, one each for picnicking, camping and overnighting in a SANParks tented overnight facility were recorded (Figures 1-14). Sample study plots were selected along the track and the portion of the S52 to be upgraded to a black-topped surface (Figures 15-25).

SANParks officials daily identified sites on-the-go for investigation between 18 and 21 April 2016 (Table 1). Additional sites were submitted after the field work was completed and those are not considered in this report since we have not visited those (i.e. alternative sites for the gate and the reception / education centre.

Table 1: Sites identified for siting the various facilities.

FACILITY	COORDINATES	DATE VISITED	TEXT FIGURE /Confirmation
Gate preferred	23° 8' 41.701" S, 30° 55' 54.770" E	18 April 2016	6 + Sekele
Shingwedzi bridge site	23°08'37.0"S 30°56'07.7" E	18 April 2016	7
Reception preferred	23° 8' 33.769" S, 30° 56' 13.851" E	18 April 2016	8 + Sekele
Western end new alignment	23°09'14.5"S 30°56'56.2" E	18 April 2016	9
Eastern end new alignment	23°09'14.5"S 30°56'56.2" E	18 April 2016	10
Picnic site original	23° 10' 41.741" S, 31° 2' 22.251" E	18 April 2016	11
Picnic site Alt 1	23° 10' 30.294" S, 31° 1' 22.276" E		11
Picnic site Alt 2		19 April 2016	13 +11

Camping site original	23° 11' 4.707" S, 31° 1' 16.530" E.	18 April 2016	11
Camping site Alt 1	23° 11' 47.413" S, 31° 2' 9.819" E.	21 April 2016	14 + 11
Tented camp original	23° 11' 22.034" S, 31° 2' 18.936"E	19 April 2016	11
Tented camp Alt 1	23° 11' 34.122" S, 31° 1' 34.400" E	21 April 2016	12 + 11
WBV nest 1	23°11'39.94"S 31°1'39.26" E		
WBV nest 2	23°11'48.67"S 31°2'5.23"E		
WBV nest 3	23°11'27.40"S 31°2'23.80"E		
Ranger track	23°10'9.1"S 31°3'2.4" E	19 April 2016	16
Ranger track	23°10'8.8"S 31°6'41.5" E	19 April 2016	17
Ranger track	23°12'23.3"S 31°11'33.4" E	19 April 2016	18
Ranger track	23°12'46.1"S 31°12'12.6" E	19 April 2016	19
Shingwedzi crossing	23°12'32.9"S 31°14'0.1" E	19 April 2016	20
S52 crossing Shingwedzi	23°12'32.9"S 31°14'0.1" E	20 April 2016	21
S52 crossing Tshanga	23°12'28.1"S 31°14'18.1" E	20 April 2016	22
Riparian forest along S52	23°11'29.5"S 31°15'38.7" E	20 April 2016	23
Floral community along S52	23°11'06.8"S 31°17'17.7" E	20 April 2016	24
Stunted mopane along S52	23°11'51.3"S 31°16'24.1" E	20 April 2016	25
H1-6 and S52 T-junction	23°10'46.0"S 31°19'20.9" E	20 April 2016	26

Acocks (1988), Mucina and Rutherford (2006), Low & Rebelo (1996), Knobel and Bredenkamp (2006), SANBI & DEAT (2009) discuss the distinguishing plant associations of the study area in broad terms. It should be acknowledged that botanical geographers have made immense strides in defining plant associations (particularly assemblages denoted as vegetation units or veld types), whereas this cannot be said of zoologists. The reason is that vertebrate distributions are not very dependent on the minutiae of plant associations. Rautenbach (1978 & 1982) found that mammal assemblages can at best be correlated with botanically defined biomes, such as those by Low and Rebelo (1996 & 1998), and latterly by Mucina and Rutherford (2006) as well Knobel and Bredenkamp (2006). Hence, although the former's work has been superseded by the work of the latter two, the definitions of biomes are similar and both remain valid for mammals and are therefore recognized as a reasonable determinant of mammal distribution.

The local occurrences of mammals are, on the other hand, 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 global distribution ranges.

Three criteria were used to gauge the probability of occurrences of vertebrate species on the study site. These include known distribution ranges, habitat preferences and the qualitative and quantitative presence and extent of suitable habitats on site:

- *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 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 categorized as *medium* normally do not occur at high population numbers, but cannot be deemed as rare.
- *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 categorized as *low* are generally deemed to be rare.

5.1 Field Survey

During the site visit, mammals, birds, reptiles and frogs were identified by visual sightings through random transect walks and patrolling with a vehicle. 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, birds by their calls, old nests, moulted feathers, spoor, droppings and food remains, and herpetofauna by their calls.

5.2 Desktop Survey

As many mammals and herpetofauna are either secretive, nocturnal, hibernators and/or seasonal, and whereas some birds are seasonal migrators, distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of such species based on authoritative tomes, scientific literature, field guides, atlases and data bases. This can be done with a high level of confidence irrespective of season.

5.3 Taxon-specific Requirements

Mammals: During the visit the site was surveyed and assessed for the potential occurrence of Red Data and/or 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*), a member of shrews such as the Forest shrew (*Myosorex varius*), Southern African hedgehog *(Atelerix frontalis), a number of bats such as the* Short-eared trident bat (*Cloeotis percivali*), African clawless otter (*Aonyx capensis*), Spotted-necked otter (*Lutra maculicollis*), Marsh mongoose (*Atilax paludinosus*), Brown hyena (*Parahyaena brunnea*), etc.

Birds: Birds occurring at the sites of the proposed infrastructure components, and along the route of the proposed road were assessed in several steps, as detailed below. Red-listed species were identified using the most recent (2015) edition of the Red Data Book for South Africa, Lesotho and Swaziland (Taylor et al. 2015).

Prior to the site visit, a desktop study was undertaken in which bird species that potentially occur at the site and in the surrounding areas were identified using data from the first and second South African Bird Atlas Projects (SABAP 1 and 2). SABAP 2 data are based on records for pentads (i.e., 5' X 5'), where SABAP 1 data were based on quarter-degree grid cells (i.e., 15' X 15'). A list of species potentially occurring at the site was developed using data for all the SABAP 2 pentads

within which the project is located, plus surrounding pentads (Figure 1). The pentads at the four corners of this region are: NW: 2300_3045; NE: 2300_3120; 2315_3045; SW: 2315_3120. The area considered during the desktop study is thus much larger than the area likely to be affected by the project (Figure 26). This approach is adopted to ensure that all species potentially occurring at the site, whether resident, nomadic, or migratory, are identified.

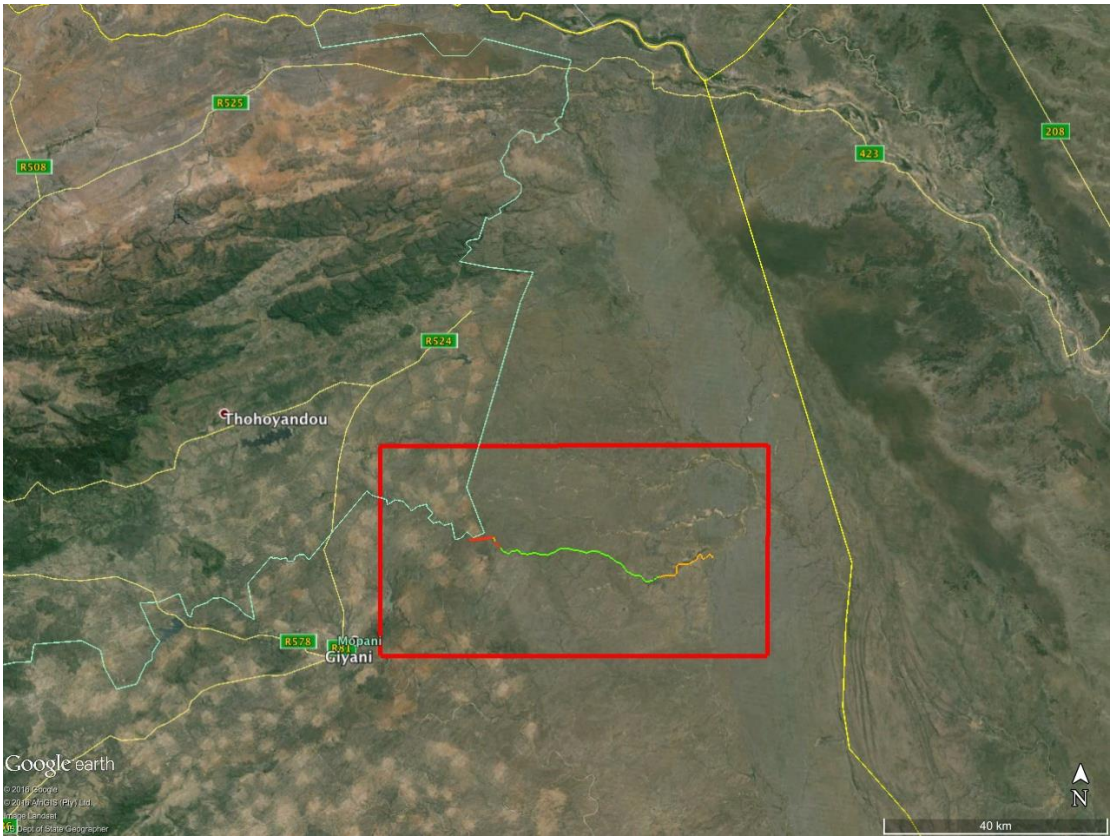

Figure 1: Approximate extent of area included (red rectangle) when generating the list of birds potentially occurring along the route of the proposed road and associated developments (the lines within the rectangle indicate the road route). Image courtesy of Google Earth.

Site visits took place on 18-21 April 2016. The weather during the visit was typically warm, clear and with little wind. During the site visits, birds occurring at the sites of the various project components and along the route of the proposed road were identified by walking transects and driving transects. During walking transects, an observer with binoculars walked slowly through the site, identifying all birds encountered (seen or heard), identifying nests observed, and assessing the avian habitats present.

Because the project is located within Kruger National Park and hence can be considered highly sensitive, we deemed it prudent to obtain expert advice on potential impacts. For this purpose, we corresponded with Dr Ian Whyte, who was employed by SANParks for several decades and who has exceptional firsthand knowledge of the ecology of birds in KNP.

Herpetofauna: During the visit, the site was surveyed and assessed for the potential occurrence of South African Red Data species in Limpopo Province (Minter, *et al*, 2004; Alexander & Marais, 2007; Du Preez & Carruthers, 2009 and Bates, *et al*, 2014), such as: Nile Crocodile (*Crocodylus*

niloticus); Nile Crocodile (*Crocodylus niloticus*); Woodbush Flat Gecko (*Afroedura multiporis multiporis*); Muller's Velvet Gecko (*Homopholis mulleri*); Granite Dwarf Gecko (*Lygodactylus graniticolus*); Methuen's Dwarf Gecko (*Lygodactylus methueni);* Cryptic Dwarf Gecko (*Lygodactylus nigropunctatus incognitus);* Makgabeng Dwarf Gecko (*Lygodactylus nigropunctatus montiscaeruli);* Soutpansberg Dwarf Gecko (*Lygodactylusocellatus soutpansbergensis);* Waterberg Dwarf Gecko (*Lygodactylus waterbergensis);* Soutpansberg Rock Lizard (*Vhembelacerta rupicola*); Coppery Grass Lizard (*Chamaeasaura aenea*); Large-scaled Grass Lizard (*Chamaesaura macrolepis*); Northern Crag Lizard (*Pseudocordylus transvaalensis*); Unexpected Flat Lizard (*Platysaurus intermedius inopinus*); Orange-Throated Flat Lizard (*Platysaurus monotropis*); Fitzsimons' Flat Lizard (*Platysaurus orientalis fitzimonsi*); Eastwood's Long-Tailed Seps (*Tetradactylus eastwoodae*); Stripe-Bellied Legless Skink (*Acontias kgalagadi subtaeniatus*); Richard's Legless Skink (*Acontias richardi*); Woodbush Legless Skink (*Acontias rieppeli*); White-Bellied Dwarf Burrowing Skink (*Scelotes limpopoensis albiventris*); Striped Harlequin Snake (*Homoroselaps dorsalis*); Northern Forest Rain Frog (*Breviceps sylvestris*) and Giant Bullfrogs (*Pyxicephalus adspersus*);

5.4 Assessment criteria

The conservation status of habitats within the study site can be assigned to one of five levels of sensitivity, i.e.

High: Ecologically sensitive and valuable land, with high species richness, sensitive ecosystems or Red Data species, that should be conserved and no development allowed.

Medium-high: Land where sections are disturbed but that is still ecologically sensitive to development/disturbance.

Medium:Land on which low-impact development with limited impact on the ecosystem could be considered, but where it is still recommended that certain portions of the natural habitat be maintained as open spaces.

Medium-low: Land on which small sections could be considered for conservation but where the area in general has little conservation value.

Low: Land that has little conservation value and that could be considered for developed with little to no impact on the habitats or avifauna.

These correlate with the significance ratings for the development as discussed in Section 6.5, and are tabulated as follows:

RANKING	65-100	64-36	35-16	15-5	1-4
SIGNIFICANCE	Very High	High	Moderate	Low	Minor
CONSERVATION STATUS	High	Medium-high	Medium	Medium-low	Low

5.5 Impact Assessment Criteria

The methods and format of the impact tables used in this report are in accordance to the requirements of the 2014 NEMA Regulations. This approach is more empirical and yields quantitative values ideal for comparative purposes.

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **probability (P)** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable

(probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).

- The **duration (D)**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;
- The **extent (E)**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **magnitude (M)**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- the **significance (S)**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high;
  - the significance rating is calculated by the following formula:

S (significance) = (D + E + M) x (P)

- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be *mitigated.*

The numerical value of the calculation is assigned to a significance category.

RANKING	65-100	64-36	35-16	15-5	1-4
SIGNIFICANCE	Very High	High	Moderate	Low	Minor

Impacts should be identified for the construction and operational phases of the proposed development. Proposed mitigation measures should be practical and feasible such that they can be realistically implemented by the applicant.

6. STUDY AREA

The South African National Parks Board (SANParks) intends to offer visitors another strategically located entrance to the Kruger National Park (KNP) at Giyani (Limpopo Province). The project comprises a new entrance gate (Figures 1 and 5), a high-water bridge over the Shingwedzi River (Figures 1 and and 6), a new reception centre with education facilities (Figures 1 and 7), a picnic

site, a camp site, a tented camp (Figures 1, 10, 11, 12, 13 and 14) and a ca. 50 kilometer black-topped road routed parallel to the Shingwedzi River and connects with the H1-6 Road linking Shingwedzi and Mopane Rest camps (the sudy site). The new road will be an upgrade of a suitable portion of the gravelled S52 route to Bataleur camp and the graded Shangoni Ranger patrol track. To the east the upgraded road will again cross the Shingwedzi River as well as the Tshanga tribuatary across low water bridges (Figures 19, 20 and Figure 21). Most of the distance the upgraded road will be parallel to the Shingwedzi River (Figure 2). Most of the the road will be north of the Shingwedzi River, and the section between the Shingwedzi Low Water bridge (Figures 19 and 20) and the H1-6 will traverse through mopane veld south of the river. A short alignment has to be constructed to connect the western terminal end of the Shangoni Ranger patrol road with the reception centre (Figures 1, 8 and 9). The upgraded road will be six meters wide with a one meter shoulder on each side.

The extent of the reception centre will be < one hectare and that of the picnic site, tented camp and camping terrain will respectively be < 3 hectares.

It was deemed prudent to identify three discrete sites for the picnic site, the camping site and the tented camp conveniently close to the reception centre to offer visitors those amenities required by travellers after a long journey. A site for each of these three amenities were chosen close to the Shingwedzi River (Figures 1, 2, 3, 4 and 10) so that scenic views over the river in the riparian zone could be appreciated. Convenience structures will be constructed in the adjacent mopane woodland so as to minimize impact on the riparian zone vegetation. Initially an alternative site for each of these discreet convenience units were proposed. The original proposed sites were subsequently omitted from SANParks planning, but considering the fact that by then we have already surveyd these sites, and in view of the fact that analyses of data prompted us to bring these again under consideration (Figure 10).

Eight different Mopane Bushveld vegetation untits are recognized by Mucina and Rutherford (2006). Collectively these are described as an ‘ecoregion’ which is the dominate vegetation assemblage on the plains of the northern KNP from Elephants Rest Camp northwards. The entire Shangoni initiative addressed in this report will be in Mopane woodland, predominantly in Mopane Basalt Shrubland vegetation unit (Mucina and Rutherford, 2006) (Figure 4).

Colophospermum mopane, commonly called mopane, is a tree in the legume family (Fabaceae) that grows in hot, dry, low-lying plains 200 to 1,150 meters in elevation, in the far northern parts of southern Africa. The tree only occurs in Africa and is the only species in the genus *Colophospermum*. Its distinctive butterfly-shaped (bifoliate) leaf and thin seed pod make it easy to identify. In terms of human use it is, together with camel thorn and lead wood, one of the three regionally important firewood trees. It is native to Botswana, South Africa, Zimbabwe, Mozambique, Zambia, Namibia, Angola and Malawi. It is found growing in alkaline (high lime content) soils which are shallow and not well drained. It also flourishes in alluvial soils such as along the river, Tshanga tributary and feeder washes in the study area. In small portions of South Africa and larger adjacent areas of Botswana and Zimbabwe, the trees tend to vary between two and 18 m, often called "mopane scrub" (shrub) but also sometimes taller and forming woodland, where further north the trees are taller and form tall woodlands referred to as cathedral mopane. This tree does not grow well outside hot, frost-free areas with summer rainfall.

Although there are inherent differences in mopane woodland structure along the linear footprint of the proposed development, all subunits are herein treated as a vertebrate arboreal habitat type. Two other major vertebrate habitat types are represented in the study site, namely terrestrial and wetlands along especially the Shingwedzi River. Although rupiculous habitat is present near the study site, it is absent within the development zone and the 500 meters of adjacent zones.

The topography of the 50km development along the Shingwedzi River from the western KNP boundary to the H1-6 road consists of gently undulating lowland woody plains. Higher aspects of the undulating landscape in the form of modest rocky ridges are more than 500 meters outside the linear study area. However, rocky overhangs and deep crevices are most likely a feature of these randjies; these are ideal daytime roosts for cave-dwelling bats that will commute to the river system to nightly hawk for invertebrate prey abundant along water courses.

Four soil types occur along the route of the proposed upgraded tourist road (Figure 3). Ecologically the substrates vary from compacted red sandy soil, to lighter-colored soil heavily imbedded with rock and gravel, to alluvial soil along water courses. Termitaria are important components of a terrestrial habitat; although not common in the study site.

The Shingwedzi River is seasonal, but during normal rainfall seasons a number of hippo pools remain during winter and provide water for game. A number of dry washes decant storm water into the river and the Tshanga tributary (Figures 2, 6, 16, 17, 19, 20 and 21). Riparian zones are generally clearly demarcated by taller mopane, apple leaf, lead wood, jackal berry, nyala berry and fig tree trees growing on deeper alluvial soils. However, understory in the riparian zone is weakly developed, and rank semi-aquatic vegetation is scarce (Figures 6, 16, 17, 19, 20, 21 and 22). The present graveled public road and the Shangoni ranger track (i.e. the future upgraded black top public road) are constructed just outside the riparian zones and meander through a variety of mopane vegetation associations (Figures 15 – 18, 22-24).

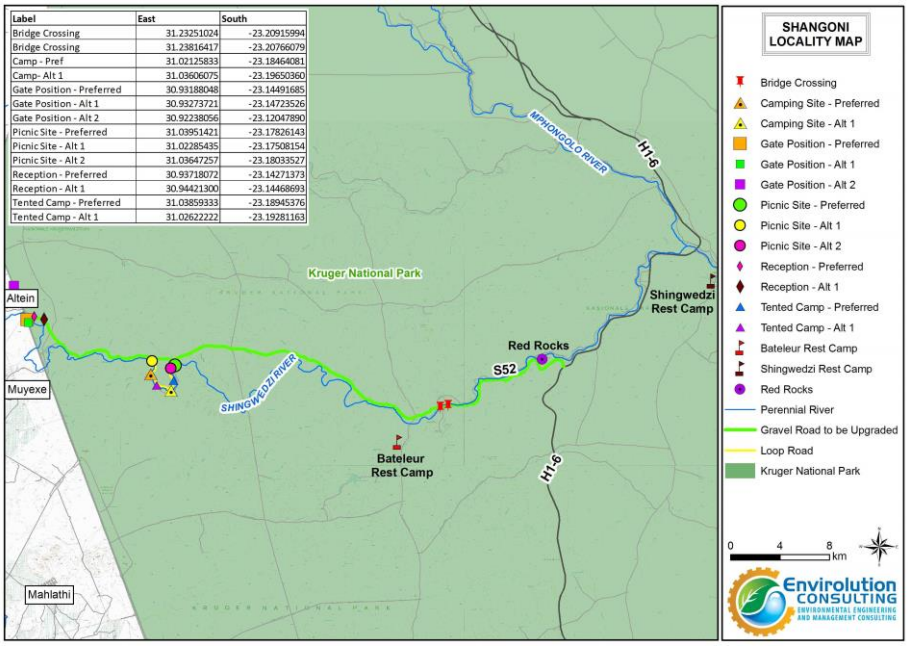

Figure 2: Locality map of the intended development as originally submitted. All the sites considered during the field work are shown on Figure 11. Between the H1-6 and

the first crossing of the Shingwedzi River the upgraded road will be south of the river, and thereafter north of the river.

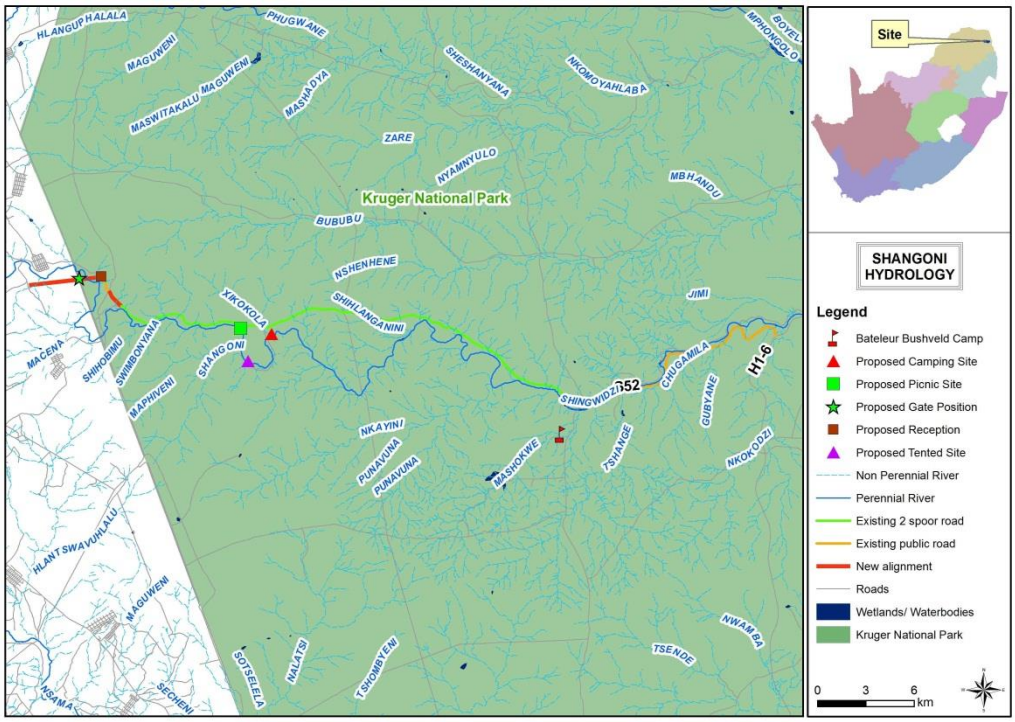

Figure 3: The hydrology map illustrates the many dry washes that decant storm water into the Shingwedzi River.

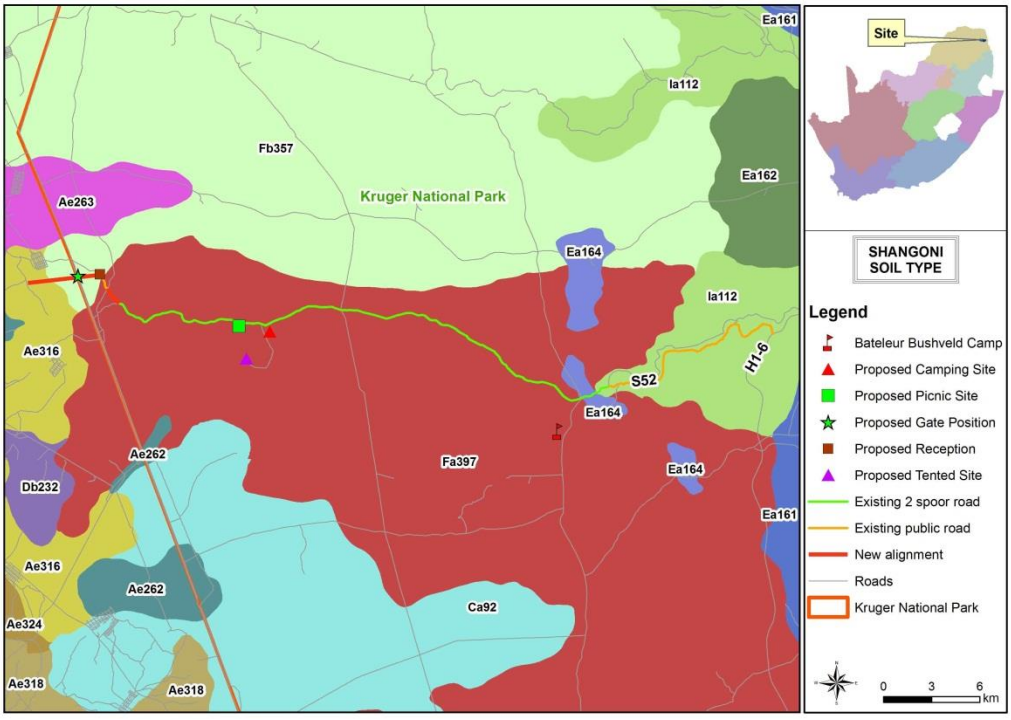

Figure 4: Detailed map of soil types along the upgraded tourist road. Ecologically the soils present themselves as compacted red soil and light red-brown soil with gravel and rocks.

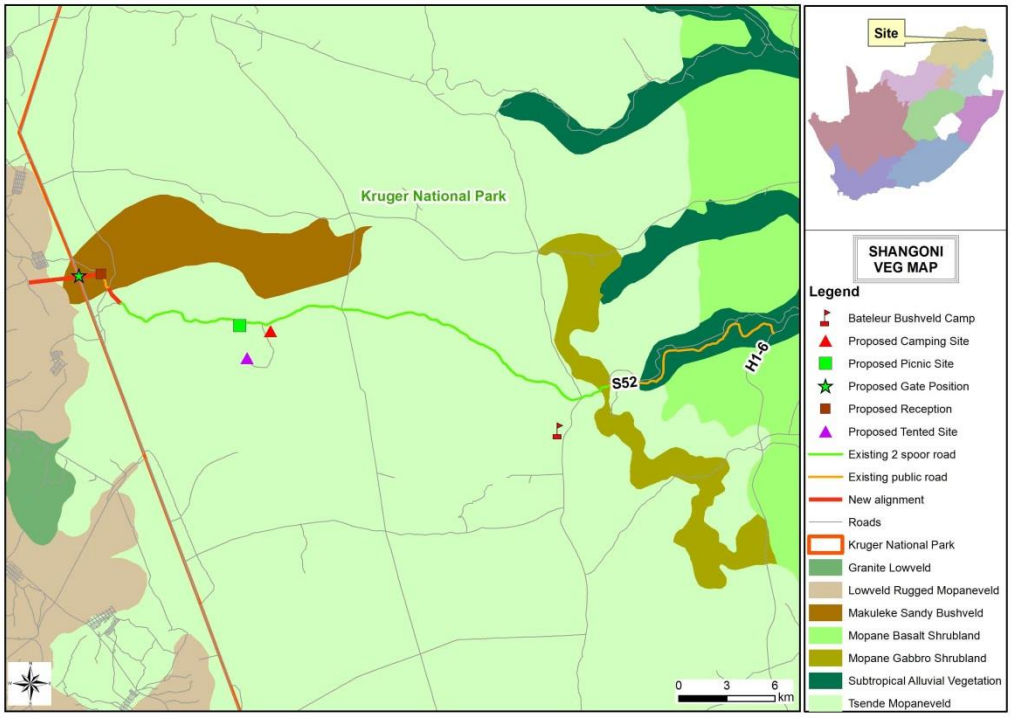

Figure 5: All of the development will be in variants of mopane woodland, which in this report is dealt with as an arboreal major habitat.

Figure 6: The original planned location of the Shangoni Gate at 23º 08' 40.2"S; 30º 55' 53.6"E. On the Park side stunted mopane woodland on red soil prevails and to the west side of the fence is knob thorn woodland.

Figure 7: Less than one kilometer after entering the Park via the Shangoni Gate (Figure) visitors will cross the deeply incised seasonal Shingwedzi River via a high-water bridge at 23º 08' 37.0"S; 30º 56' 07.7"E.

Figure 8: After crossing the Shingwedzi River visitors will within a kilometer book in at the Reception Centre at 23º 08' 37.7"S; 30º 56' 17.4"E. Note the mopane scrub.

Figure 9: Close to the Reception Center a short new road will connect with the Shangoni Ranger Patrol Road. Illustrated is the western location of the short new alignment in mixed mopane woodland at 23º 09' 14.5"S; 30º 56' 56.2"E.

Figure 10: The eastern position of the new alignment where it will join the Shangoni Patrol Road at 23º 09' 45.2"S; 30º 52' 20.6"E.

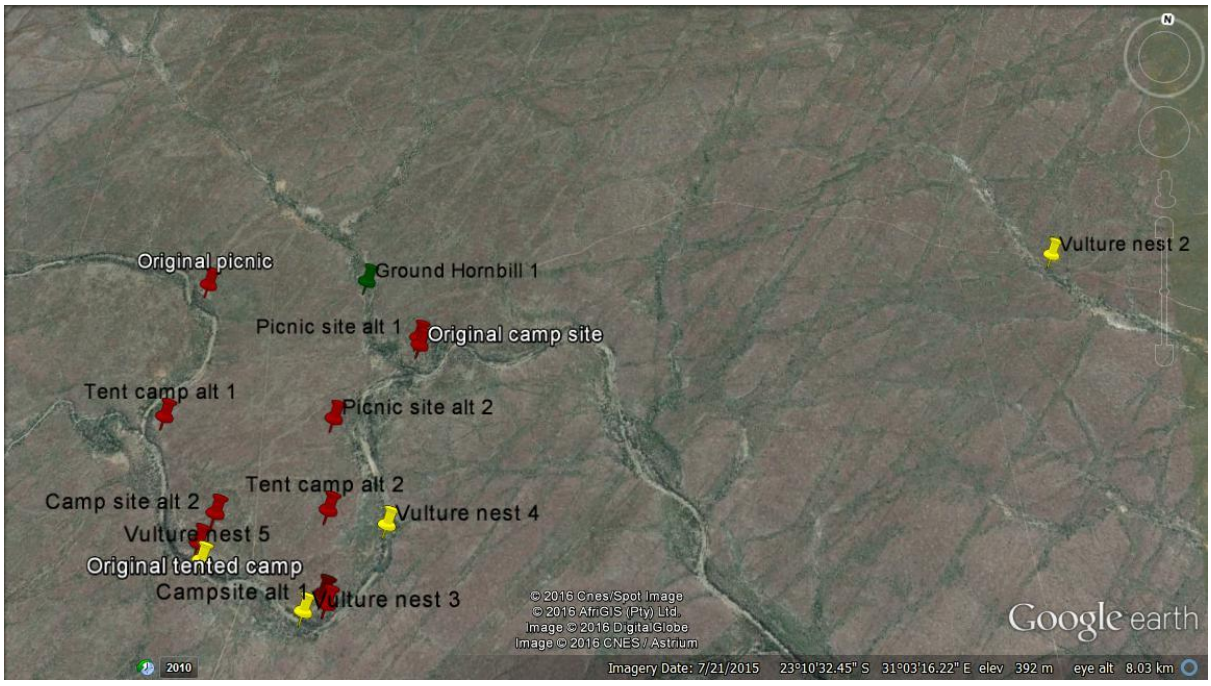

Figure 11: Original and two alternative localities for each of a picnic site, a tented camp and a camping terrain relative to four vulture and one ground hornbill nests. Assigning purposes as briefed during the field work for each site differ slightly from the finalized map subsequently subjected by SANParks.

Figure 12: The Alternative 1 site for a tented camp with a scenic view over the Shingwedzi River at 23º 11' 05.09"S; 31º 01' 19.6"E.

Figure 13: The proposed Alternative 1 for a picnic site at the outer edge of the Shingwedzi River riparian zone at 23º 10' 41.47"S; 31º 02' 24.30"E (See Figure 5). The shady site is on level and fairly open terrain.

Figure 14: The Alternative 1 site for a camping terrain with a scenic view over a hippo pool in the Shingwedzi River at 23º 11' 44.7"S; 31º 02' 10.59"E.

Figure 15: The alternatives for the picnic site, the camping terrain and tented camp are in mopane woodland at least a 100 meters away from the Shingwedzi River riparian zone. These are to be developed should sound scientific objectives are raised opposing the Alternatives 1 facilities straddling riparian forest and mopane woodland.

Figure 16: Mixed Mopane / Terminalia scrubland along the Shangoni Ranger patrol road at 23º 10' 09.1"S; 31º 03' 02.4"E.

Figure 17: One of many storm water drainage lines along the Shangoni Ranger patrol road at 23º 10' 08.8"S; 31º 06' 41.5"E.

Figure 18: Taller mopane trees forming a riparian forest along a seasonal streambed at 23º 12' 23.3"S; 31º 11' 33.4"E.

Figure 19: *Terminalia prunoides* / mopane floral community along the Shangoni Ranger patrol road at 23º 12' 46.1"S; 31º 12' 12.6"E.

Figure 20: The Shingwedzi River photographed from the low water bridge at 23º 12' 32.9"S; 031º 14' 00.1"E, near the confluence with the Tshanga stream.

Figure 21: The low water bridge over the Shingwedzi River along the S52 road to Bataleur Camp at 23º 12' 32.9"S; 31º 14' 00.1"E.

Figure 22: View over the Tshanga streambed along the S52 to Bataleur Camp, photographed from the low water bridge at 23º 12' 28.1"S; 31º 14' 18.1"E.

Figure 23: High riparian forest with apple leaf and mopane trees between the S52 and the Shingwedzi River at 23º 11' 29.5"S; 31º 15' 38.7"E.

Figure 24: A Salvodore / mopane floral community along the S52 at 23º 11' 06.8"S; 31º 17' 17.7"E

Figure 25: A stunted stand of mopane on rocky soil along the S52 at 23º 10' 51.3"S; 31º 16' 24.1"E.

Figure 26: The T-junction of the S52 to Bataleur and the H1-6 Road at 23º 10' 46.0"S; 31º 19' 20.9"E.

7. RESULTS

For this account a site visit was conducted by a botanist, mammologist and two ornithologists on 18 - 21 April 2016. For herpetofauna a desktop study was conducted, but benefitting from observations by the field team and literature information. A wetland, visual impact and heritage specialist also investigated the site at the same time. The days were warm and sunny with a light wind, and there had been some rain recently but less than expected overall

7.1 MAMMALS

7.1.1 Mammal Habitat Assessment

Acocks (1988), Mucina and Rutherford (2006), Low & Rebelo (1996), Knobel and Bredenkamp (2006) and SANBI & DEAT (2009) discuss the distinguishing plant associations of the study area in broad terms. It should be acknowledged that botanical geographers have made immense strides in defining plant associations (particularly assemblages denoted as vegetation units or veld types), whereas this cannot be said of zoologists. The reason is that vertebrate distributions are not very dependent on the minutiae of plant associations. Rautenbach (1978 & 1982) found that mammal assemblages can at best be correlated with botanically defined biomes, such as those by Low and Rebelo (1996 & 1998), and latterly by Mucina and Rutherford (2006) as well Knobel and Bredenkamp (2006). Hence, although the former's work has been superseded by the work of the latter two, the definitions of biomes are similar and both remain valid for mammals.

The local occurrences of mammals 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 mammal species by evaluating the habitat types within the context of global distribution ranges.

Three of the major habitat types are represented on the study site, i.e. terrestrial, arboreal and wetlands. Given the fact that conservation is the fundamental objective of the SANParks, it follows that habitat types remain in pristine condition and are subject only to natural cycles such as seasons and cyclic rainfall.

Terrestrial habitat is represented by the ground-level biotic and abiotic components. The soils are generally compacted or imbedded with rocks and gravel, as such presenting a challenge for burrowing mammals such as aardvarks, springhares and Bushveld gerbils. Typically of mopane woodlands, basal cover is generally sparse, especially so in the shade of stands of cathedral mopane. As such, nourishment and refuge against predation are suboptimal.

Arboreal habitat is as widespread as the terrestrial habitat, but quality varies with the height of trees and arboreal mammals are unlikely to occupy mopane scrubland. Discerning arboreal small mammals such as the two tree rat species are restricted to mature *Acacia* trees and are thus absent in mopane woodlands. However, bushbabies, tree squirrels and savanna dormice are listed as definite residents.

Quantitatively and qualitatively wetlands and associated rank semi-aquatic vegetation vacillate seasonal in harmony with the rainfall regime and fluctuating water levels of the river, hippo pools and small pans in the woodlands. Waterside semi-aquatic vegetation in riparian zones spatially fluctuates as water levels change and seldom develop to full potential. Additionally, riparian semi-aquatic vegetation is a rich source of fodder for grazers to the detriment of cover potential for small mammals. Moisture-reliant small mammal populations (viz. cane rats, African marsh rats, vlei rats, shrews) concomitantly remain paltry and are in a never-ending survival struggle.

7.1.2 Observed and Expected Mammal Species Richness

The KNP is South Africa's flagship national park, and since it is situated in the Eastern Lowveld savanna it also boasts the most complex ecosystem and faunal richness. The mammal fauna of the park has been exhaustively surveyed, *inter alia* by Pienaar et al. (1985), Rautenbach (1975), Rautenbach and Espie (1982), Rautenbach et al. (1984 & 1985), Schlitter et al. (1980), and the life-histories of species has later been collated in Sub-Saharan context by Smithers (1983). These sources were used to compile the list of species to be found in and along the site. The list was then audited by sightings during the four days of field observations.

The South African National Park Board's mandate is complex. Its first priority is wise environmental management, which is difficult given changes in macro ecological conditions such as boundary fences curbing mass migrations of blue wildebeests, desiccation of the Lowveld, or CITES's recently withdrawn ban on ivory trade (not to mention vociferous

opposition by the Green Brigade to culling as a management tool). A second priority is to make the park accessible to its owners, namely the South African citizenry. The Shangoni project and this report are indeed a marriage between these two directives. In some borderline cases some liberties have to be taken to satisfy client interests, such as roads just outside the riparian zones to maximize game sightings in riverbeds and riparian forests. SANParks have to cater for a wide plethora of client tastes, in this case safe and rustic refreshment places and overnight facilities. Both these directives are fundamental to our investigations and findings.

The outstanding feature of the Kruger Park wildlife is that its species assemblages reflect the historical scenario; other than minor fluctuations or minor human interferences the ambiance, sights and smells of the site and surrounds is the same than pre-civilization times. Threats to species welfare are well-managed and are close to the hearts of the South African public, such as the present-day poaching of rhinos.

In collating the species richness of the study area (Table 1) the following has been taken into account: Habitat requirements for some discerning species are absent (such as mature *Acacia* trees for tree rats). The presence of species known only from a single locality in exclusive habitats (such as Commerson's roundleaf bat, the Damara and Lesser woolly bats as well as Ansorgei's free-tailed bat from Pafuri; Anchietae's pipstrelle from a streambed near Skukuza; and Botswana;s long-eared bat from Punda Maria) are also excluded from the list of resident of and vagrants to the study site. The precautionary principle has been applied by including wetland-reliant species such as vlei rats and the Crocidura shrews listed, or small species using moribund termitaria for refuges (dwarf shrews and pygmy mice), and cave-dwelling bats such as horseshoes bat species, round-leaf bats and split-faced bats.

A mopane ecosystem is not as productive as the southern sweet bushveld. This overview, however, interpret the impact of the proposed development in the context of a mopane ecosystem.

Seventy-eight species are concluded to be residents in or vagrants to the site. It is contended that this assemblage mirrors that of the stone- and iron-age ages, with no loss of a species since. The potential impact of the various features of the proposed development is weighed against the reigning conservation of these species and their habitats.

Table 2: Mammal diversity. The species observed or deduced to occupy the site. (Systematics and taxonomy as proposed by Bronner et.al [2003], Skinner & Chimimba [2005], Apps [2012] and Stuart & Stuart [2015]).

		ENGLISH NAME
	Order Macroscelididae	
	Family Macroscelididae	
DD√	*Elephantulus brachyrhynchus*	Short-snouted elephant shrew

	Order Tubulidentata	
	Family Orycteropodidae	
√	*Orycteropus afer*	Aardvark
	Order Proboscidea	
	Family Elephantidae	
√	*Loxodontia africana*	
	Order Lagomorpha	
	Family Leporidae	
√	*Lepus saxatilis*	Scrub hare
	Order Rodentia	
	Family Bathyergidae	
√	*Cryptomys hottentotus*	African mole rat
	Family Hystricidae	
√	*Hystrix africaeaustralis*	Cape porcupine
	Family Tryonomyidae	
√	*Thryonomys swinderianus*	Greater cane rat
	Family Pedetidae	
√	*Pedetes capensis*	Springhare
	Family Sciuridae	
√	*Paraxerus cepapi*	Tree squirrel
	Family Myoxidae	
√	*Graphiurus murinus*	Woodland dormouse
	Family Muridae	
DD√	*Lemniscomys rosalia*	Single-striped grass mouse
NT?	*Dasymys incomtus*	African marsh rat
DD?	*Gramnomys dolichurus*	Woodland thicket rat
√	*Mus minutoides*	Pygmy mouse
√	*Mastomys natalensis*	Natal multimammate mouse
√	*Mastomys coucha*	Southern multimammate mouse
√	*Aethomys chrysophilus*	Red veld rat
√	*Aethomys ineptus*	Tete veld rat
√	*Otomys angoniensis*	Angoni vlei rat
DD√	*Gerbilliscus leucogaster*	Bushveld gerbil
√	*Gerbilliscus brantsii*	Highveld gerbil
√	*Saccostomus campestris*	Pouched mouse
√	*Dendromus melanotis*	Grey pygmy climbing mouse
√	*Dendromus mesomelas*	Brants' climbing mouse
√	*Dendromus mystacalis*	Chestnut climbing mouse
√	*Steatomys pratensis*	Fat mouse
	Order Primates	
	Family Galagidae	
√	*Galago moholi*	South African galago
	Family Cercopithecidae	
√	*Papio hamadryas*	Chacma baboon
√	*Cercopithecus pygerythrus*	Vervet monkey
	Order Eulipotypha	
	Family Soricidae	
DD√	*Suncus lixus*	Greater dwarf shrew
DD√	*Crocidura fuscomurina*	Tiny musk shrew
DD√	*Crocidura cyanea*	Reddish-grey musk shrew
DD√	*Crocidura silacea*	Lesser grey-brown musk shrew
DD√	*Crocidura hirta*	Lesser red musk shrew
	Family Erinaceidae	
	Order Chiroptera	
	Family Pteropidae	
√	*Epomophorus wahlbergi*	Wahlberg's epauletted fruit bat

√DD	*E. gambianus crypturus*	Gambian epauletted fruit bat
*	*Rousettus aegyptiaca*	Egyptian fruit bat
	Family Embalonuridae	
√	*Taphozous mauritianus*	Mauritian tomb bat
	Family Molossidae	
√	*Mops condylurus*	Angolan free-tailed bat
√	*Chaerephon pumila*	Little free-tailed bat
√	*Tadarida aegyptiaca*	Egyptian free-tailed bat
	Family Vespertilionidae	
NT*	*Miniopterus schreibersii*	Schreibers' long-fingered bat
√	*Pipistrellus hesperidus*	African pipistrelle
√	*Pipistrellus hesperidus*	African (Kuhl's) pipistrelle
NT√	*Pipistrellus rusticus*	Rusty pipistrelle
√	*Neoromicia nanus*	Banana bat
√	*Neoromicia zuluensis*	Aloe serotine bat
√	*Neoromicia capensis*	Cape serotine bat
NT*	*Myotis welwitchii*	Welwitsch's hairy bat
NT*	*Myotis tricolor*	Temminck's hairy bat
√NT	*Glauconycteris variegata*	Butterfly bat
√	*Scotophilus dinganii*	African yellow house bat
√	*Scotophilus viridis*	Greenish yellow house bat
√	*Nycticeinops schlieffenii*	Schlieffen's bat
NT*	*Kerivoula lanosa*	Lesser woolly bat
	Family Nycteridae	
*	*Nycteris thebaica*	Egyptian slit-faced bat
	Family Rhinolophidae	
NT*	*Rhinolophus hildebrandtii*	Hildebrant's horseshoe bat
NT*	*Rhinolophus fumigatus*	Rüppell's horseshoe bat
NT*	*Rhinolophus clivosus*	Geoffroy's horseshoe bat
NT*	*Rhinolophus darlingi*	Darling's horseshoe bat
*	*Rhinolophus simulator*	Bushveld horseshoe bat
	Family Hipposideridae	
DD√	*Hipposideros caffer*	Sundevall's roundleaf bat
	Order Pholidota	
	Family Manidae	
V√	*Manis temminckii*	Ground pangolin
	Order Carnivora	
	Family Hyaenidae	
√	*Proteles cristatus*	Aardwolf
NT√	*Parahyaena brunnea*	Brown hyena
√	*Crocuta crocuta*	Spotted hyena
	Family Felidae	
Vu√	*Acinonyx jubatus*	Cheetah
√	*Panthera pardus*	Leopard
√Vu	*Panthera leo*	Lion
√	*Caracal caracal*	Caracal
√	*Felis silvestris*	African wild cat
√NT	*Leptailurus serval*	Serval
	Family Viverridae	
√	*Civettictis civetta*	African civet
√	*Genetta genetta*	Small-spotted genet
√	*Genetta tigrina*	SA large-spotted genet
	Family Herpestidae	
*DD	*Paracynictis selousi*	Selous' mongoose
√	*Galerella sanguinea*	Slender mongoose
√	*Ichneumia albicauda*	White-tailed mongoose
√	*Atilax paludinosus*	Marsh mongoose

√	*Mungos mungo*	Banded mongoose
√	*Helogale parvula*	Dwarf mongoose
	Family Canidae	
√En	*Lycaon pictus*	Wild dog
√NT	*Canis adustus*	Side-striped jackal
√	*Canis mesomelas*	Black-backed jackal
	Family Mustelidae	
√	*Aonyx capensis*	African clawless otter
NT√	*Mellivora capensis*	Honey badger
√	*Ictonyx striatus*	Striped polecat
*DD	*Poecilogale albinucha*	African weasel
	Order Perissodactyla	
	Family Rhinocerotidae	
√	*Ceratotherium simum*	White rhinoceros
√Vu	*Diceros bicornis*	Black rhinoceros
	Family Equidae	
√	*Equus quagga*	Plains zebra
	Order Suiformes	
	Family Suidae	
√	*Potamochoerus larvatus*	Bushpig
√	*Phacochoerus africanus*	Common warthog
	Order Whippomorpha	
	Family Hippopotamidae	
√	*Hippopotamus amphibious*	Hippopotamus
	Order Ruminanta	
	Family Giraffidae	
√	*Giraffa camelopardalis*	Giraffe
	Family Bovidae	
√	*Syncerus caffer*	African buffalo
√	*Tragelaphus strepsiceros*	Kudu
√	*Tragelaphus angasii*	Nyala
√	*Tragelaphus scriptus*	Bushbuck
√	*Tragelaphus oryx*	Eland
√	*Connochaetes taurinus*	Blue wildebeest
*	*Alcelaphus lichtensteiii*	Lichtenstein's hartebeest
√	*Alcelaphus buselaphus*	Red hartebeest
*En	*Damaliscus lunatus*	Tsessebe
√Vu	*Hippotragus equinus*	Roan
√	*Hippotragus niger*	Sable
√	*Sylvicapra grimmia*	Common duiker
√	*Redunca arundinum*	Southern reedbuck
√	*Kobus ellipsiprymnus*	Waterbuck
√	*Raphicerus campestris*	Steenbok
*	*Raphicerus sharpei*	Sharpe's grysbok
√	*Aepyceros melampus*	Impala

√ Definitely there (sightings or literature records) 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.

7.1.3 Red Listed Mammal Species Identified:

-By the Scientific Community (Friedman and Daly (editors) 2004)

Of the 78 species concluded to occur in the vicinity of the development, 35 are IUCN Red Listed (Friedmann and Daly, 2004); 13 species have Data Deficient (DD) rankings, 15 are Near Threatened (NT), five are Vulnerable (VU) and two are Endangered (En)) (Table 1).

In the majority of cases, species became universally endangered as result of a quantitative and/or qualitative habitat decline. This is, however, not applicable in the Kruger Park where ecological processes, resources and services are sheltered against human interferences. Considering the excellent conservation character of the site and adjoining areas, it is submitted that the Red Data species mentioned here are not under *in situ* survival pressure, although their overall conservation are jeopardized (viz. the pangolin, brown hyena, serval, wild dog, honey badger and others). On the other hand, some species are locally endangered as result of an edge effect (viz. tsessebe, roan and others).

The ecology and population dynamics of "Data Deficient" (DD) small mammal species listed in Table 1 have not been adequately studied to provide quantitative field data to empirically assign a conservation ranking, and are thus as a precaution considered as 'Data Deficient' Red Data species. "DD"-rated shrews, for instance, operate at the apex of their food pyramid via an invertebrate trophic sublevel, which means that their population numbers are significantly lower than that of their prey species in order to maintain sustainable prey population levels. Because of their diet, they are furthermore not readily trapped with conventional bait or traps, which may mean that their numbers are under-estimated. Specimen collection of shrews using drift fences and pitfalls invariable yield better acquisition results than live-trapping, which reiterate the sentiment that shrews numbers are more often than not under-estimated and that many species' conservation status are misconstrued.

Cave-dwelling bats are obligatory hibernators. In order to survive winters (and concomitant dearth of invertebrate prey) cave-dwelling bats colonies overwinter in caves. Fat reserves are accumulated during summer's profuse aerial prey and during hibernation used as 'fuel' when overwintering at much-reduced physiological processes (viz. one heart-beat per minute). Should hibernating bats be disturbed, they use fat reserves at an accelerated physiological rate to 'wake up' in order to flee. It follows that should they are often disturbed (such as by cave explorers), bats run out of fuel before the advent of summer and abundant invertebrate prey, and succumb from lack of 'fuel'.

7.2 AVIFAUNA

7.2.1 Bird Habitat Assessment

The proposed road upgrade, Shangoni Gate and associated infrastructure fall within Kruger National Park, an area of global conservation significance and an Important Bird and Biodiversity Area (IBA) recognized both regionally and globally (Marnewick et al. 2015).

7.2.2 Avian habitats

Avian habitats along the route of the proposed road upgrade, and at the sites of the new gate, reception area, picnic site and tented camp, can be categorized as follows:

- Mopane (*Colophospermum mopane*) woodland – the dominant habitat type in the area is mopane woodland of medium height. The woodland is comparatively homogenous, although there are occasional patches of mixed woodland consisting of a mix of mopane, *Terminalia* and other species.

- Riparian vegetation – the vegetation lining the Shingwedzi River and its tributaries consists of larger trees, including jackal berry, nyala berry and figs, as well as patches of dry thicket. The riparian vegetation occurs in a fairly narrow band along the river. The trees in the riparian band provide nesting sites for a number of large raptors, including the *Critically Endangered* White-backed Vulture.

7.2.3 Avifauna

The avian communities along the route of the proposed road are largely typical of those occurring in mopane woodland and riparian habitats. The area holds a number of threatened species, including several large raptors for which Kruger National Park serves as an important stronghold.

A total of 132 species were confirmed to be present at the site, and the occurrence of an additional 123 species is considered likely (Table 1). These include a number of red-listed species (Table 2).

Table 3: ***Bird species recorded in the area considered for the desktop survey (Figure 1). The current (2015) status of each red-listed species is provided (NT = Near Threatened; VU = Vulnerable; EN = Endangered; CR = Critically Endangered), and the likelihood of each species occurring at the site is rated as confirmed, high, medium or low.***

English name	Scientific name	Red Data Status	Likelihood of Occurrence
Apalis, Bar-throated	*Apalis thoracica*		Low
Apalis, Yellow-breasted	*Apalis flavida*		Confirmed
Avocet, Pied	*Recurvirostra avosetta*		Low
Babbler, Arrow-marked	*Turdoides jardineii*		Confirmed
Barbet, Acacia Pied	*Tricholaema leucomelas*		High
Barbet, Black-collared	*Lybius torquatus*		High
Barbet, Crested	*Trachyphonus vaillantii*		Confirmed
Bateleur, Bateleur	*Terathopius ecaudatus*	EN	Confirmed
Batis, Chinspot	*Batis molitor*		Confirmed
Bee-eater, Blue-cheeked	*Merops persicus*		Low
Bee-eater, European	*Merops apiaster*		Confirmed
Bee-eater, Little	*Merops pusillus*		High
Bee-eater, Southern Carmine	*Merops nubicoides*		High
Bee-eater, White-fronted	*Merops bullockoides*		Confirmed
Bishop, Southern Red	*Euplectes orix*		Medium
Bishop, Yellow-crowned	*Euplectes afer*		High

Bittern, Dwarf	*Ixobrychus sturmii*		Low
Bittern, Little	*Ixobrychus minutus*		Low
Boubou, Southern	*Laniarius ferrugineus*		High
Boubou, Tropical	*Laniarius aethiopicus*		Low
Brownbul, Terrestrial	*Phyllastrephus terrestris*		High
Brubru, Brubru	*Nilaus afer*		Confirmed
Buffalo-weaver, Red-billed	*Bubalornis niger*		Confirmed
Bulbul, Dark-capped	*Pycnonotus tricolor*		Confirmed
Bunting, Cinnamon-breasted	*Emberiza tahapisi*		Confirmed
Bunting, Golden-breasted	*Emberiza flaviventris*		High
Bunting, Lark-like	*Emberiza impetuani*		Confirmed
Bush-shrike, Gorgeous	*Telophorus quadricolor*		Low
Bush-shrike, Grey-headed	*Malaconotus blanchoti*		Confirmed
Bush-shrike, Orange-breasted	*Telophorus sulfureopectus*		Confirmed
Bustard, Black-bellied	*Lissotis melanogaster*		High
Bustard, Kori	*Ardeotis kori*	NT	Medium
Buttonquail, Kurrichane	*Turnix sylvaticus*		High
Buzzard, Lizard	*Kaupifalco monogrammicus*		Confirmed
Buzzard, Steppe	*Buteo vulpinus*		High
Camaroptera, Green-backed	*Camaroptera brachyura*		Confirmed
Camaroptera, Grey-backed	*Camaroptera brevicaudata*		Confirmed
Canary, Yellow-fronted	*Crithagra mozambicus*		Confirmed
Chat, Arnot's	*Myrmecocichla arnoti*		Medium
Chat, Familiar	*Cercomela familiaris*		Low
Cisticola, Croaking	*Cisticola natalensis*		Medium
Cisticola, Desert	*Cisticola aridulus*		Medium
Cisticola, Luapula	*Cisticola luapula*		Low
Cisticola, Rattling	*Cisticola chiniana*		Confirmed
Cisticola, Red-faced	*Cisticola erythrops*		Confirmed
Cisticola, Rufous-winged	*Cisticola galactotes*		Low
Cisticola, Zitting	*Cisticola juncidis*		High
Cliff-chat, Mocking	*Thamnolaea cinnamomeiventris*		Low
Coot, Red-knobbed	*Fulica cristata*		Low
Cormorant, Reed	*Phalacrocorax africanus*		High
Cormorant, White-breasted	*Phalacrocorax carbo*		High
Coucal, Black	*Centropus grillii*		Low
Coucal, Burchell's	*Centropus burchellii*		Confirmed
Coucal, White-browed	*Centropus superciliosus*		Low
Courser, Bronze-winged	*Rhinoptilus chalcopterus*		High
Courser, Temminck's	*Cursorius temminckii*		Low
Courser, Three-banded	*Rhinoptilus cinctus*		Low
Crake, African	*Crecopsis egregia*		Low
Crake, Baillon's	*Porzana pusilla*		Low
Crake, Black	*Amaurornis flavirostris*		High

Crake, Corn	*Crex crex*		Low
Crested-flycatcher, Blue-mantled	*Trochocercus cyanomelas*		Low
Crombec, Long-billed	*Sylvietta rufescens*		Confirmed
Crow, Pied	*Corvus albus*		High
Cuckoo-shrike, Black	*Campephaga flava*		Confirmed
Cuckoo-shrike, Grey	*Coracina caesia*		Low
Cuckoo-shrike, White-breasted	*Coracina pectoralis*		Low
Cuckoo, African	*Cuculus gularis*		High
Cuckoo, Black	*Cuculus clamosus*		Low
Cuckoo, Common	*Cuculus canorus*		Low
Cuckoo, Diderick	*Chrysococcyx caprius*		High
Cuckoo, Great Spotted	*Clamator glandarius*		High
Cuckoo, Jacobin	*Clamator jacobinus*		Confirmed
Cuckoo, Klaas's	*Chrysococcyx klaas*		High
Cuckoo, Levaillant's	*Clamator levaillantii*		High
Cuckoo, Red-chested	*Cuculus solitarius*		High
Cuckoo, Thick-billed	*Pachycoccyx audeberti*		Low
Darter, African	*Anhinga rufa*		High
Dove, African Mourning	*Streptopelia decipiens*		Confirmed
Dove, Laughing	*Streptopelia senegalensis*		Confirmed
Dove, Namaqua	*Oena capensis*		Confirmed
Dove, Red-eyed	*Streptopelia semitorquata*		Confirmed
Dove, Rock	*Columba livia*		High
Dove, Tambourine	*Turtur tympanistria*		Medium
Drongo, Fork-tailed	*Dicrurus adsimilis*		Confirmed
Duck, African Black	*Anas sparsa*		High
Duck, Comb	*Sarkidiornis melanotos*		High
Duck, Fulvous	*Dendrocygna bicolor*		Low
Duck, White-backed	*Thalassornis leuconotus*		Low
Duck, White-faced	*Dendrocygna viduata*		Confirmed
Duck, Yellow-billed	*Anas undulata*		Low
Eagle-owl, Spotted	*Bubo africanus*		High
Eagle-owl, Verreaux's	*Bubo lacteus*		High
Eagle, Booted	*Aquila pennatus*		Confirmed
Eagle, Lesser Spotted	*Aquila pomarina*		High
Eagle, Martial	*Polemaetus bellicosus*	EN	Confirmed
Eagle, Steppe	*Aquila nipalensis*		High
Eagle, Tawny	*Aquila rapax*	EN	Confirmed
Eagle, Verreaux's	*Aquila verreauxii*	VU	Low
Eagle, Wahlberg's	*Aquila wahlbergi*		High
Egret, Cattle	*Bubulcus ibis*		High
Egret, Great	*Egretta alba*		Confirmed
Egret, Little	*Egretta garzetta*		High
Egret, Yellow-billed	*Egretta intermedia*		High

Eremomela, Burnt-necked	*Eremomela usticollis*		High
Eremomela, Green-capped	*Eremomela scotops*		High
Eremomela, Yellow-bellied	*Eremomela icteropygialis*		High
Falcon, Amur	*Falco amurensis*		High
Falcon, Lanner	*Falco biarmicus*	VU	Low
Falcon, Peregrine	*Falco peregrinus*		Low
Falcon, Red-footed	*Falco vespertinus*	NT	Low
Finch, Cut-throat	*Amadina fasciata*		High
Finch, Red-headed	*Amadina erythrocephala*		Low
Firefinch, African	*Lagonosticta rubricata*		High
Firefinch, Jameson's	*Lagonosticta rhodopareia*		High
Firefinch, Red-billed	*Lagonosticta senegala*		Confirmed
Fish-eagle, African	*Haliaeetus vocifer*		Confirmed
Flamingo, Greater	*Phoenicopterus ruber*	NT	Low
Flycatcher, African Dusky	*Muscicapa adusta*		Medium
Flycatcher, Ashy	*Muscicapa caerulescens*		High
Flycatcher, Fiscal	*Sigelus silens*		Low
Flycatcher, Pale	*Bradornis pallidus*		Confirmed
Flycatcher, Southern Black	*Melaenornis pammelaina*		Confirmed
Flycatcher, Spotted	*Muscicapa striata*		High
Francolin, Coqui	*Peliperdix coqui*		Confirmed
Francolin, Crested	*Dendroperdix sephaena*		Confirmed
Francolin, Shelley's	*Scleroptila shelleyi*		Low
Go-away-bird, Grey	*Corythaixoides concolor*		Confirmed
Goose, Egyptian	*Alopochen aegyptiacus*		Confirmed
Goose, Spur-winged	*Plectropterus gambensis*		High
Goshawk, African	*Accipiter tachiro*		Low
Goshawk, Dark Chanting	*Melierax metabates*		High
Goshawk, Gabar	*Melierax gabar*		Confirmed
Grebe, Little	*Tachybaptus ruficollis*		Medium
Green-pigeon, African	*Treron calvus*		Confirmed
Greenbul, Sombre	*Andropadus importunus*		High
Greenbul, Yellow-bellied	*Chlorocichla flaviventris*		High
Greenshank, Common	*Tringa nebularia*		High
Ground-hornbill, Southern	*Bucorvus leadbeateri*	EN	Confirmed
Guineafowl, Crested	*Guttera edouardi*		Low
Guineafowl, Helmeted	*Numida meleagris*		High
Gull, Grey-headed	*Larus cirrocephalus*		Low
Hamerkop, Hamerkop	*Scopus umbretta*		Confirmed
Harrier-Hawk, African	*Polyboroides typus*		High
Harrier, Montagu's	*Circus pygargus*		Low
Harrier, Pallid	*Circus macrourus*	NT	Low
Hawk-eagle, African	*Aquila spilogaster*		Confirmed
Hawk, African Cuckoo	*Aviceda cuculoides*		Low

Hawk, Bat	*Macheiramphus alcinus*	EN	Low
Helmet-shrike, Retz's	*Prionops retzii*		Confirmed
Helmet-shrike, White-crested	*Prionops plumatus*		Confirmed
Heron, Black	*Egretta ardesiaca*		Medium
Heron, Black-headed	*Ardea melanocephala*		High
Heron, Goliath	*Ardea goliath*		Confirmed
Heron, Green-backed	*Butorides striata*		High
Heron, Grey	*Ardea cinerea*		Confirmed
Heron, Purple	*Ardea purpurea*		Low
Heron, Squacco	*Ardeola ralloides*		Medium
Hobby, Eurasian	*Falco subbuteo*		Medium
Honey-buzzard, European	*Pernis apivorus*		Low
Honeybird, Brown-backed	*Prodotiscus regulus*		Low
Honeyguide, Greater	*Indicator indicator*		Confirmed
Honeyguide, Lesser	*Indicator minor*		High
Hoopoe, African	*Upupa africana*		Confirmed
Hornbill, African Grey	*Tockus nasutus*		Confirmed
Hornbill, Crowned	*Tockus alboterminatus*		Low
Hornbill, Red-billed	*Tockus erythrorhynchus*		Confirmed
Hornbill, Southern Yellow-billed	*Tockus leucomelas*		Confirmed
Hornbill, Trumpeter	*Bycanistes bucinator*		Low
House-martin, Common	*Delichon urbicum*		High
Ibis, African Sacred	*Threskiornis aethiopicus*		Medium
Ibis, Glossy	*Plegadis falcinellus*		Low
Ibis, Hadeda	*Bostrychia hagedash*		Confirmed
Indigobird, Dusky	*Vidua funerea*		High
Indigobird, Purple	*Vidua purpurascens*		High
Indigobird, Village	*Vidua chalybeata*		Confirmed
Jacana, African	*Actophilornis africanus*		Confirmed
Kestrel, Dickinson's	*Falco dickinsoni*		Medium
Kestrel, Lesser	*Falco naumanni*		Low
Kestrel, Rock	*Falco rupicolus*		Low
Kingfisher, Brown-hooded	*Halcyon albiventris*		Confirmed
Kingfisher, Giant	*Megaceryle maximus*		High
Kingfisher, Grey-headed	*Halcyon leucocephala*		High
Kingfisher, Half-collared	*Alcedo semitorquata*	NT	Low
Kingfisher, Malachite	*Alcedo cristata*		High
Kingfisher, Pied	*Ceryle rudis*		Confirmed
Kingfisher, Striped	*Halcyon chelicuti*		Confirmed
Kingfisher, Woodland	*Halcyon senegalensis*		High
Kite, Black	*Milvus migrans*		Low
Kite, Black-shouldered	*Elanus caeruleus*		High
Kite, Yellow-billed	*Milvus aegyptius*		Confirmed
Korhaan, Red-crested	*Lophotis ruficrista*		Confirmed

Lapwing, African Wattled	*Vanellus senegallus*		High
Lapwing, Blacksmith	*Vanellus armatus*		Confirmed
Lapwing, Crowned	*Vanellus coronatus*		Confirmed
Lapwing, Senegal	*Vanellus lugubris*		High
Lapwing, White-crowned	*Vanellus albiceps*		Low
Lark, Dusky	*Pinarocorys nigricans*		High
Lark, Flappet	*Mirafra rufocinnamomea*		High
Lark, Monotonous	*Mirafra passerina*		Confirmed
Lark, Red-capped	*Calandrella cinerea*		Low
Lark, Rufous-naped	*Mirafra africana*		High
Lark, Sabota	*Calendulauda sabota*		Confirmed
Longclaw, Yellow-throated	*Macronyx croceus*		Low
Mannikin, Bronze	*Spermestes cucullatus*		High
Martin, Brown-throated	*Riparia paludicola*		High
Martin, Rock	*Hirundo fuligula*		Low
Martin, Sand	*Riparia riparia*		Low
Masked-weaver, Lesser	*Ploceus intermedius*		High
Masked-weaver, Southern	*Ploceus velatus*		Confirmed
Moorhen, Common	*Gallinula chloropus*		Low
Moorhen, Lesser	*Gallinula angulata*		Medium
Mousebird, Red-faced	*Urocolius indicus*		Confirmed
Mousebird, Speckled	*Colius striatus*		Confirmed
Myna, Common	*Acridotheres tristis*		Medium
Neddicky, Neddicky	*Cisticola fulvicapilla*		Confirmed
Nicator, Eastern	*Nicator gularis*		Low
Night-Heron, Black-crowned	*Nycticorax nycticorax*		Low
Night-Heron, White-backed	*Gorsachius leuconotus*	VU	High
Nightingale, Thrush	*Luscinia luscinia*		Low
Nightjar, European	*Caprimulgus europaeus*		Low
Nightjar, Fiery-necked	*Caprimulgus pectoralis*		Confirmed
Nightjar, Freckled	*Caprimulgus tristigma*		High
Nightjar, Pennant-winged	*Macrodipteryx vexillarius*		Low
Nightjar, Rufous-cheeked	*Caprimulgus rufigena*		Low
Nightjar, Square-tailed	*Caprimulgus fossii*		Confirmed
Openbill, African	*Anastomus lamelligerus*		Confirmed
Oriole, African Golden	*Oriolus auratus*		Low
Oriole, Black-headed	*Oriolus larvatus*		Confirmed
Oriole, Eurasian Golden	*Oriolus oriolus*		High
Osprey, Osprey	*Pandion haliaetus*		Low
Ostrich, Common	*Struthio camelus*		Low
Owl, Barn	*Tyto alba*		High
Owl, Marsh	*Asio capensis*		Low
Owlet, African Barred	*Glaucidium capense*		Low
Owlet, Pearl-spotted	*Glaucidium perlatum*		Confirmed

Oxpecker, Red-billed	*Buphagus erythrorhynchus*		Confirmed
Oxpecker, Yellow-billed	*Buphagus africanus*		Confirmed
Painted-snipe, Greater	*Rostratula benghalensis*	NT	Low
Palm-swift, African	*Cypsiurus parvus*		Confirmed
Paradise-flycatcher, African	*Terpsiphone viridis*		High
Paradise-whydah, Long-tailed	*Vidua paradisaea*		Confirmed
Parrot, Brown-headed	*Poicephalus cryptoxanthus*		Confirmed
Parrot, Grey-headed	*Poicephalus fuscicollis*		Low
Pelican, Great White	*Pelecanus onocrotalus*	VU	Low
Pelican, Pink-backed	*Pelecanus rufescens*	VU	Low
Penduline-tit, Grey	*Anthoscopus caroli*		High
Petronia, Yellow-throated	*Petronia superciliaris*		High
Pigeon, Speckled	*Columba guinea*		Low
Pipit, African	*Anthus cinnamomeus*		High
Pipit, Buffy	*Anthus vaalensis*		Medium
Pipit, Bushveld	*Anthus caffer*		Low
Pipit, Plain-backed	*Anthus leucophrys*		Low
Pipit, Striped	*Anthus lineiventris*		Low
Plover, Caspian	*Charadrius asiaticus*		Low
Plover, Chestnut-banded	*Charadrius pallidus*	NT	Low
Plover, Common Ringed	*Charadrius hiaticula*		Low
Plover, Kittlitz's	*Charadrius pecuarius*		Medium
Plover, Three-banded	*Charadrius tricollaris*		Confirmed
Plover, White-fronted	*Charadrius marginatus*		Low
Pochard, Southern	*Netta erythrophthalma*		Low
Pratincole, Collared	*Glareola pratincola*		Low
Prinia, Tawny-flanked	*Prinia subflava*		Confirmed
Puffback, Black-backed	*Dryoscopus cubla*		Confirmed
Pygmy-Goose, African	*Nettapus auritus*	VU	Low
Pygmy-Kingfisher, African	*Ispidina picta*		Low
Pytilia, Green-winged	*Pytilia melba*		Confirmed
Quail, Common	*Coturnix coturnix*		Low
Quail, Harlequin	*Coturnix delegorguei*		High
Quailfinch, African	*Ortygospiza atricollis*		High
Quelea, Red-billed	*Quelea quelea*		High
Reed-warbler, African	*Acrocephalus baeticatus*		Low
Reed-warbler, Great	*Acrocephalus arundinaceus*		Low
Robin-chat, Red-capped	*Cossypha natalensis*		High
Robin-chat, White-browed	*Cossypha heuglini*		Confirmed
Robin-chat, White-throated	*Cossypha humeralis*		High
Roller, Broad-billed	*Eurystomus glaucurus*		High
Roller, European	*Coracias garrulus*	NT	High
Roller, Lilac-breasted	*Coracias caudatus*		Confirmed
Roller, Purple	*Coracias naevius*		Confirmed

Roller, Racket-tailed	*Coracias spatulatus*		Low
Ruff, Ruff	*Philomachus pugnax*		Medium
Rush-warbler, Little	*Bradypterus baboecala*		Low
Sandgrouse, Double-banded	*Pterocles bicinctus*		Confirmed
Sandpiper, Common	*Actitis hypoleucos*		High
Sandpiper, Curlew	*Calidris ferruginea*		Low
Sandpiper, Green	*Tringa ochropus*		Low
Sandpiper, Marsh	*Tringa stagnatilis*		Low
Sandpiper, Wood	*Tringa glareola*		Confirmed
Saw-wing, Black (Southern race)	*Psalidoprocne holomelaena*		Low
Scimitarbill, Common	*Rhinopomastus cyanomelas*		Confirmed
Scops-owl, African	*Otus senegalensis*		Confirmed
Scops-owl, Southern White-faced	*Ptilopsus granti*		High
Scrub-robin, Bearded	*Cercotrichas quadrivirgata*		Medium
Scrub-robin, White-browed	*Cercotrichas leucophrys*		Confirmed
Secretarybird	*Sagittarius serpentarius*	VU	Medium
Seedeater, Streaky-headed	*Crithagra gularis*		Low
Shikra, Shikra	*Accipiter badius*		High
Shrike, Lesser Grey	*Lanius minor*		High
Shrike, Magpie	*Corvinella melanoleuca*		Confirmed
Shrike, Red-backed	*Lanius collurio*		High
Shrike, Southern White-crowned	*Eurocephalus anguitimens*		High
Snake-eagle, Black-chested	*Circaetus pectoralis*		Confirmed
Snake-eagle, Brown	*Circaetus cinereus*		Confirmed
Snipe, African	*Gallinago nigripennis*		Low
Sparrow-weaver, White-browed	*Plocepasser mahali*		High
Sparrow, Cape	*Passer melanurus*		Low
Sparrow, House	*Passer domesticus*		Confirmed
Sparrow, Northern Grey-headed	*Passer griseus*		Low
Sparrow, Southern Grey-headed	*Passer diffusus*		Confirmed
Sparrowhawk, Black	*Accipiter melanoleucus*		Low
Sparrowhawk, Little	*Accipiter minullus*		High
Sparrowhawk, Ovambo	*Accipiter ovampensis*		Low
Sparrowlark, Chestnut-backed	*Eremopterix leucotis*		High
Sparrowlark, Grey-backed	*Eremopterix verticalis*		Low
Spinetail, Böhm's	*Neafrapus boehmi*		Low
Spoonbill, African	*Platalea alba*		High
Spurfowl, Natal	*Pternistis natalensis*		Confirmed
Spurfowl, Swainson's	*Pternistis swainsonii*		Confirmed
Starling, Burchell's	*Lamprotornis australis*		Medium
Starling, Cape Glossy	*Lamprotornis nitens*		Confirmed
Starling, Greater Blue-eared	*Lamprotornis chalybaeus*		Confirmed
Starling, Red-winged	*Onychognathus morio*		Low
Starling, Violet-backed	*Cinnyricinclus leucogaster*		High

Starling, Wattled	*Creatophora cinerea*		High
Stilt, Black-winged	*Himantopus himantopus*		High
Stint, Little	*Calidris minuta*		Low
Stonechat, African	*Saxicola torquatus*		Low
Stork, Abdim's	*Ciconia abdimii*	NT	Low
Stork, Black	*Ciconia nigra*	VU	Confirmed
Stork, Marabou	*Leptoptilos crumeniferus*	NT	Confirmed
Stork, Saddle-billed	*Ephippiorhynchus senegalensis*	EN	Confirmed
Stork, White	*Ciconia ciconia*		Low
Stork, Woolly-necked	*Ciconia episcopus*		High
Stork, Yellow-billed	*Mycteria ibis*	EN	Confirmed
Sunbird, Amethyst	*Chalcomitra amethystina*		Low
Sunbird, Collared	*Hedydipna collaris*		Medium
Sunbird, Marico	*Cinnyris mariquensis*		High
Sunbird, Scarlet-chested	*Chalcomitra senegalensis*		Confirmed
Sunbird, White-bellied	*Cinnyris talatala*		Confirmed
Swallow, Barn	*Hirundo rustica*		High
Swallow, Greater Striped	*Hirundo cucullata*		Low
Swallow, Grey-rumped	*Pseudhirundo griseopyga*		Low
Swallow, Lesser Striped	*Hirundo abyssinica*		Confirmed
Swallow, Mosque	*Hirundo senegalensis*		Confirmed
Swallow, Pearl-breasted	*Hirundo dimidiata*		High
Swallow, Red-breasted	*Hirundo semirufa*		High
Swallow, Wire-tailed	*Hirundo smithii*		Confirmed
Swamp-warbler, Lesser	*Acrocephalus gracilirostris*		Low
Swamphen, African Purple	*Porphyrio madagascariensis*		Low
Swift, African Black	*Apus barbatus*		High
Swift, Alpine	*Tachymarptis melba*		High
Swift, Common	*Apus apus*		Medium
Swift, Horus	*Apus horus*		Low
Swift, Little	*Apus affinis*		Confirmed
Swift, White-rumped	*Apus caffer*		Confirmed
Tchagra, Black-crowned	*Tchagra senegalus*		Confirmed
Tchagra, Brown-crowned	*Tchagra australis*		Confirmed
Teal, Cape	*Anas capensis*		Low
Teal, Hottentot	*Anas hottentota*		Low
Teal, Red-billed	*Anas erythrorhyncha*		Medium
Tern, Whiskered	*Chlidonias hybrida*		Low
Tern, White-winged	*Chlidonias leucopterus*		Low
Thick-knee, Spotted	*Burhinus capensis*		High
Thick-knee, Water	*Burhinus vermiculatus*		Confirmed
Thrush, Groundscraper	*Psophocichla litsipsirupa*		Confirmed
Thrush, Kurrichane	*Turdus libonyanus*		Confirmed
Tinkerbird, Yellow-fronted	*Pogoniulus chrysoconus*		High

Tit-babbler, Chestnut-vented	*Parisoma subcaeruleum*		Low
Tit-flycatcher, Grey	*Myioparus plumbeus*		High
Tit, Southern Black	*Parus niger*		Confirmed
Turaco, Purple-crested	*Gallirex porphyreolophus*		Low
Turtle-dove, Cape	*Streptopelia capicola*		Confirmed
Vulture, Cape	*Gyps coprotheres*	EN	High
Vulture, Hooded	*Necrosyrtes monachus*	CR	Confirmed
Vulture, Lappet-faced	*Torgos tracheliotus*	EN	High
Vulture, White-backed	*Gyps africanus*	CR	Confirmed
Vulture, White-headed	*Trigonoceps occipitalis*	CR	High
Wagtail, African Pied	*Motacilla aguimp*		Confirmed
Wagtail, Cape	*Motacilla capensis*		High
Warbler, Garden	*Sylvia borin*		Low
Warbler, Icterine	*Hippolais icterina*		High
Warbler, Marsh	*Acrocephalus palustris*		Low
Warbler, Olive-tree	*Hippolais olivetorum*		Medium
Warbler, River	*Locustella fluviatilis*		Low
Warbler, Willow	*Phylloscopus trochilus*		High
Waxbill, Blue	*Uraeginthus angolensis*		Confirmed
Waxbill, Common	*Estrilda astrild*		High
Waxbill, Orange-breasted	*Amandava subflava*		Low
Waxbill, Violet-eared	*Granatina granatina*		High
Weaver, Golden	*Ploceus xanthops*		Low
Weaver, Red-headed	*Anaplectes rubriceps*		Confirmed
Weaver, Spectacled	*Ploceus ocularis*		Confirmed
Weaver, Thick-billed	*Amblyospiza albifrons*		High
Weaver, Village	*Ploceus cucullatus*		High
White-eye, Cape	*Zosterops virens*		High
White-eye, Orange River	*Zosterops pallidus*		Low
Whydah, Pin-tailed	*Vidua macroura*		Confirmed
Whydah, Shaft-tailed	*Vidua regia*		High
Widowbird, Red-collared	*Euplectes ardens*		Low
Widowbird, White-winged	*Euplectes albonotatus*		Medium
Wood-dove, Emerald-spotted	*Turtur chalcospilos*		Confirmed
Wood-hoopoe, Green	*Phoeniculus purpureus*		Confirmed
Wood-owl, African	*Strix woodfordii*		Low
Woodpecker, Bearded	*Dendropicos namaquus*		High
Woodpecker, Bennett's	*Campethera bennettii*		High
Woodpecker, Cardinal	*Dendropicos fuscescens*		Confirmed
Woodpecker, Golden-tailed	*Campethera abingoni*		Confirmed
Wren-warbler, Stierling's	*Calamonastes stierlingi*		High

7.2.3 Threatened Species

A total of 30 Near Threatened or Threatened bird species have been recorded in the area considered during the desktop survey (Table 2). The presence of 10 of these species was confirmed during the surveys, and several more are known to occur in the area. The most significant potential impact related to threatened species identified during the surveys involves the presence of several active nests of the *Critically Endangered* White-backed Vulture in trees along the Shingwedzi River in the vicinity of the proposed picnic site and tented camp. The Red Data status of the White-backed Vulture has recently been changed from *Vulnerable* to *Critically Endangered* on account of catastrophic population declines. In light of the rapidly deteriorating conservation status of this species, a strongly precautionary approach is needed when preventing negative impacts on these breeding individuals. It is strongly recommended that a buffer zone with a radius of 0.5 km around each nest be strictly observed, with no activities whatsoever allowed to take place within these buffer zones (discussed further below).

Table 4: ***Location of White-backed Vulture nests along Shingwedzi River in vicinity of proposed picnic site, campsite and tented camp (see Figure 2).***

Nest code	Latitude (S)	Longitude (E)
WBV nest 1	23°11'39.94"	31°01'39.26"E
WBV nest 2	23°11'48.67"	31°02'05.23"E
WBV nest 3	23°11'27.40"	31°02'23.80"E

Table 5: ***Red-listed species whose possible presence at the site of the proposed road, gate and associated infrastructure was evaluated during the assessment process. Species whose presence was confirmed during the surveys are indicated in bold font.***

Species	Scientific name	Red Data[1]	NEMBA2	Assessment of likelihood of presence at site
Pelican, Pink-backed	*Pelecanus rufescens*	VU	EN	Unlikely. No suitable habitat – occurs in large water bodies
Pelican, Great White	*Pelecanus onocrotalus*	VU		Unlikely. No suitable habitat – occurs in large water bodies
Night-Heron, White-backed	*Gorsachius leuconotus*	VU		Likely to occur along suitably vegetated sections of the Shingwedzi river.
Stork, Marabou	***Leptoptilos crumeniferus***	**NT**		**Confirmed**
Stork, Saddle-billed	***Ephippiorhynchus senegalensis***	**EN**	**EN**	**Confirmed**
Stork, Yellow-billed	***Mycteria ibis***	**EN**		**Confirmed**
Stork, Abdim's	*Ciconia abdimii*	NT		Possible, but unlikely. Occurs in grasslands, woodlands and cultivated fields in rural areas, and is unlikely to venture into mopane.
Stork, Black	***Ciconia nigra***	**VU**	**VU**	**Confirmed**
Flamingo, Greater	*Phoenicopterus ruber*	NT		Unlikely. No suitable habitat – occurs in lakes and pans.
Pygmy-goose, African	*Nettapus auritus*	VU		Unlikely. Occurs in permanent standing water bodies such as large dams.
Secretarybird	*Sagittarius serpentarius*	VU		Possible, but unlikely. Typically occurs in more open grassland habitats, but could venture into mopane on occasion.
Vulture, Cape	*Gyps coprotheres*	EN	EN	Likely to occur in the area when feeding on carcasses. Cliff-nester, so extremely unlikely to breed in the area.
Vulture, White-backed	***Gyps africanus***	**CR**	**EN**	**Confirmed - several active nests near proposed tented camp and picnic site locations. Discussed further in text.**
Vulture, Lappet-faced	*Torgos tracheliotus*	EN	EN	Known to occur in area, even though was not seen during surveys
Vulture, White-headed	*Trigonoceps occipitalis*	CR	VU	Known to occur in area, even though was not seen during surveys
Vulture, Hooded	***Necrosyrtes monachus***	**CR**	**EN**	**Confirmed.**
Falcon, Lanner	*Falco biarmicus*	VU		Possible, but habitats in the area are unlikely to be important foraging area.
Falcon, Red-footed	*Falco vespertinus*	NT		Unlikely – does not use mopane habitats

Hawk, Bat	*Macheiramphus alcinus*	EN		Possible. Has been recorded on several occasions near Shingwedzi Camp. Habitat in this area likely too dry for it to occur regularly.
Eagle, Verreaux's	*Aquila verreauxii*	VU		Unlikely – mainly confined to mountainous habitats
Eagle, Tawny	***Aquila rapax***	**EN**	**VU**	**Confirmed**
Eagle, Martial	***Polemaetus bellicosus***	**EN**	**VU**	**Confirmed**
Bateleur, Bateleur	***Terathopius ecaudatus***	**EN**	**VU**	**Confirmed**
Harrier, Pallid	*Circus macrourus*	NT		Unlikely – no suitable habitat.
Bustard, Kori	*Ardeotis kori*	NT	VU	Possible. Generally associated with more open habitats than occur along road route, but some individuals may occur in mopane.
Painted-snipe, Greater	*Rostratula benghalensis*	NT		Unlikely. Occurs in thick vegetation along the edges of water bodies.
Plover, Chestnut-banded	*Charadrius pallidus*	NT		Unlikely. No suitable habitat.
Kingfisher, Half-collared	*Alcedo semitorquata*	NT		Unlikely. No suitable habitat – clear, vegetated fast-flowing streams.
Roller, European	*Coracias garrulus*	NT		High – the fact that this migratory species was not seen during surveys likely reflects the time of year.
Ground-Hornbill, Southern	***Bucorvus leadbeateri***	**EN**	**PR**	**Confirmed – several groups seen along the route of the road.**

[1]Current (2015) IUCN Red List Status for South Africa, Lesotho and Swaziland (Taylor et al. 2015). NT = *Near Threatened*; VU = *Vulnerable*; EN = *Endangered*; CR = *Critically Endangered.* [2]Indicates species listed as Protected ("PR"), Vulnerable ("VU"), Endangered ('EN") or Critically Endangered ("CR") in the National Environmental Management: Biodiversity Act, 2004 list of Threatened or Protected Species (2007 version.

7.3 HERPETOFAUNA

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 global distribution ranges.

7.3.1 Herpetofauna Habitat Assessment

From a herpetological habitat perspective, it was established that three of the four major habitats are naturally present on the study site, namely terrestrial, arboreal and wetland-associated vegetation cover.

Most of the study site is pristine and natural habitat has been transformed by anthropogenic influences in only a few places for gravel roads and low water bridges. The soils of the study site are generally embedded with rocks and gravel, which provide cover for small herpetofauna. Moribund termitaria were recorded on the study site. These structures are good indicators of the occurrence of small herpetofauna. Accordingly, it is estimated that the reptile and amphibian population density for the study site is higher. At the time of the site visit the basal cover was poor due to the drought and grazing by game and would not provide adequate cover for small terrestrial herpetofauna. Due to the drought and the fact that Mopane woodland in general does not have a lot of grass, their prey is probably widely distributed; foraging grounds would need to be extensive to support the different populations of herpetofauna.

Although rupiculous habitat is present near the study site, it is absent within the development zone and the 500 metres adjacent areas. Most rupiculous species would be indicated as a *Low* probability of occurring based on ecological parameters. Due to the absence of natural rupiculous habitat, some species like the common flat lizard and common giant plated lizard were omitted from the species list.

The Shingwedzi River is seasonal but during normal rainfall seasons a number of hippo pools remain during winter and provide water for water-dependent herpetofauna, including the Nile crocodile. A number of dry washes decant storm water into the Shingwedzi River and the Tshanga tributary. These drainage lines are corridors for herpetofauna movement. Small pans in the woodlands provide habitat for frog species that breed in temporary water. All wetlands are protected in Limpopo Province and are regarded as sensitive.

An important feature of the study site is the Mopane woodland. Other indigenous trees occur mainly along the riparian zones, which include apple leaf, leadwood, jackal berry, nyala berry and fig-tree. These trees grow in deeper alluvial soils. Arboreal habitat is therefore present in a functional sense and all Lowveld arboreal herpetofauna should be present on the study site. There are several dead logs, which provide shelter and food for some herpetofauna.

7.3.2 Observed and Expected Herpetofauna Species Richness

74 reptile species may occur on the study site (Table 4) as well as a possible 26 amphibian species (Table 4).

Many of these herpetofauna species are robust generalists with the ability to capitalise on any environment. It should be noted that potential occurrence is interpreted as being possible over a period of time, as a result of expansions and contractions of population densities and ranges which stimulate migration.

The American red-eared terrapin (*Trachemys scripta elegans*) and the Brahminy blind snake (*Ramphotyphlops braminus*) are the only two feral reptile or amphibian species known to occur in South Africa (De Moor and Bruton, 1988; Picker and Griffiths, 2011), but with only a few populations, they are not expected to occur on this particular site.

The species assemblage is typical of what can be expected in extensive natural areas with sufficient habitat to sustain populations. Most of the species of the resident diversity (Table 4) are fairly common and widespread (viz. Turner's gecko, common dwarf gecko, Van Son's gecko, striped rock skink, southern rock monitor, common flap-neck chameleon, southern tree agama, Southern African python, puff adder, brown house snake, Mozambique spitting cobra, boomslang, common egg eater, Muller's platanna, banded rubber frog, tremolo sand frog, Boettger's caco, bubbling kassina, eastern olive toad and southern foam nest frog).

Table 6: Reptile and Amphibian diversity. The species observed or deduced to occupy the site. Systematic arrangement and nomenclature according to Pienaar *et.al* 1976, Pienaar *et.al* 1983, Branch (1998), Minter, *et.al* (2004), Alexander & Marais (2007), Du Preez & Carruthers (2009) and Bates *et.al* (2014)

	SCIENTIFIC NAME	ENGLISH NAME
	CLASS: REPTILIA	REPTILES
	Order: TESTUDINES	TORTOISES & TERRAPINS
	Family: Pelomedusidae	Side-Necked terrapins
*	*Pelomedusa subrufa*	Marsh Terrapin
√	*Pelusios sinuatus*	Serrated Hinged Terrapin
	Family:Testudinidae	Tortoises
√	*Kinixys spekii*	Speke's Hinged-Back Tortoise
√	*Stigmochelys pardalis*	Leopard Tortoise
	Order: Crocodylia	Crocodiles
√Vu	*Crocodylus niloticus*	Nile Crocodile
	Order: SQUAMATA	SCALE-BEARING REPTILES
	Suborder:LACERTILIA	LIZARDS
	Family: Gekkonidae	Geckos
√	*Chondrodactylus turneri*	Turner's Gecko
√	*Hemidactylus mabouia*	Common Tropical House Gecko
*	*Homopholis wahlbergii*	Wahlberg's Velvet Gecko
√	*Lygodactylus capensis capensis*	Common Dwarf Gecko
√	*Pachydactylus vansoni*	Van Son's Gecko
	Family: Amphisbaenidae	Amphisbaenians
?	*Monopeltis decosteri*	De Coster's Worm Lizard
	Family: Lacertidae	Old World Lizards or Lacertids
√	*Heliobolus lugubris*	Bushveld Lizard
√	*Meroles squamulosus*	Savanna Lizard

	SCIENTIFIC NAME	ENGLISH NAME
*	*Nucras intertexta*	Spotted Sandveld Lizard
	Family: Cordylidae	Cordylids
√	*Cordylus jonesii*	Jones' Girdled Lizard
	Family: Gerrhosauridae	Plated Lizards
?	*Broadleysaurus major*	Rough-Scaled Plated Lizard
√	*Gerhosaurus flavigularis*	Yellow-Throated Plated Lizard
?	*Gerhosaurus intermedius*	Eastern Black-Lined Plated Lizard
	Family: Scincidae	Skinks
*	*Acontias plumbeus*	Giant Legless Skink
√	*Afroablepharus maculicollis*	Spotted-Neck Snake-Eyed Skink
*	*Afroablepharus wahlbergii*	Wahlberg's Snake-Eyed Skink
√	*Mochlus sundevallii sundevallii*	Sundevall's Writhing Skink
√	*Trachylepis margaritifer*	Rainbow Skink
√	*Trachylepis striata*	Striped Rock Skink
√	*Trachylepis varia*	Variable Skink
?	*Scelotes bidigittatus*	Lowveld Dwarf Burrowing Skink
	Family: Varanidae	Monitor Lizards
√	*Varanus albigularis albigularis*	Southern Rock Monitor
√	*Varanus niloticus*	Nile Monitor
	Family: Chamaeleonidae	Chameleons
√	*Chamaeleo dilepis dilepis*	Common Flap-Neck Chameleon
	Family: Agamidae	Agamas
√	*Agama aculeata distanti*	Eastern Ground Agama
√	*Acanthocercus atricollis atricollis*	Southern Tree Agama
	Suborder: SERPENTES	SNAKES
	Family: Typhlopidae	Blind Snakes
*	*Megatyphlops schlegelii*	Schlegel's Giant Blind Snake
?	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake
	Family: Leptotyphlopidae	Thread Snakes
*	*Leptotyphlops distanti*	Distant's Thread Snake
*	*Leptotyphlops incognitus*	Incogniti Thread Snake
?	*Leptotyphlops scutifrons*	Peter's Thread Snake
?	*Myriopholis longicauda*	Long-Tailed Thread Snake
	Family:Pythonidae	Pythons
√	*Python natalensis*	Southern African Python
	Family: Viperidae	Adders
√	*Bitis arietans arietans*	Puff Adder
*	*Causus defilippii*	Snouted Night Adder
	Family: Lamprophiidae	
?	*Amblyodipsas polylepis polylepis*	Common Purple-Glossed Snake
√	*Aparallactus capensis*	Black-headed Centipede Eater
?	*Atractaspis bibronii*	Bibron's Stiletto Snake Snake
?	*Xenocalamus bicolor lineatus*	Striped Quill-Snouted Snake
√	*Boaedon capensis*	Common House Snake
?	*Gonionotophis capensis capensis*	Common File Snake
?	*Gonionotophis nyassae*	Black File Snake
?	*Lycodonomorphus inornatus*	Olive Ground Snake
*	*Lycodonomorphus rufulus*	Brown Water Snake
*	*Lycophidion capense capense*	Cape Wolf Snake
?	*Hemirhagerrhis nototaenia*	Eastern Bark Snake
?	*Psammophis angolensis*	Dwarf Sand Snake

	SCIENTIFIC NAME	ENGLISH NAME
√	*Psammophis mossambicus*	Olive Grass Snake
√	*Psammophis subtaeniatus*	Western Yellow-Bellied Sand Snake
*	*Psammophylax tritaeniatus*	Striped Grass Snake
√	*Rhamphiophis rostratus*	Rufous Beaked Snake
?	*Duberria lutrix lutrix*	South African Slug-Eater
?	*Prosymna bivittata*	Two-Striped Shovel-Snout
?	*Prosymna lineata*	Lined Shovel-Snout
√	*Prosymna stuhlmannii*	East African Shovel-Snout
?	*Pseudaspis cana*	Mole Snake
	Family: Elapidae	Cobras, Mambas and Others
*	*Aspidelaps scutatus intermedius*	Intermediate Shield Cobra
√	*Dendroaspis polylepis*	Black Mamba
?	*Elapsoidea boulengeri*	Boulenger's Garter Snake
√	*Naja annulifera*	Snouted Cobra
√	*Naja mossambica*	Mozambique Spitting Cobra
	Family: Colubridae	
√	*Crotaphopeltis hotamboeia*	Red-Lipped Snake
√	*Dasypeltis scabra*	Rhombic Egg Eater
√	*Dispholidus typus*	Boomslang
*	*Philothamnus hoplogaster*	Southeastern Green Snake
*	*Philothamnus semivariegatus*	Spotted Bush Snake
*	*Telescopus semiannulatus semiannulatus*	Eastern Tiger Snake
√	*Thelotornis capensis capensis*	Southern Twig Snake
	CLASS: AMPHIBIA	AMPHIBIANS
	Order: ANURA	FROGS
	Family: Pipidae	Clawed Frogs
√	*Xenopus muelleri*	Muller's Platanna
	Family: Bufonidae	Toads
√	*Poyntonophrynus fenoulheti*	Northern Pygmy Toad
√	*Amietaophrynus garmani*	Eastern Olive Toad
?	*Amietaophrynus gutturalis*	Guttural Toad
?	*Amietaophrynus rangeri*	Raucous Toad
√	*Amietophrynus maculatus*	Flat-Back Toad
?	*Schismaderma carens*	Red Toad
	Family: Hemisotidae	Shovel-Nosed Frogs
√	*Hemisus marmoratus*	Mottled-Shovel-Nosed Frog
	Family: Hyperoliidae	Reed Frogs
√	*Hyperolius pusillus*	Water Lily Frog
√	*Hyperolius marmoratus taeniatus*	Painted Reed Frog
√	*Kassina maculata*	Red-Legged Kassina
√	*Kassina senegalesis*	Bubbling Kassina
	Family: Arthroleptidae	Tree frogs
√	*Leptopelis mossambicus*	Brown-Backed Tree Frog
	Family: Breviceptidae	Rain Frogs
√	*Breviceps adspersus*	Bushveld Rain Frog
	Family: Microhylidae	Rubber frogs
√	*Phrynomantis bifasciatus*	Banded Rubber Frog
	Family: Phrynobatrachidae	Puddle Frog

	SCIENTIFIC NAME	ENGLISH NAME
√	*Phrynobatrachus mababiensis*	Dwarf Puddle Frog
√	*Phrynobatrachus natalensis*	Snoring Puddle Frog
	Family: Ptychadenidae	Grass Frogs
√	*Ptychadena anchietae*	Plain Grass Frog
√	*Ptychadena porosissima*	Broad-Banded Grass Frog
	Family: Pyxicephalidae	
√	*Cocosternum boettgeri*	Boettger's Caco or Common Caco
√	*Hildebrandtia ornata*	Ornata Frog
√	*Pyxicephalus edulis*	Edible Bullfrog
√	*Tomopterna cryptotis*	Tremolo Sand Frog
?	*Tomopterna krugerensis*	Knocking Sand Frog
√	*Tomopterna marmorata*	Russet-Backed Sand Frog
	Family: Rhacophoridae	Foam Nest Frogs
√	*Chiromantis xerampelina*	Southern Foam Nest Frog

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

Red Data species rankings as defined in Branch, The Conservation Status of South Africa's threatened Reptiles': 89 – 103. In:- G.H.Verdoorn & J. le Roux (editors), 'The State of Southern Africa's Species (2002), Minter, *et.al*, Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (2004) and Bates, *et.al*, Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland (2014) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, NT = Near Threatened, DD = Data Deficient. All other species are deemed of Least Concern.

7.3.3. Red Data Listed Herpetofauna Identified
-By the Scientific Community

The study site falls outside the natural range of Woodbush flat gecko; Muller's velvet gecko; granite dwarf gecko; Methuen's dwarf gecko*; c*ryptic dwarf gecko*;* Makgabeng dwarf gecko*;* Soutpansberg dwarf gecko*;* Waterberg dwarf gecko*;* Soutpansberg rock lizard; coppery grass lizard; large-scaled grass lizard; northern crag lizard; unexpected flat lizard; orange-throated flat lizard; Fitzsimons' flat lizard; Eastwood's long-tailed seps; stripe-bellied legless skink; Richard's legless skink; Woodbush legless skink; white-bellied dwarf burrowing skink; striped harlequin snake; northern forest rain frog and giant bullfrogs. None of these species should occur on the study site.

The study site falls inside the natural range of the Southern African python. According to Broadley (1990), Southern African pythons favour moist, rocky, well-wooded valleys, plantations or bush country, but seldom if ever stray far from permanent water. The study site thus provides suitable habitat for the Southern African python. The Southern African python's national status has changed from Vulnerable (Branch, 1988) to regional Least Concern (Alexander, 2014), although it is currently still a ToPS-listed species (Threatened or Protected Species).

The Nile crocodile's national status is Vulnerable (Marias, 2014). In southern Africa, the Nile crocodile is largely restricted to game and nature reserves. It is estimated that there are fewer than 12 000 individuals remaining in the wilds in southern Africa. The greatest threat to the Nile

crocodile is the reduction in habitat resulting from extraction of water for human usage. Water pollution is also a huge threat. All the rivers in the Kruger National park (KNP) flow past industrial areas, and it has been suggested that some crocodile deaths in the KNP are caused by contaminated water. The situation in the Olifants River has been extensively covered by the media. This iconic species is often the only reptile that tourists tick on their "game spotted list" in the KNP, and apart from its importance in biodiversity and the ecological role it plays, this species has huge tourist value. The Shingwedzi River is seasonal, but during normal rainfall seasons a number of hippo pools remain during the winter and would provide habitat for the Nile crocodile.

8. FINDINGS AND POTENTIAL IMPLICATIONS

8.1 Assessment criteria

The road upgrade will spatially be significantly larger than the other aspects of the development. However, the new black-topped road will be an upgrade of the existing gravelled road (S52) and graded track (Shangoni Ranger patrol track) where environmental (as it is) is a *fait accompli*. The pristine terrains for the gate, reception / education facility, the picnic site, tented camp and camping facility will collectively be in the order of < 12 hectares, which is insignificant relative to the extent of the entire park. In this instance the conservation status of the study site is therefore rated as **Medium-*High,*** *i.e. Land where sections are disturbed but that is still ecologically sensitive to development/disturbance*. (See Section 5.4 – Assessment Criteria to express conservation status).

The short new road alignment close to the bridge will be short and will traverse mopane shrub. This development will be modest.

Runoff water from the upgraded road will be managed as on other roads in the Kruger Park, which is rated as adequate.

8.2 Overall Impact Impressions (vertebrates)

- Species richness: The proposed development will yield no noticeable influence of species richness given the extensive nature of the area where the improvements are planned.
- Threatened species: No threatened species will be fatally impacted by the proposed development since their survival potential is accommodated in the rest of the extensive natural areas of the park, contingent on heeding our proposals to safeguard vulture nests against disturbances.
- Sensitive areas: Two issues are red-flagged as sensitive. The first is the riparian zone which is normally regarded as no-go areas. However, we suggest that visitors are allowed controlled access to riparian zones to maximize wildlife sightings and ambiance. To compensate for this concession we propose a "light footprint" development in especially riparian zones where no large trees are to be sacrificed. The second issue to address is the proximity of three White-backed Vulture nests in the vicinity of the five southernmost proposed development sites (Figure 10); - we advise against these in favour of five northernmost sites closest to the black-topped road but still in / near the riparian zone (See Section 9: 'Proposed Mitigations').

- Habitat(s) quality and extent: We understood and support the notion that no larger trees will be removed to maximize shade for visitors and minimize environmental damage. Site clearing by removing understory is justified.
- Impact on species richness and conservation: It is contended that, given mitigation proposals, there will be no impact on either species richness or overall conservation interests.
- Connectivity: Connectivity is, and will not be affected in any way. It is necessary to mention the amazing manner in which vertebrates become habituated to vehicles and human presence.
- Roadkill risk: The increase in traffic along the road will result in an increased risk of mortality for mammals, birds, reptiles and amphibians. This issue is particularly pertinent to SANParks staff members who will be using the road to travel to and from Giyani, Thohoyandou and surrounding areas, and who may use this road at night when the risk of roadkill is far greater, particularly when speeding is involved. Groups of birds at particular risk include owls, nightjars and Bronze-winged Coursers.
- Creation of nest sites: For a number of bird species, the proposed development will create new nesting opportunities. For instance, road culverts provide nesting sites for Red-breasted Swallows, Lesser-striped Swallows, White-rumped and Little Swifts. The buildings at the gate, reception area, picnic area, campsite and tented camp may similar provide nest sites, as will the new bridge over the Shingwedzi River.
- Management recommendations: See Section 9: 'Proposed Mitigations'.
- General: Nil.

8.3 Impacts on mammals and herpetofauna

The fundamental purpose of the Kruger National Park (and any other nature conservation area) is to conserve the environment in its historical pristine condition. This new development will therefore impinge on the environmental *status quo*, and the consideration here is to consider the character and spatial impact relative to the magnitude of the park as well as SANPark's other fundamental mandate, i.e. facilitating access to the public.

The conservation rating of the site for mammals and herpetofauna is considered to be Medium-High, which is a reflection on the relatively insignificance of the proposed road and new facilities within a prime conservation asset. Neither connectivity nor ecological services will be affected by the road and minimally by the <3 hectares fenced tented camp, camping terrain and picnic site.

Table 7: Direct impact on faunal communities

Nature: The modest compounds for the light-footprint new tented camp, camping terrain, picnic site, as well as the reception/education centre and the upgraded road will spatially be insignificant relative to the overall extent of the park, and their impact will be fractional; the road will not impact more on connectivity or habitat loss than the existing road whereas the compounds will excluded only larger animals and still allow access for garden-variety birds, small mammals and reptiles.
The development can be reversed with human intervention, although rehabilitation of the new black-topped road will be more costly and intensive.
No irreplaceable loss of resources is anticipated.

Mitigation the impacts is standard procedure for SANParks developments.

	Without mitigation		With mitigation	
CONSTRUCTION PHASE				
Probability	Probable	3	Probable	3
Duration	Short duration	3	Short duration	3
Extent	Limited to site	1	Limited to site	1
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**18**	**Moderate**	**18**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Probable	3	Probable	3
Duration	Long term	4	Long term	4
Extent	Limited to site	1	Limited to Site (1)	1
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**21**	**Moderate**	**21**
Status (positive or negative)	**Negative**		**Negative**	
Reversibility	High		High	
Irreplaceable loss of resources?	Low		Low	
Can impacts be mitigated?	Yes			

Mitigation:

- The standard 50km/h SANParks speed restriction is deemed adequate if it is enforced.
- The tented camp, camp terrain and picnic site should preferably be planned according to the "light footprint" / rustic principle.
- Visitors are only allowed on the road between sunrise and sunset to avoid night-time fatalities.
- Normal precautionary measures included in the SANParks construction and operational *modus operandus* would suffice viz. unwarranted use of natural resources (viz. poaching, trapping, harvesting plant materials).
- Impacts can be offset by providing extraordinary opportunities such as bat hotels, sufficiently-sized drainage pipes supporting bridges to coincidentally serve as daytime roosts for cave-dwelling bats, nooks and crannies as refuge for reptiles, nesting, educational amenities (such as at the reception facility), bird baths etc.
- All staff and contractors must undergo an environmental induction course held by the ECO as well as faunal education and awareness programmes.
- Residents must be made aware of the value of fauna.

Cumulative impacts: Submitted to be initially minimal and thereafter stabilized, as the development will be relatively very small and most fauna species have relatively high mobility or adaptivity. Impact to connectivity and ecological services will be insignificant, especially since mammals and herps adapt fast to low-key and consistent disturbances such as daytime slow moving traffic.

Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.

Table 8: Loss of faunal habitat and ecological structure

Nature: The construction and operational phase of the proposed development will result in the negligible loss of mammal, reptile and amphibian habitats. Within the context of the park *in toto*, this impact relates to the limited destruction/disturbance of existing vegetation by machinery and workers, impacting directly on the ecological condition of natural vegetation and habitat availability. These activities will have negligible impact on foraging and breeding ecology. Loss of vegetation generally affects nutrient cycles, removes the organic litter layer and results in habitat fragmentation and destruction of wildlife corridors; these will be limited to a total footprint of < 12 hectares and where loss will in any case exclude mature trees. The additional loss of habitat as result of the upgraded road will be limited to slightly wider road servitude.

The minimal loss of habitat due to development can be reversed with human intervention, although the new black topped road will be more costly and will require a more intensive effort.

No irreplaceable loss of resources is anticipated.

Mitigation the impacts is standard procedure for SANParks developments.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Probable	3	Probable	3
Duration	Short duration	3	Sort duration	3
Extent	Site specific	1	Site specific	1
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**18**	**Moderate**	**18**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Probable	3	Probable	3
Duration	Long term	4	Long term	4
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Moderate	2	Low (7)	2
Significance	**Moderate**	**21**	**Moderate**	**21**
Status (positive or negative)	Negative		Negative	
Reversibility	High		High	
Irreplaceable loss of resources?	Negligible		Negligible	
Can impacts be mitigated?	Yes			

Mitigation:

- None other than the standard precautionary measures incorporated in SANParks best-practice development protocol in a conservation area.
- Runoff rain water from the black-topped road will influence grass and seedling germination that in turn will require the standard maintenance procedures developed by SANParks over time.
- SANParks *modus operandus* for storm water management will suffice.
- Education and awareness campaigns on faunal species and their habitat are recommended to help increase awareness, respect and responsibility towards the environment for all staff and contractors.

Cumulative impacts: Expected to be minimal.

Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.

8.4 Impacts on birds

Overview

The proposed project consists of the following components:

1) Entrance gate
2) New access road from gate to reception area
3) Bridge over Shingwedzi River between gate and reception
4) Reception area – buildings, parking area, etc
5) New road of approximately 1.2 km by passing Shangoni Section Ranger station
6) Upgrade of existing management track (approximately 30 km) to tar road
7) Picnic site
8) Campsite
9) Tented camp
10) Construction of new access roads to picnic site, campsite and tented camp
11) Upgrade of existing gravel tourist road to existing tar road (H1-6).

The proposed tar road will, for nearly all of its length, consist of an upgrade of existing gravel roads. Thus, many of the impacts related to habitat have already occurred. The major impacts of the proposed road will therefore be related to construction activities, and the increase in traffic that a tarred road open to the public will generate. From an avifaunal perspective, the most serious of these impacts will likely relate to roadkills; assuming that speed limits are strictly enforced for both visitors and SANParks staff, this impact can to a large extent be mitigated.

The new Shangoni gate and reception area will involve the clearing of small areas of natural habitat, as will the proposed picnic site, campsite and tented camps (presumably, less than 5 ha each). Given the sensitivity of this area, the footprint of these developments must each be kept to a bare minimum.

Table 9: Avian habitat loss

Nature: The new Shangoni gate and reception area will involve the clearing of small areas of natural habitat, as will the proposed picnic site, campsite and tented camps (presumably, less than 5 ha each). This will likely destroy areas used by birds for foraging and breeding.				
	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Very probable	4	Probable	3
Duration	Short term	2	Short term	2
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Medium	6	Medium	4
Significance	**Moderate**	**36**	**Low**	**21**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Very probable	4	Probable	3
Duration	Permanent	5	Permanent	5
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Medium	6	Medium	4
Significance	**Moderate**	**48**	**Low**	**30**

Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	
Mitigation: • The spatial extent of construction activities must be minimized, and as far as possible must be restricted to the areas on which buildings, roads etc will actually be located. • The boundaries of the development footprint areas are to be clearly demarcated and it must be ensured that all activities remain within the demarcated footprint area. • Provide adequate briefing for site personnel and residents. • Any bird nests that are found during the construction period must be reported to the Environmental Control Officer (ECO).		
Cumulative impacts: Expected to be minimal, given the small area involved.		
Residual Risks: None anticipated provided that the mitigation measures are implemented correctly.		

Table 10: Impact on birds due to ddisturbances associated with increased human presence in the area.

Nature: The presence of vehicles and construction workers will cause disturbance to avifauna, with the movement and activities of personnel on site and the associated noise, pollution and litter all having a negative effect on birds. In addition, the presence of construction workers will increase the probability of activities such as illegal hunting of birds. The permanent presence of a larger number of people than presently occur at the site will result in greater disturbance of birds that use the area for foraging and breeding.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Very probable	4	Probable	3
Duration	Short term	2	Short term	2
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Medium	5	Low	3
Significance	**Moderate**	**32**	**Low**	**18**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Very probable	4	Probable	3
Duration	Permanent	5	Permanent	5
Extent	Limited to Local Area	2	Limited to Local Area	2
Magnitude	Low	3	Low	1
Significance	**Moderate**	**40**	**Low**	**24**
Status (positive or negative)	Negative		Negative	
Reversibility	High		High	
Irreplaceable loss of resources?	Low		Low	
Can impacts be mitigated?	Yes			

Mitigation:

- Movement of construction vehicles and workers beyond the boundary of the site must be minimized. In addition, workers must be instructed to minimize disturbance of birds at all times, and steps must be taken to ensure that no illegal hunting occurs.
- The boundaries of the development footprint areas are to be clearly demarcated and it must be ensured that all activities remain within the demarcated footprint area.
- Disturbance by residents of birds breeding and foraging in the area should be minimized.
- The normal rules applicable to visitors to Kruger NP must be strictly enforced at the campsite, tented camp, picnic area, etc.
- The *Critically Endangered* White-backed Vultures that are breeding in the vicinity of the proposed campsite and tented camp require special consideration in terms of mitigation. As stipulated elsewhere in this report, 500-m buffer zones must be maintained around each nest site, within which no activity takes place.

Cumulative impacts: Expected to be minimal, based on the low impact of human disturbance on birds evident at similar sites elsewhere in Kruger National Park.

Residual Risks: None anticipated provided that the mitigation measures are implemented correctly.

Table 11: Creation of nest sites

Nature: For a number of bird species, the proposed development will create new nesting opportunities. For instance, road culverts provide nesting sites for Red-breasted Swallows, Lesser-striped Swallows, White-rumped and Little Swifts. The buildings at the gate, reception area, picnic area, campsite and tented camp may similar provide nest sites, as will the new bridge over the Shingwedzi River

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Very improbable	1	Very improbable	1
Duration	Short term	2	Short term	2
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Minor	1	Minor	1
Significance	**Low**	**4**	**Low**	**4**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Very probable	4	Very probable	4
Duration	Permanent	5	Permanent	5
Extent	Limited to Site	1	Limited to Site	1
Magnitude	Minor	1	Minor	1
Significance	**Low**	**28**	**Low**	**28**
Status (positive or negative)	Positive		Positive	
Reversibility	High		High	
Irreplaceable loss of resources?	Low		Low	
Can impacts be mitigated?	Not necessary			
Mitigation:				
Cumulative impacts: May increase numbers of some bird species in the area.				
Residual Risks: None anticipated.				

Table 12: Avian mortality via roadkills

Nature: The increase in traffic along the road will result in an increased risk of mortality for mammals, birds, reptiles and amphibians. This issue is particularly pertinent to SANParks staff members who will be using the road to travel to and from Giyani, Thohoyandou and surrounding areas, and who may use this road at night when the risk of roadkill is far greater, particularly when speeding is involved. Groups of birds at particular risk include owls, nightjars and Bronze-winged Coursers.				
	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Probable	3	Improbable	2
Duration	Short term	2	Short term	2
Extent	Limited to Site	1	Limited to Site	1
Magnitude	High	8	High	8
Significance	**Moderate**	**33**	**Low**	**22**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Very probable	4	Improbable	2
Duration	Permanent	5	Permanent	5
Extent	Limited to Site	1	Limited to Site	1
Magnitude	High	8	High	8
Significance	**Moderate**	**56**	**Low**	**28**
Status (positive or negative)	Negative		Negative	
Reversibility	Low		Low	
Irreplaceable loss of resources?	Medium		Low	
Can impacts be mitigated?	Yes			
Mitigation: • Driving at night on the new road by SANParks staff must be kept to a minimum. • Speed limits must be strictly enforced. The author's opinion is that the usual speed limit of 65 kmph applicable to SANParks staff is too high to avoid roadkills of nocturnal birds, as these birds are often dazzled by oncoming lights. **It is thus recommended that a speed limit of 40 kmph be applied to anyone using the new road at night.**				
Cumulative impacts: Will increase avian mortality via road kills, and result in demographic changes for populations of nocturnal birds along the new road.				
Residual Risks: None anticipated provided that the mitigation measures are implemented correctly.				

8.5 Assessment of alternative sites

Originally three sites were identified for structural development of amenities (picnic, camping terrain and tented rest camp) – these were later retracted and replaced by seven other sites to be investigated for public amenities. In the course of our investigations and considerations it was deemed necessary to include the original three sites, bringing sites to a total of ten (Figure 10).

9. PROPOSED MITIGATIONS

It is submitted that the proposed development of a new access gate, bridge, reception / educational centre, a picnic site, a tented rest camp, a camping terrain and a black-top upgrade of 50km of existing graded / gravelled dirt roads will not unduly affect conservation status of any vertebrate species or their preferred habitat nor ecological services. However, the following mitigation will further ameliorate the impact of the development.

• White-backed Vultures are currently listed as *Critically Endangered*, because of recent and ongoing catastrophic population declines. Nests are re-used seasonally, but are abandoned if breeding pairs are unduly disturbed. In order to avoid visual and noise disturbances to breeding vultures (particularly during the construction phase of the project), it is recommended that 500-m radius buffer zones be strictly observed, and no activities take place within these. Several locations proposed for the tented camp and campsite fall within these buffer zones (Figure 27). Therefore, it is suggested that the five northernmost locations are considered, i.e. Tented alt 1, Picnic original, Picnic alt 1, Camp original and Picnic site alt 2 (Figure 27).

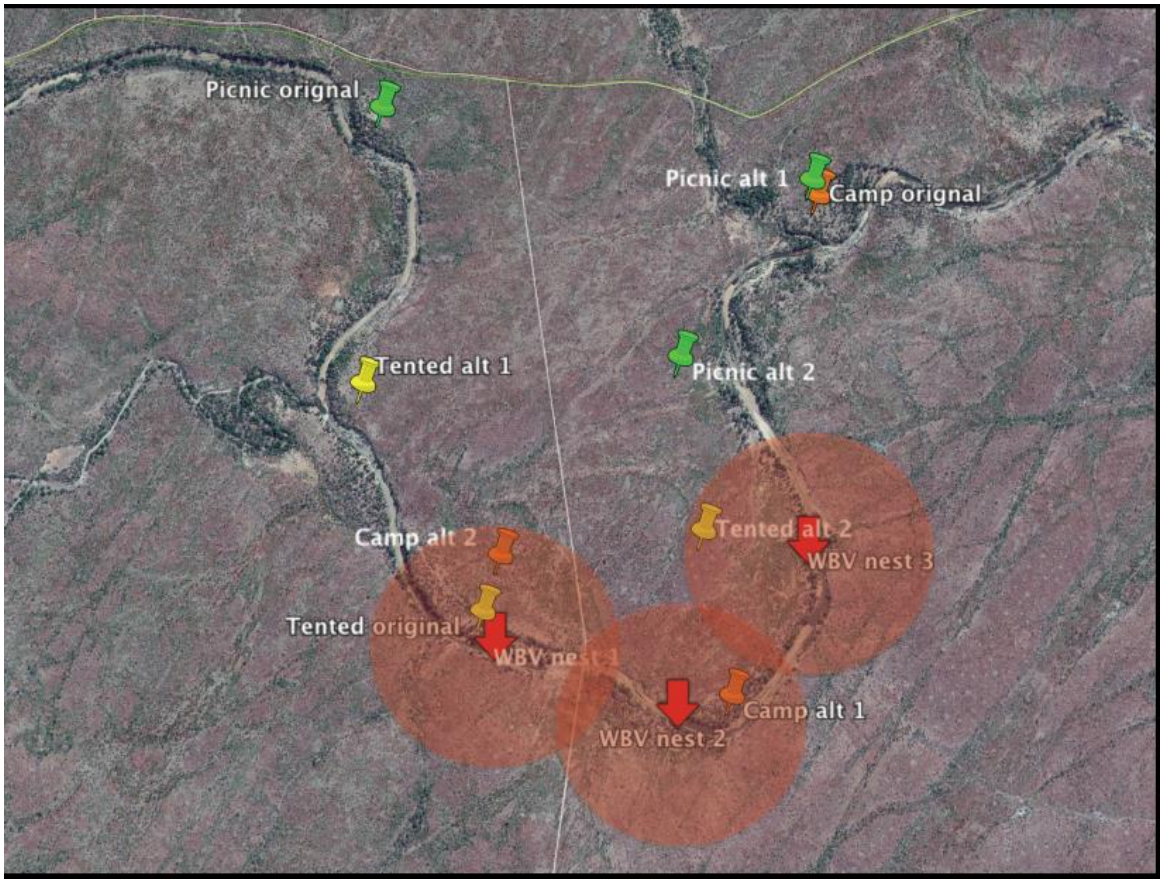

Figure 27: Buffer zones (red circles) recommended to prevent disturbance to breeding White-backed Vultures in the vicinity of the proposed campsite, tented camp and picnic site.

- SANParks notion is lauded to make riparian zones available to eco-tourism by planning sites for the picnic site, the tented rest camp and the camping terrain to straddle the riparian zone and mopane woodland. Ablution structures are to be built in the mopane

woodland. Environmental damage in riparian zones will be minimal since no mature trees will be removed and understory is under-developed

- It is understood and supported that the picnic site, the tented rest camp and the camping terrain will be fenced for public safety.
- A “light footprint” is petitioned for the picnic site, the tented rest camp and the camping terrain. Rustic buildings and structures are suggested, such as building with wood split-poles. Paving with grass-bricks should be favoured over concrete slabs.
- Large trees are to be protected for their shade, bird habitat and aesthetics.
- 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.
- Speed limits along the tarred road must be strictly enforced, particularly for SANParks staff using the road at night.
- Disturbance during the construction phase of the project must be minimized, particularly with regards the construction of the tarred road.

10. LIMITATIONS, ASSUMPTIONS AND GAPS IN INFORMATION

The vertebrate team has sufficient experience and ample access to information sources to confidently compile lists of biota such as presented herein to support conclusions and suggested mitigation measures based on site visits. In instances where doubt exists, a species is assumed to be a possible occupant (viz. Red rock rabbits, pygmy shews, pythons and bull frogs); -this approach renders the conclusions to be robust. In instances where the possible occurrence has significant ecological implications, an intensive survey is recommended. In view of the latter, it is highly unlikely whether an intensive survey to augment this site visit will add significantly to the data base, and the additional costs are unlikely to warrant the effort.

11. CONCLUSION

The conservation status of the study area to be affected by the development and adjacent land is rated as **Medium-*High,*** *i.e. Land where sections are disturbed but that is still ecologically sensitive to development/disturbance*. The numerical significance (impact) values for the tourist amenities and for the upgraded road fall within the Moderate Environmental Significance class (See Section 8.2), in the case of public amenities only marginally.

In order not to risk disturbances to three breeding vulture pairs by noise and movements in a public amenity, we recommend that the southern sites in the vicinity of the vulture nests are not considered for development (Figure 27). However, the five northern sites (Original Picnic Site, the Tented Camp Alternative 1, the Picnic Site Alternative 2, Picnic Site Alternative 1, and Camping Site Original) can be developed in any combination for any of the three stated purposes.

Runoff water from the upgraded road will be managed as on other roads in the Kruger Park, which is rated as adequate.

The conservation status of no vertebrate species will be jeopardized, given allowances for the three vulture nests.

Servicing eco-tourism is one of SANParks two main mandates. It is therefore heartening that resting / overnight amenities will be considered when straddling riparian zones and mopane woodland – the first as an allowance to eco-tourism attraction and the latter for siting ablutions. Damage in the riparian zones will be minimal since no large trees will be removed and understory is underdeveloped. It is suggested that a 'light footprint" development regime is applied with easily rehabilitated developments (viz. rustic structures, grass-brick paving) and decisive respect for mature trees. However, the SANParks notion that campers will park their vehicles some distance from their camping site is not client-friendly; for vacationing visitors a vehicle is akin to a mobile suitcase with headlights – there is always something required in the vehicle, apart from locking valuables. There is also the imperative of providing for campers with rooftop tents. SANParks is encouraged to plan around this visitor imperative.

Nowhere will sensitive ecosystems or ecological services be affected.

It is concluded that the impact of the development will be negligible. The footprint of the gate and reception / educational facilities will be small (each < than one hectare). The fenced sites for the picnic site, tented rest camp and camping will be respectively < 3 hectares. Collectively these will spatially be insignificant when measured against the total landmass of the entire park, apart from the fact that environmental damage will be limited to land-clearing of brush and undergrowth. The upgrade of the existing roads road will slightly increase its impact, and rehabilitate the blacktop surface will be more extensive, should that will ever be an issue. The existing road (and by implication the upgraded road under contention) does not impinge on the riparian zone, but generally no buffer zone outside the edge of the riparian zone is allowed. This is interpreted as being in the best interests of clients to maximize sightings of wildlife.

The new short road alignment close to the to-be-constructed high-water bridge will be short and will traverse shrub mopane. This imperative is considered to be minor.

It is contended that the proposed development will be in line with SANPark's commitment to its clients and will not detract significantly from its conservation mandate.

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Low, A.E. & Rebelo, A.G. (eds). 1998. Vegetation of South Africa, Lesotho and Swaziland. A companion to the Vegetation Map of South Africa, Lesotho and Swaziland. Department of Environmental Affairs & Tourism, Pretoria.

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Mumme, R. L., S. J. Schoech, G. E. Woolfenden, and J. W. Fitzpatrick. 2000. Life and death in the fast lane: demographic consequences of road mortality in the Florida Scrub-jay. Conservation Biology 14:501-51

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Pienaar, U. de V., S.C.J. Joubert, A. Hall-Martin, G. de Graaff & I.L. Rautenbach. 1987. Field Guide to the Mammals of the Kruger National Park. Ed. I.L. Rautenbach. C. Struik Publishers, Cape Town and the National Parks Board of Trustees, Pretoria. 176pp.

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Rautenbach, I.L. 1978. A numerical re-appraisal of the southern African biotic zones. Bulletin of the Carnegie Museum of Natural History 6:175-187.

Rautenbach, I.L. & I.W. Espie. 1982. First records of occurrence for two species of bats in the Kruger National Park. Koedoe 25:111-112.

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Sutter, G. C., S. K. Davis, and D. C. Duncan. 2000. Grassland songbird abundance along roads and trails in southern Saskatchewan. Journal of Field Ornithology 71:110-116.

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Taylor, M. R., F. Peacock, and R. M. Wanless. 2015. The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg, South Africa.

Taylor, P.J. 1998. The Smaller Mammals of KwaZulu-Natal. University of Natal Press: Pietermaritzburg.

Taylor, P.J. 2000. Bats of Southern Africa. University of Natal Press: Pietermaritzburg.

Thiollay, J.-M. 1999. Responses of an avian community to rain forest degradation. Biodiversity and Conservation 8:513-534.

Van Niekerk, J. 2015. Environmental Guidelines and Laws for Beef Cattle Feedlots in South Africa. (With a quick guide to common transgressions and relevant legislation in Appendix A). South African Feedlot Association (SAFA).

Van Schalkwyk, M. 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004); Publication of Lists of Critically Endangered, Endangered, Vulnerqable and Protected Species.

Van Wyk, J.C.P., Kok, D.J. & Du Preez, L.H. 1992. Growth and behaviour of tadpoles and juveniles of the African Bullfrog, Pyxicephalus adspersus Tschudi 1838. J Herp. Assoc. Afr. 40:56.

Weiermans, J., and R. J. van Aarde. 2003. Roads as ecological edges for rehabilitating coastal dune assemblages in northern KwaZulu-Natal, South Africa. Restoration Ecology **11**:43-49.

12. CURRICULUM VITAE

RÉSUMÉ

IGNATIUS LOURENS RAUTENBACH Ph.D., Prof. Nat. Sci.
Independent Environmental Consultant – MAMMALOGY.

Identity Number	421201 5012 00 5
Gender	Male
Date of Birth	1 December 1942; born Germiston, RSA
Nationality	South African
Home Languages	Bilingual (English & Afrikaans)
Postal Address	45 Helgaard Street, Kilner Park, Pretoria, RSA 0186. Tel no +27 12 3334112, Cell +27 082 3351288. E-mail naasrauten@mweb.co.za
Former Position	Director: Planning, Northern Flagship Institute
Present Position	Consultant – Specialist, Environmental Impact Assessments (Applied research); Photographing microstock for four agencies
Qualifications	**B.Sc**. (UP) 1966; **T.H.E.D** (Pta TTC) 1967, **M.Sc.** (UP) 1971, **Ph.D**. (Un. Natal) 1971

Professional Honours

1. Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400300/05
2. Fellow of the Photographic Society of South Africa
3. Master photographer at club level
4. Honorary life member of the S.A. Wildlife Management Association.

Notable Research Contribution In-depth survey of the Mammals of the Transvaal. 1982. 211pp. Ecoplan Monograph 1.

Notable Literary Contribution Rautenbach, Naas & Annalene Rautenbach. 2008. *Photography for Focused Beginners.* 302pp with 250 images. Green Door Studio, Pretoria.

Formal Courses Attended Computer Literacy, Project Management, Contract Design, Senior Management

Employment history
May 2001 - Present Self-employed, collaborator with Eco-Agent CC Ecological Consultants as well as Galago Environmental [environmental impact assessments], technical writing, and photography
April 1999 - August 2001 Director: Planning, Northern Flagship Institution
Jan 1991 - April 1999 Executive Director, Transvaal Museum
July 1967 - Dec 1990 Curator (in charge) of the Division of Mammalogy, Transvaal Museum. Promoted to Principal Scientist rank as of June 1985
March - June 1967 Research student at the Mammal Research Institute of the Zoology Department, University of Pretoria
July 1966, Nov l966 - Febr 1967 Member of the Smithsonian Institution's field teams collectively partaking in the 'African Mammal Project'
1966: Part-time research assistant to Prof. J. Meester, University of Pretoria
1962 - 1965 Temporary assistant during University holidays in the Nematology laboratories, Agricultural Technical Services
1991 - 2002 Founder member and non-executive director of the Board of Trustees of
1993 - 2001 Founder member and Trustee of the privatised Museums Pension Fund
1997 - 2001 Non-executive director of the Tswaing Section 21 Company

Professional Achievements
Managed a research institute of 125 members of staff. Solicited numerous grants totalling ≥ R1 000 000. Initiated and overseen building programmes of R30 million at the Transvaal Museum. Conceptualised and managed 12 display programmes.

Research: Author and co-author of 85 scientific publications re mammalogy in peer reviewed subject journals, 18 popular articles, 10 books, and >400 contractual EIA research reports. Extensive field work and laboratory experience in Africa, Europe, USA, Alaska, Brazil and Mexico. B -rated by FRD as scientist of international status 1983 – 1995.

Students: Additional to museum manager duties, **c**o-supervised 5 B.Sc. (Hons.), 2 M.Sc. and 2 Ph.D. students.

Public Recognition:
Public speaking *inter alia* Enrichment Lecturer on board the 6* *SS Silver Wind*, radio talks, TV appearances.

Hobbies
Technical writing, photography, field logistics, biological observations, wood working, cooking, designs.

Personal Evaluation
I am goal-orientated, expecting fellow workers and associates to share this trait. I am an extrovert, sensitive to amicable interpersonal relations. I have a wide interest span ranging from zoological consulting, photography, cooking, sport, news, gardening and out of necessity, DIY. To compensate for my less than perfect memory, I lead a structured and organised life to deal with the detail of a variety of interests. Often to the chagrin to people close to me, I have an inclination to “Think Out of the Box”.

ABRIDGED CURRICULUM VITAE

ANDREW E. MCKECHNIE

Professor
Department of Zoology and Entomology
University of Pretoria

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ACADEMIC QUALIFICATIONS

Ph.D. (Zoology), University of Natal, April 2002
M.Sc. *cum laude* (Zoology), University of Natal, April 1999
B.Sc. (Honours) *cum laude* (Zoology), University of Natal, April 1997
B.Sc. (Majors: Zoology and Botany), University of Natal, April 1996

PROFESSIONAL QUALIFICATIONS

Professional Natural Scientist (*Pr. Sci. Nat.*; Registration number: 400205/05), South African Council for Natural Scientific Professions

TECHNICAL REPORTS [31 in total, only 10 most recent shown]

McKechnie, A.E. 2013. *Specialist avifaunal assessment: proposed Frankfort Power Station.* Prepared for Rural Maintenance.

McKechnie, A.E. 2013. *Specialist avifaunal assessment: proposed MOGS oil storage facility, Saldanha Bay.* Prepared for Enviro-Insight.

McKechnie, A.E. 2012. *Specialist winter avifaunal assessment: proposed Prieska Photovoltaic Plant.* Prepared for Enviro-Insight.

McKechnie, A.E., Verburgt, L., Chimimba, C.T., Orban, B. and Niemand, L.J. 2011. *Initial environmental assessment report: proposed Chisanga Falls Hydroelectric Generation Facility*. Prepared for Rural Maintenance.

McKechnie, A.E., Verburgt, L., Chimimba, C.T., Orban, B. and Niemand, L.J. 2011. *Initial environmental assessment report: proposed expansion to the Kayelekera Coal Mine, northern Malawi*. Prepared for Rural Maintenance.

McKechnie, A.E., Verburgt, L., Chimimba, C.T., Orban, B. and Niemand, L.J. 2010. *Malawi Mini Grids Ecological Assessment Report*. Prepared for Rural Maintenance and Millennium Challenge Corporation.

McKechnie, A.E. 2010. *Specialist survey report: assessment of impacts on birds, with particular reference to threatened and near threatened species: proposed subdivision of portion 39, Olifantsvlei 327 IQ, Gauteng*. Prepared for Prism EMS.

McKechnie, A.E. 2009. *Specialist survey report: assessment of impacts on birds, with particular reference African Grass-owls, White-bellied Korhaans, African Finfoots and Half-collared Kingfishers:proposed residential development on portion 63, Rietvallei 180 IQ, Roodepoort, Gauteng*. Prepared for Prism EMS.

McKechnie, A.E. 2009. *Specialist survey report: Assessment of impacts on birds: proposed wind farm development on Burgershoop 107 and Elandspoort 99 HS, Mpumalanga.* Prepared for K2M Environmental.

Schwaibold, U., Alexander, G.J., **McKechnie, A.E.**, et al. 2009. *Monitoring recommendations for fauna: AngloGold Ashanti Vaal Reef and West Wits.* Prepared for AngloGold.

PEER-REVIEWED SCIENTIFIC PUBLICATIONS [71 in total, only three most recent shown]

Pietersen, D.W., Symes, C.T., Woodborne, S.W., **McKechnie, A.E.** and Jansen, R. (in press) Diet and prey selectivity of the specialist myrmecophage, Temminck's ground pangolin (*Smutsia temminckii*). *Journal of Zoology*

Smit, B. and **McKechnie, A.E.** 2015. Water and energy fluxes during summer in an arid-zone passerine bird. *Ibis* 157(4): 774-786.

Whitfield, M.C., Smit, B., **McKechnie, A.E**. and Wolf, B.O. 2015. Avian thermoregulation in the heat: scaling of heat tolerance and evaporative cooling capacity in three southern African arid-zone passerines. *Journal of Experimental Biology* 218: 1705-1714.

ARTICLES IN SEMI-POPULAR MAGAZINES [73 in total, only three most recent shown]

McKechnie, A.E. 2016. Mercury rising - South Africa's national parks are getting warmer. *African* in press.

McKechnie, A.E. 2016. Enormous, enigmatic, extinct – the elephant birds of Madagascar. *African Birdlife* press.

Noakes, M.J. and **McKechnie, A.E.** 2015 Hot or not? Physiological variation in white-browed sparrow-weavers. *African Birdlife* September/October 2015: 12-13.

CONFERENCE PRESENTATIONS [110 in total, only plenary lectures shown]

McKechnie. A.E., Smit, B., Hockey, P.A.R. and Wolf, B.O. Taking the heat: climate change and desert *At*: Frontiers in South African Ornithology, 15-16 March 2012, Port Elizabeth, South Africa.

McKechnie, A.E., Smit, B., Cory Toussaint, D., Boyles, J.G. and Wolf, B.O. Hot birds and bats: approaches to predicting climate change impacts in small endotherms. *At:* Joint ZSSA and PARSA Conference, 10-13 July 2011, Stellenbosch, South Africa.

SCIENTIFIC AWARDS AND RECOGNITION [only last five years shown]

2013	Finalist: 2012/2013 NSTF/BHP Billiton Awards
2013	Exceptional Academic Achiever, University of Pretoria
2011	Founding Member, South Africa Young Academy of Science
2008-2012	Exceptional Young Researcher Award, University of Pretoria

STUDENT SUPERVISION

Current supervision: 4 PhD, 1 BSc(Hons); Current co-supervision: 3 PhD

Past supervision: 1 PhD, 10 MSc, 9 BSc (Hons); Past co-supervision: 1 PhD, 2 MSc, 3 BSc (Hons)

EDITORSHIP

Associate Editor: *Climate Change Responses*

Associate Editor: *Emu – Austral Ornithology*

Editorial Board: *Journal of Comparative Physiology* B

INVITED SEMINARS AND LECTURES [23 in total, only 3 most recent shown]

Mitrani Department for Desert Ecology, Ben-Gurion University of the Negev, Israel, August 2015.

School of Biological Sciences, University of Queensland, July 2015

Hawkesbury Institute for the Environment, University of Western Sydney, July 2015.

OTHER CONTRIBUTIONS

Scientific Advisor, *African Birdlife* magazine

Expert reviewer - South African National Standard SANS 10386 Annex C

Member, Research Ethics and Scientific Committee, National Zoological Gardens

Member, Steering Committee, Endangered Wildlife Trust Threatened Grassland Species Program

Council Member, Zoological Society of Southern Africa [2009-2013]

SOCIETY MEMBERSHIP

American Ornithologists' Union
Australia and New Zealand Society for Comparative Physiology and Biochemistry
Cooper Ornithological Society
International Ornithologists' Union
Society for Integrative and Comparative Biology
Zoological Society of Southern Africa

ABRIDGED CURRIVULUM VITAE VAN WYK:

JACOBUS CASPARUS PETRUS (JACO)

Identity number 680804 5041 08 4
Gender Male
Date of birth 4 August 1968
Nationality South African
Home languages Afrikaans, fluent in English
Postal address P.O. Box 25085, Monument Park, Pretoria, 0105.
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E-mail **jcpvanwyk@absamail.co.za**
Present position Co-Department Head, Environmental Education & Life Sciences, Hoërskool Waterkloof
Consultant Specialist Environmental Assessments, EIAs, writing, photo-recording
Qualifications **B.Sc**. (U.F.S.) **B.Sc. (Hon.)** (U.F.S.), **H.E.D** (U.F.S.), **M.Sc.** (U.F.S.)
Honours Foundation of Research Development bursary holder
Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400062/09
Notable Research Contribution In-depth field study of the giant bullfrog

Formal Courses Attended Outcomes Based Education, University of the South Africa (2002)
Introductory Evolution, University of the Witwatersrand (2008)
OBE, GET & FET training, 2002-2008, Education Department

Employment history

2000 – Present Co-Department Head for Environmental Education & Life Sciences, Hoërskool Waterkloof, Pretoria.
1995 - 1999 Teaching Biology (Grades 8 – 12) and Physics / Chemistry (Grades 8 – 9) at the Wilgerivier High School, Free State. Duties included teaching, mid-level management and administration.
July 1994 – Dec 1994 Teaching Botany practical tutorials to 1st year students at the Botany & Zoology Department of the Qwa-Qwa campus of the University of Free State, plant collecting, amphibian research
1993 - 1994 Mammal Research Institute (University of Pretoria) research associate on the Prince Edward Islands: topics field biology and population dynamics of invasive alien rodents, three indigenous seals, invertebrate assemblages, censussing king penguin chicks and lesser sheathbills, and marine pollution
1991 - 1993 Laboratory demonstrator for Zoological and Entomological practical tutorials, and caring for live research material, University of the Free State
1986 - 1990 Wildlife management and eco-guiding, Mt. Everest Game Farm, Harrismith
Professional Achievement **Research:** Author and co-author of 52 scientific publications in peer-reviewed and popular subject journals, and >60 contractual EIA research reports. Extensive field work and laboratory experience in Africa
Public Recognition: Public speaking *inter alia* radio talks, TV appearances
Hobbies: Popular writing, travel, marathon running, climbing (viz Kilimanjaro), photography, biological observations, public speaking.

Curriculum Vitae

BIOGRAPHIC DETAILS

First Names:	Michelle Leigh
Last Name:	Thompson
Gender:	Female
Date of Birth:	19 May 1989
ID Number:	8905190183089
Marital Status:	Single
Contact Address:	191 Murray Street, Brooklyn, Pretoria 0181
Cellphone and e-mail:	(+27)71 869 9042 mltompson@zoology.up.ac.za
Languages:	English, Afrikaans
Drivers Licence:	South African Code B, light motor vehicle licence

TERTIARY EDUCATON

2014 - Current	**PhD (Zoology).** Department of Zoology and Entomology, University of Pretoria, South Africa. Title: Climate change and arid-zone birds: validation of a behavioural index for assessing species' relative vulnerabilities to rising temperatures. Advisors: Prof Andrew McKechnie, Dr Susan Cunningham.
2012	**MSc (Zoology), *cum laude*.** Department of Zoology and Entomology, University of Pretoria, South Africa. Title: Influence of solar radiation on heat production capacity and daily heterothermy in energy constrained Eastern rock elephant shrews (*Elephantulus myurus*). Advisors: Prof Andrew McKechnie, Dr Nomakwezi Mzilikazi.
2011	**BSc Honours (Zoology).** Department of Zoology and Entomology, University of Pretoria, South Africa. Title: Relative learning capabilities of benthic sharks. Advisors: Prof Marthan Bester, Ryan Johnson, Adam Johnstone.
2010	**BSc (Zoology).** Department of Zoology and Entomology, University of Pretoria, South Africa.

TEACHING EXPERIENCE

2012 – Current	**Teaching assistant.** Department of Zoology and Entomology, University of Pretoria, South Africa. Courses: Evolutionary Physiology, Ecophysiology, Physiology
2012 – Current	**Mentorship Program.** Department of Zoology and Entomology, University of Pretoria, South Africa. Mentoring one final-year undergraduate student per year, teaching lab procedures and maintenance as well as animal maintenance.
2012 – 2014	**Private Tutor.** Highschool level (Grade 10 – 12) Biology, Physical Science.

AWARDS & SCIENTIFIC/SCHOLARLY RECOGNITION

2014 – 2016	DST-NRF Centre of Excellence Bursary (R120 000 p.a)
2014	Received MSc *cum laude*
2012 – 2014	NRF MSc Free-standing Bursary (R40 000 *p.a.*)
2010	Subject Merit Bursary

SOCIETIES

2016	Student representative for Department of Zoology and Entomology for the Post-graduate Association for the Natural and Agricultural Sciences (PSANA)
2016	Association of Field Ornithologists
2011, 2015	Golden Key International Honour Society
2011	Zoological Society of South Africa

PEER-REVIEWED SCIENTIFIC PUBLICATIONS

Thompson ML, Mzilikazi N, Bennett N, McKechnie AE. 2015. Solar radiation during rewarming from torpor in elephant shrews: supplementation or substitution of endogenous heat production? *PLoS one* 10, p. e0120442 http://dx.doi.org/10.1371/journal.pone.0120442

CONFERENCES

Thompson ML, Cunningham SJ, McKechnie AE. It's cool to be dominant: Social status and thermoregulation in birds. *Learn about Birds*. 10-11 March 2016. Kruger National Park. South Africa.

Thompson ML, Mzilikazi N, Bennett N, McKechnie AE. The Effects of solar radiation on heterothermy and metabolic thermogenesis capacity in the eastern rock elephant shrew, *Elephantulus myurus. Zoological Society of South Africa.* 15-17 July 2015. Grahamstown. South Africa.

Thompson ML, Mzilikazi N, Bennett N, McKechnie AE. The Effects of solar radiation on heterothermy and metabolic thermogenesis capacity in the eastern rock elephant shrew, *Elephantulus myurus. Physiology and Pharmacology of Temperature Regulation*. 7-12 September 2014. Kruger National Park. South Africa

OTHER CONTRIBUTIONS

Reviewer for *African Zoology*